FINAL REPORT:

STONEY CREEK URBAN BOUNDARY EXPANSION AREA (SCUBE) EAST

SUBWATERSHED STUDY

Prepared by:

AQUAFOR BEECH LIMITED
8177 Torbram Road
Brampton, Ontario
L6T 5C5

Prepared for:

The City of Hamilton

May 15, 2013
Aquafor Beech Reference: 64711

EXECUTIVE SUMMARY

The City of Hamilton is in the process of preparing the Fruitland-Winona Secondary Plan in support of future urban development within the Stoney Creek Urban Boundary Expansion (SCUBE) area. This study, termed the SCUBE Subwatershed Study, or alternatively, the SCUBE *East* Subwatershed Study, is one of two subwatershed studies being undertaken in support of the Secondary Plan. The study focuses on the lands to the East of McNeilly Road, between Lake Ontario and the Niagara Escarpment, and eastward to the City boundary. The study area consists of the drainage areas from Watercourses 7.2, 9, 10, and Fifty Creek.

The Subwatershed Study is being conducted as a Master Plan under the Municipal Class Environmental Assessment (Class EA) process, and is intended to satisfy Phases 1 and 2 of the Class EA process.

The Subwatershed Study is being undertaken in three phases:

1. Establish existing environmental conditions;
2. Evaluate future impacts and select, from a set of alternatives, a recommended management plan; and
3. Develop an implementation plan

This Report covers Phase1 and Phase 2 of the Subwatershed Study process.

For Phase 1 of the Study, the existing environmental resources within the study area were defined in order to identify key features and functions, to establish baseline conditions for the assessment of potential impacts from future urban development, and to identify development constraints and potential future opportunities. A summary of the key environmental features and functions to be considered is provided below.

Surface Water Resources

Hydrologic and hydraulic models were applied to assess the stormwater runoff and flooding

characteristics of the study area. Based on this analysis, together with input from the City, the public and other agencies, future development constraints and opportunities related to surface water resources were defined. The key points are summarized as follows:

- No new development will be permitted within the flood-susceptible lands defined by the Regulatory (100-year) Floodplain limits (Watercourses 9 and Fifty Creek).
- Future development lands discharging runoff to streams with potential downstream flood or erosion concerns will require flood (quantity) control facilities to control post-development peak flows to pre-development levels.
- Source and conveyance control stormwater measures, where feasible, should be applied to preserve the existing hydrology and minimize increases in runoff volumes and flow rates.
- Proposed improvements to Lewis Road also include an opportunity to construct a new open channel along the west side of Lewis Road from Barton Street to just south of the CN Railway.
- Previous historical planning for Watercourse 7 to the west of the SCUBE study area may include an opportunity to construct a new open channel along the south side of the CN Railway to divert the headwaters of Watercourse 7.2 to the Main Branch of Watercourse 7.

Groundwater Resources

Monitoring wells were installed and a review of the geology and hydrogeology of the study area was undertaken in order to gain an understanding of the groundwater resources within the study area, including potential groundwater recharge and discharge locations. Based on these assessments, future development constraints and opportunities related to groundwater resources are summarized below:

- The majority of the developable SCUBE lands are overlain by silt-clay soils, with groundwater recharge potential classified as “moderate” to “low”. However, future stormwater management planning should include measures, where feasible, to minimize changes to the existing groundwater recharge rate of approximately 140 mm per year in these soils. This will, in turn, help to minimize future increases in runoff rates.
- Sand and gravel deposits situated near the base of the escarpment between McNeilly Road and Lewis Road represent a zone of high groundwater recharge potential and function as a

potential contributor of baseflow to stream reaches to the north. The existing recharge potential of approximately 230 mm per year from this feature should be protected through future source and conveyance control stormwater management measures which promote the infiltration of clean runoff.

Fluvial Geomorphology

A geomorphic field investigation was completed in order to classify stream reaches and to assess existing conditions and channel characteristics on the streams in the vicinity of the SCUBE development area. The findings of this assessment are summarized as follows:

- Within the study area, no existing erosion hazards were identified for mitigation through natural channel design approaches, however, future stormwater management planning should include erosion control facilities for development lands draining to unlined streams such as Fifty Creek, Watercourse 7.2, and the west tributary of Watercourse 9.
- Monitoring of specific stream reaches along Fifty Creek is recommended based on observed evidence of natural scour and the abundance of fine-grained channel boundary materials. Restoration opportunities at these locations are largely limited by the established riparian forest and no immediate risks to the public are apparent. However, these areas should be monitored to ensure any potential negative impacts in the future are mitigated in a timely manner.
- Isolated stream reaches along Fifty Creek may be sensitive to slope instability under future land use conditions based on observed evidence of valley slope steepness and the close proximity of the active channel to the valley wall(s). Special consideration should be given to these areas during future development or re-development (e.g., stable slope setbacks, erosion buffers).
- Throughout the watercourse corridors numerous areas are littered with artificial debris and garbage. Removal of this material during development phases will improve aquatic habitat and locally reduce potential erosion impacts.

Aquatic Resources

A tolerant warmwater fish community exists in Fifty Creek downstream of Highway 8 and

should be protected through a 15 m Vegetation Protection Zone applied to each side of the stream. Other stream reaches were identified as contributing to downstream fish habitat, and under City of Hamilton policy would be assigned a similar 15 m buffer.

Given the above aquatic habitat findings, stormwater management planning for future development should include water quality controls. The Hamilton Conservation Authority requires that stormwater management facilities provide "Level 2" or "normal" level of protection as defined in the MOE Manual. Opportunities could also be pursued to enhance baseflow through stormwater management, re-vegetating riparian areas with native woody vegetation, and, where possible, enhance some of the drainage features supporting indirect habitat to allow them to support seasonal use by fish.

Terrestrial Resources

The majority of the terrestrial features in the study area are cultural meadows, plantations, savannahs and woodlands that exist in a highly disturbed and/or early successional state. Terrestrial features identified for protection include the Fifty Creek ESA and Fifty Creek Locally Significant Wetland Complex (which should be protected with a 30 m Vegetation Protection Zone), the Fifty Creek riparian vegetation and adjacent woodlots, in addition to the Niagara Escarpment Protection Area. Other woodlot and hedgerow features represent enhancement opportunities if they can be accommodated into future block planning for the area. There is also potential to protect a riparian corridor along Fifty Creek that would link the ESA located in the Fifty Creek Conservation Area at the Lake Ontario Shoreline with the Niagara Escarpment Protected Area.

Bird and amphibian monitoring was completed for the SCUBE study area. Within the eastern portion of the SCUBE Central land parcel, Bobolink, a bird species recently classified as "threatened" was observed. Phase 3 of the Subwatershed Study will include further discussions with MNR, the City and landowners to assess the protection status of these lands.

Stream Corridors

Future development limits along stream corridors identified for protection would incorporate

several of the constraints listed above, including flood hazards, slope/erosion hazards, fishery buffers, and riparian woodlots. In addition, future field surveys would be required to identify the top-of-bank location along any defined valley features. An environmental buffer/setback, typically in the order of 5 to 10 metres, is then normally applied to the outermost feature or hazard in order to establish the limits of future development along the stream corridor.

Figure 3.17 of the report provides a summary of the above environmental constraints and opportunities for the SCUBE study area.

Phase 2 of the Subwatershed Study included the definition of goals and objectives, impact assessment of the proposed future urban development, review of alternative control measures, and development of recommended Stormwater Management and Natural Heritage Strategies.

Subwatershed Goals and Objectives

Following the review and definition of existing conditions and the resulting environmental constraints and opportunities within the SCUBE study area, subwatershed goals and objectives were then defined for the various environmental resources within the study area, including:

- Ensure the groundwater recharge function provided by the soils of the study area is maintained;
- Provide a safe hydrologic regime and stable stream systems;
- Protect the quality of surface water;
- Establish a healthy aquatic ecosystem which supports warmwater fisheries both within and downstream of the study area streams; and
- Establish a healthy terrestrial ecosystem;
- Provision of linkages between natural areas within a connected Natural Heritage System.

Impact Assessment

The potential impacts of proposed future urban development within the SCUBE study area on the

environmental resources were then evaluated. Potential impacts include the following:

- Decreased groundwater recharge rates and corresponding increase in runoff volumes associated with the increased impervious surface coverage of the urban landuses;
- Increased pollutant loadings and reduced water quality;
- Potential increased rates of erosion and flooding along downstream creek reaches due to higher runoff volumes and flow rates;
- Weakened or destruction of aquatic habitats through degraded water quality, increased erosion, and reduced baseflows;
- Loss or weakening of terrestrial resources through fragmentation of wildlife corridors.

Evaluation of Alternative Management Measures

Alternative measures, referred to as Best Management Practices (BMPs), were reviewed to mitigate these potential impacts and meet the selected objectives. Consistent with the Environmental Assessment approach for the study, a wide range of alternatives were reviewed, screened and evaluated against various physical, social, technical and financial criteria. A two-phased evaluation process, consisting of a screening level assessment followed by a detailed assessment, was used to evaluate the alternative measures.

The following techniques were found to meet the screening-level criteria of the first phase of the evaluation process and were carried forward to the detailed assessment:

- traditional source controls;
- LID source controls;
- LID conveyance control measures;
- end-of-pipe wet ponds; and
- stream restoration.

The following techniques were judged to not meet the screening-level criteria and were not carried forward:

- the "do nothing" option;
- end-of-pipe wetlands; and
- end-of-pipe dry ponds

The stormwater management techniques carried forward from the screening level assessment were then used to develop a set of ten (10) stormwater management alternatives for the SCUBE study area. The alternatives were composed of both individual techniques and combinations of various techniques.

Stormwater Management Strategy

Through the evaluation process, a preferred stormwater management strategy for the SCUBE study area was selected, comprising a combination of the following:

- LID source controls for water balance as well as associated water quality and erosion benefits. The identified targets include:
  - Silt/clay soils - capture and infiltrate the first 1.5 mm over the catchment area for residential landuses, and 3 mm for commercial/institutional landuses;
  - Sandy soils - capture and infiltrate the first 3 mm over the catchment area (residential landuses).
- end-of-pipe wet ponds for Level 2 or "normal" water quality control, as well as post-to-pre runoff control for flooding and erosion, where required:
  - For lands draining to the lined portion of Watercourse 9 (water quality control only), targets include 65 to 105 m^3/ha of permanent pool storage, depending on landuses, and 40 m^3/ha of active storage.
  - For all other lands, water quality and flood/erosion control is required. Targets include 65 to 105 m^3/ha of permanent pool storage, depending on landuses, and approximately 550 m^3/ha of active storage for erosion and flood control.
- stream restoration to benefit aquatic and terrestrial resources.

Possible future channel construction works have also been recommended as part of previous studies upstream of the CNR line on Watercourse 7.2 and along Lewis Road to the Western Tributary of Watercourse 9. Although these proposed future channels are conceptual in nature and their ultimate characteristics and capacities are not known at this time, these works do represent potential capacity improvements over the existing systems which could ultimately relax the flood control storage requirements for future stormwater ponds.

It was also recognized that the feasibility of end-of-pipe stormwater ponds is constrained somewhat by the size of the area it services. Therefore, for small catchment areas, less than 5 hectares in size, an alternative strategy was recommended in which traditional source controls would be applied in place of wet ponds.

Figure 7.1 of the report illustrates the Stormwater Management Strategy elements, including conceptual stormwater pond locations.

Natural Heritage Strategy

The Study also provided recommendations with respect to the Natural Heritage System for the SCUBE study area. The Recommended Natural Heritage System is illustrated in Figure 8.14 and consists of protected terrestrial features, terrestrial linkage areas, and recommended areas for enhancement. Protected areas include:

- the Niagara Escarpment Protection Area;
- identified terrestrial core areas, including the Fifty Point ESA, Fifty Creek Locally Significant Wetland Complex, Fifty Creek riparian lands, and woodlot at the base of Watercourse 9;
- a 30m Vegetation Protection Zone (15 each side) along the warmwater fish habitat stream corridor of Fifty Creek, Watercourse 7.2, Watercourse 9 and Watercourse 10;
- a 60 m Vegetation Protection Zone (30 m each side) along the Fifty Creek ESA and Fifty Creek Locally Significant Wetland Complex.

- regulatory floodplains; and
- the eastern portion of the SCUBE Central land parcel, where a bird species, Bobolink, was observed. This species has recently been designated Threatened and its habitat is protected under the provisions of the Endangered Species Act (2007).

With respect to the last point above, it was recommended that the entire portion of the SCUBE Central Lands east of Lewis Road be designated Area Specific Policy Area (ASPA) pending MNR development of a species-specific regulation for the protection of Bobolink habitat.

Aquafor Beech Limited reviewed vegetation units characterized by Dillon Consulting Limited (2010) or Natural Resources Solutions Incorporated (2007) using the Ecological Land Classification System for Southern Ontario and identified one Woodland Linkage (Woodland Linkage 1) and 17 Linkages of other natural vegetation types not previously mapped by the City of Hamilton (2009).

Enhancement opportunities were also discussed and include the protected areas and linkage areas noted above, as well as proposed 30m wildlife linkage corridors and stream corridors.

Public Consultation

Consistent with the Environmental Assessment approach for the study, the environmental constraints and opportunities for the SCUBE study area were presented to the public at an Open House event in November 2008. The preliminary recommended Stormwater Management and Natural Heritage Strategies that comprise the results for the SCUBE Subwatershed Study were presented to the public at a second subsequent Open House event in June 2010. Here, City staff and Study Team consultants provided responses to questions and clarifications raised by the public.

Future Phase 3 Subwatershed Study

Although this current Subwatershed Study covers only Phase 1 and Phase 2 of the Subwatershed

Study process, a future Phase 3 Report will be prepared dealing with implementation of the Subwatershed Study results. In general, this third phase is anticipated to cover the following:

- review and selection of appropriate types of LID measures to be applied;
- design guidance for the proposed LID measures;
- design guidance for the proposed stormwater management ponds;
- review of the future report requirements for subsequent design phases of development;
- policy recommendations; and
- recommendations with respect to funding responsibility.

Table of Contents

APPENDICES

APPENDIX A: Hydrologic Modelling

APPENDIX B: Hydraulic Modelling

APPENDIX C: Groundwater Recharge Calculations

APPENDIX D: Public Consultation

APPENDIX E: Consolidated Species Lists

APPENDIX F: MNR List of COSSARO-designated Species at Risk Known or Suspected to Occur in the City of Hamilton

APPENDIX G: North-South Environmental Incorporated Review of Bobolink Habitat

APPENDIX H: Preliminary Meander Belt Assessment

APPENDIX I: 2012 Breeding Bird Report

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

1.1 General

The City of Hamilton is in the process of preparing the Fruitland-Winona Secondary Plan in support of future urban development within the Stoney Creek Urban Boundary Expansion (SCUBE) area. An earlier Ontario Municipal Board (OMB) settlement identified the need for Secondary Planning within the SCUBE lands, with the exception of the lands known as Winona North, also referred to as Special Policy Area "F", parts A & B. The OMB settlement required that a comprehensive stormwater planning study be undertaken for Special Policy Area F.

The purpose of this Subwatershed Study report is to investigate and inventory the natural resources which could potentially be impacted by future urban development within specific portions of the overall SCUBE area and to identify constraints and opportunities associated with existing/proposed landuses. These constraints and opportunities are then to develop a comprehensive Subwatershed Management Plan, including stormwater management and natural heritage strategies for the area.

This study focuses on two main portions of the overall SCUBE area (Figure 1.1):

- **SCUBE Central** – composed of the vacant lands generally bounded by Barton Street to the north, Highway No. 8 to the south, McNeilly Road to the west and the existing residential community west of Winona Road to the east
- **SCUBE East (Winona North, Special Policy Area F)** – consisting of two parcels of land:
    - **Parcel A** – bounded by the CN railway to the north, Barton Street to the south, and located immediately east of the Winona Urban Community;
    - **Parcel B** – bounded by South Service Road to the north, the CN railway to the south, Winona Road to the west, and the City of Hamilton boundary to the east.

KEY MAP

Legend

- Study Area
- SCUBE Development Lands
- Streams

NOTES:

0 125 250 500 750 1,000

Meters

Acuate Beech

77 James Street North
Hamilton ON
L8R 2K3
Phone: (905) 546-2424
Fax: (905) 546-4435

Hamilton

SCUBE Subwatershed Study
Study Area

FIGURE No. 1.1

DATE: November 2010

Outside of the SCUBE East and SCUBE Central lands, the lands bounded by Barton Street and the QEW west of Winona Road are designated as employment lands and are already partially developed. These lands will continue to experience future urban development as the remaining vacant/agricultural lands are converted to urban landuses.

The Subwatershed Study Area consists of the drainage boundaries of the watercourses which drain the proposed future development areas, namely Watercourses 7.2, 9, 10 and Fifty Creek (Watercourse 12). This encompasses roughly all of the lands east of McNeilly Road to the City boundary, and from Lake Ontario to just above the Niagara Escarpment.

1.2 Subwatershed Planning

The process of Subwatershed Planning has evolved over the last 20 years. The typical Subwatershed Plan of the 1980's, which was commonly termed “Master Drainage Plan”, was primarily concerned with two issues; flooding and erosion. In the latter part of the 1980s the plan evolved and typically dealt with the above issues as well as water quality and occasionally aquatic resources.

Presently, Subwatershed Plans deal with a number of issues including:

- flooding;
- erosion;
- water quality;
- the water budget (i.e., groundwater, baseflow and peak flows);
- terrestrial and aquatic habitat;
- woodlands, including woodlots and forests;
- wetlands;
- Areas of Natural and Scientific Interest;
- Environmentally Sensitive Areas;
- aesthetics; and
- recreation.

Furthermore, the plans are ecosystem based, with the potential interaction between each of the environmental features being strongly considered.

Integration of the Land Use Planning Process with Water Resource Management Planning has also evolved over the last 20 years. Whereas the common practice in the mid eighties involved the development of Official, Secondary and Draft Plans with nominal consideration of environmental consequences; present practice considers the two planning processes in unison. The Subwatershed Plan, in this manner, becomes an integral part of the overall planning process, and if successfully completed should provide:

- a solid foundation such that the environmental features will be protected, enhanced or restored under present conditions, and as land use changes occur; and
- an environmentally sound framework within which those involved in planning and decision-making can evaluate the consequences of current and post-development scenarios in the context of the entire subwatershed.

1.3 Study Goal and Objectives

1.3.1 Study Goal

The Subwatershed Study goal may be defined as:

> "development of a management plan which is designed to allow environmentally responsible resource management and municipal planning decisions to be made as land use changes occur within the subwatershed."

1.3.2 Study Objectives

The objectives of this study are summarized below according to the three phases that comprise a Subwatershed Study. This report has been prepared to present the results for Phases 1 and 2 of the process.

Phase 1: Establish Environmental Conditions

- define existing environmental conditions;
- identify and evaluate the natural features and functions of the study area and their potential interrelationship with other natural features (the term "natural feature" is used to describe various environmental or water related attributes); and
- develop constraints and opportunities mapping to identify developable lands, non-developable lands, and lands requiring environmental mitigation before development can occur.

Phase 2: Evaluate Alternative Management Strategies and Develop a Recommended Plan

- identify potential impacts to natural features and functions;
- identify protective measures (best management practices, or BMP's) that, when implemented, will protect, enhance or restore the environmental features and functions;
- select, based on environmental, social and cost conditions, several alternative Subwatershed Management Strategies;
- evaluate each Strategy, based on criteria which may include environmental enhancement, cost, land requirements and stakeholder preference.
- select, from the alternatives, a recommended subwatershed strategy (or plan)

Following completion of Phases 1 and 2 of the Study, the remaining third phase will be undertaken:

Phase 3: Develop an Implementation Plan

- develop an Implementation Plan to ensure the long term integrity of the Recommended Plan, including the identification of issues and areas where further detailed studies may be required at the draft plan of subdivision stage of the planning process.
- identify any future recommended monitoring studies or contingency plans.
- Integrate the Subwatershed Study findings with City Official Plan Policy

1.4 Class Environmental Assessment (EA) Process

The Subwatershed Study is being conducted as a Master Plan under the Municipal Class Environmental Assessment (Class EA) process. In order to meet the intent of the Environmental Assessment Act, the study will need to satisfy Phases 1 and 2 of the Class EA process:

- Phase 1 – identification of the problem (deficiency) or opportunity; and
- Phase 2 – identification of alternative solutions to address the problem or opportunity by taking into consideration the existing environment, and establish the preferred solution taking into account public and review agency input.

The relationship between the components of the Subwatershed Study process (see Section 1.3.2) and the Class EA process is depicted in Figure 1.2.

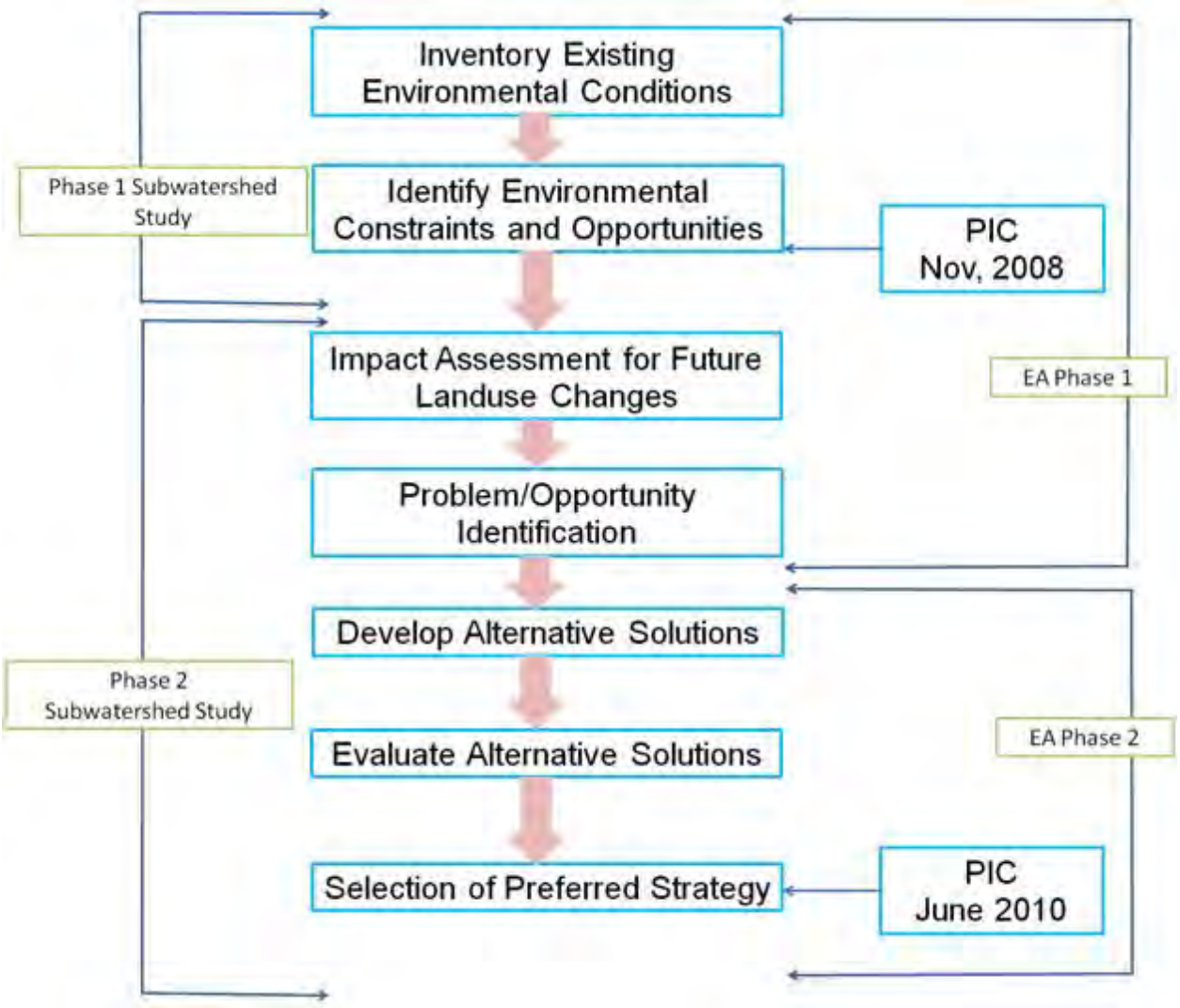


Figure 1.2: Subwatershed Study & Environmental Assessment Study Process

2.0 STUDY AREA AND BACKGROUND

2.1 Study Area

The SCUBE Subwatershed study area is located within the community of Stoney Creek, in the northeast portion of the City of Hamilton. As shown in Figure 1.1, the study area encompasses approximately 1450 hectares (14.5 km^2) and is drained by five main watercourses:

- Watercourse 7.2;
- Watercourse 9;
- Watercourse 10 and adjacent storm sewer tributaries;
- Watercourse 11; and
- Fifty Creek (Watercourse 12)

Further detailed descriptions and photographs for the main stream reaches are provided in Section 3.3 and 3.5.

2.2 Existing Landuses

Landuses within the study area consist of a mix of natural areas, dormant and active agricultural lands, residential development, and commercial/industrial landuses.

The southern boundary of the study area is characterized by agricultural landuses atop the Niagara Escarpment, and the natural areas across the escarpment face. The Winona Urban Community is located in the central portion of the Study area and consists of a mix of residential and supporting institutional and commercial landuses. The lands surrounding the Winona Urban Community are generally agricultural in nature with urban development concentrated along the Barton Street and Highway No. 8 corridors.

Landuses between the CN railway and QEW highway corridors consist of industrial/commercial lands west of Winona Road, and mainly agricultural lands east of Winona Road. North of the

QEW corridor, landuses consist primarily of residential developments, and the Fifty Point Conservation Area at the outlet of Fifty Creek.

2.3 Proposed Landuses

A draft preferred landuse concept for the SCUBE lands has been developed by the City of Hamilton. The lands within the SCUBE Central area between Barton Street and Highway No. 8 will be developed primarily for community use with residential and supporting retail, schools, parks and community services.

Within the SCUBE East lands, Parcel B (i.e., north of the CN Rail corridor) will be developed as an employment area with a mix of commercial and industrial uses. Parcel A (i.e., south of the CN Rail corridor) will be developed primarily for community use with residential and supporting retail, schools, parks and community services.

Outside of the SCUBE East and SCUBE Central lands, the lands bounded by Barton Street and the QEW west of Winona Road are designated as employment lands and are already partially developed. These lands will continue to experience future urban development as the remaining vacant/agricultural lands are converted to urban landuses.

2.4 Background Reports

A series of historical study reports were provided by the City of Hamilton for background review and consideration during the SCUBE Subwatershed Study. Each of these is reviewed below.

Stormwater Quality Management Strategy - Community of Stoney Creek Master Plan (Philips Engineering, June 2004)

The goal of this study was to develop a stormwater quality management strategy for the former City of Stoney Creek. The first phase of the study was a review and inventory of existing stormwater management facilities and stormwater outfalls. The next phase comprised an

assessment of management opportunities for existing and future landuses. A "long-list" of water quality practices was screened based on factors such as feasibility, potential water quality benefits, cost and social impacts. The resulting "short list" of alternatives was further assessed in a quantitative manner based on their effect on contaminant loadings, costs, and land requirements.

The preferred solution includes a hierarchy of stormwater quality measures beginning with lot-level source controls, followed by conveyance and end-of-pipe practices, in addition to management practices to provide an effective approach to providing stormwater quality treatment.

Findings relevant to the SCUBE Subwatershed area include the following:

- watercourse habitat which have high priority for improvements in water quality include Watercourse No. 7, 9, and Fifty Creek;
- water quality in Fifty Creek would improve through conversion of septic systems to municipal sanitary services as landuses change;
- there may be opportunities to improve habitat connectivity through a review of the culverts near the outlet of Fifty Creek;
- opportunities to retrofit existing stormwater ponds were reviewed, but none were recommended within the SCUBE Subwatershed Study area; and
- a series of potential stormwater ponds to service future development were also reviewed and prioritized.

Lewis Road Improvements Class Environmental Assessment from Barton Street to South Service Road – Drainage and Stormwater Management Report (Draft) (Genivar Ontario Inc., July 2007)

This report, in Draft form, was prepared to address the drainage and stormwater management components of the Environmental Assessment for Lewis Road improvements. The report reviews the existing drainage patterns along the Lewis Road corridor and makes

recommendations with respect to the proposed future drainage system and associated stormwater management opportunities. Key items from the report include the following:

- the road improvements will have an urban road cross-section with catch basins and storm sewers;
- roadway runoff from both the major system (overland) and minor system (storm sewer) will discharge to Watercourse No. 9;
- the existing drainage directions will be maintained, however, culvert and channel capacity upgrades are recommended;
- an open channel is proposed to convey external flows northward along the west side of Lewis Road from Barton Street to just south of the CN Railway, and then eastward to the main branch of Watercourse No. 9 at the CN Rail culvert.
- oil-grit separators are recommended at storm sewer outlets to provide water quality control.

Watercourse No.7 Creek System Improvements – Class Environmental Assessment (Philips Engineering, September 2003)

The primary purpose of this study was to determine a preferred watercourse system improvement solution for Watercourse No. 7, between Barton Street and Lake Ontario, to address flooding, erosion, terrestrial and aquatic habitat issues. The preferred solution was a combination of watercourse improvements through natural channel design, together with a stormwater management facility for flood and erosion control storage.

Specific issues noted during the background review that are relevant to the current SCUBE Subwatershed Study include the following:

- Watercourse 7.2 has been diverted to the west of McNeilly Road, upstream of the QEW/South Service Road to a new culvert at Watercourse 7; and

- the eastern branch of Watercourse 7, west of McNeilly Road, was classified as a perennial

stream. This is consistent with findings from the groundwater assessment undertaken in this Subwatershed Study (refer to Section 3.4), which indicates a potential groundwater linkage between sand/gravel deposits near Highway 8 and the streams to the north.

- Although not discussed in detail in this background report, discussions with City staff indicate that previous historical plans had suggested a possible diversion of the headwaters of Watercourse 7.2 to the Main Branch of Watercourse 7 via a new channel along the south side of the CNR line.

Well Installation and Testing Program – SCUBE East Subwatershed Study, Special Policy Area F (Jagger Hims Limited, June 2008)

This report summarizes the installation and testing of six groundwater monitoring wells in the SCUBE subwatershed study area. The wells were installed at three separate sites, with a shallow (overburden) well and a deep (bedrock) well at each location. Findings from the study are summarized as follows:

- the shallow overburden typically consists of clay and silt soils;
- bedrock consists of red Queenston shale;
- hydraulic conductivity tests were completed with the following results:
- for the overburden wells in clayey silt soils, K ranged from 8E-9 m/s to 3E-7 m/s; and
- for the deeper bedrock wells, K ranged from 6E-8 m/s to 3E-6 m/s.

Arvin Avenue Extension - Class Environmental Assessment (AECOM, December 2008)

This report was prepared to study the proposed extension of Arvin Avenue in response to an increasing pressure to provide access to lands in the Stoney Creek Industrial Park. Arvin Avenue presently exists in segments and ends outside of the SCUBE study area, west of McNeilly Road. The study recommends the extension of Arvin Avenue easterly through the SCUBE study area, between Barton Street and the CN Railway, terminating at a cul-de-sac east of Lewis Road.

Key items from the report include the following:

- the road improvements will have an urban road cross-section with catch basins and storm sewers;
- the proposed extension would cross the proposed tributary channel of Watercourse 9 planned for the west side of Lewis Road.
- a 4.0m x 1.5m culvert is proposed for the Watercourse 9 crossing. The culvert will have an open footing design in order to benefit fish habitat with natural substrate for the creek bottom;
- the preferred design incorporates the assumption that post-development peak flows from future upstream development areas will be required to match pre-development peak flows by way of on-site controls and/or end-of-pipe stormwater facilities.

3.0 EXISTING SUBWATERSHED CONDITIONS

3.1 General

The following sections provide an overview of the environmental features and functions of the SCUBE Study Area. The natural ecosystem that existed prior to human settlement has been altered. Activities that have resulted in change include agricultural practices, construction of roads, highways, buildings and industries.

Defining the current state of the environment, as well as the relationship between each feature is necessary in order to characterize key environmental functions, define opportunities and constraints associated with future development, and to ultimately establish alternative strategies to protect, enhance or restore the environmental features over time.

3.2 Environmental Features

For the purposes of this study, the term environmental feature has been used to describe various environmental or water related attributes which presently exist within the SCUBE study area. These include:

- terrestrial features, including landforms, vegetation, wetlands and wildlife;
- aquatic features, including aquatic habitats, aquatic vegetation and aquatic communities;
- surface water resource features, including the quantity and quality of water in the streams, and associated floodplain features;
- groundwater resources, including the quantity and quality of water which is recharged and discharged from the groundwater table; and
- stream morphologic features including erosion.

It is important to recognize that environmental features can be highly inter-related because of their ecological functions and environmental pathways or linkages. For example, a vegetated floodplain feature may provide conveyance for floods and spring melts, provide habitat for plants and animals and provide shade for the watercourse, maintaining cool water temperatures for fish.

3.3 Surface Water Resources

The surface water component of this study reviews the existing stormwater drainage patterns within the SCUBE area and defines flood hazard lands through hydrologic / hydraulic modeling and floodplain mapping.

The primary function of a floodplain is the conveyance of flood waters during extreme storm events and spring melts. It is dependent upon the shape of the channel and associated floodplain, the flow rate and the location of structures (buildings, roads, etc.). Hamilton Conservation Authority regulates development applications within flood-susceptible areas such as the floodplains of watercourse systems. Future urban development is not permitted within the Regulatory Floodplain limits. Floodline mapping was undertaken for this study to identify areas susceptible to flooding under Regulatory Flood conditions. For this study area, Hamilton Conservation Authority defines the Regulatory Flood as the 100-year flood event.

Discussions with City and Hamilton Conservation Authority staff indicated that floodline mapping and associated modeling for Watercourse 7 is being completed under a separate study. Most of the tributaries of Watersheds 10 and 11 have been replaced with urban drainage systems downstream of the QEW and do not have any significant open channel segments upstream of the QEW. Therefore, hydrologic and hydraulic modeling/analyses to define floodplain limits were focused on Watercourse 9 and Watercourse 12 (Fifty Creek) for this Subwatershed Study.

3.3.1 Existing Drainage Patterns

Existing drainage patterns are illustrated in Figure 3.1. As shown, the study area is drained by five main watercourses:

SCUBE

Subwatershed Study - Phase 1

Legend

- Watercourse Catchment
- Subcatchment
- 101 / 10 ha — Subcatchment No. / Subcatchment Area
- Storm Sewer
- Watercourse
- 12-1 — Flow Node
- Major System Drainage
- Minor System Drainage
- Stream Flow Gauge Location

Scale: N.T.S.

Figure 3.1

Existing Drainage Pattern

- Watercourse 7.2 – This watercourse drains the western portion of the study area. Historically, the stream discharged directly north to Lake Ontario. However, the area upstream of the QEW has been diverted to the west of McNeilly Road, to a culvert under South Service Road/QEW at Watercourse 7. Currently, the majority of the stormwater flows are conveyed to Watercourse 7.2 via shallow overland channelized flow routes.

- Watercourse 9 – This watercourse drains the western portions of the Winona Urban Community via an engineered channel flowing along the south side of the CN railway, then north to Lake Ontario. A significant portion of the runoff originating along the Niagara Escarpment between Lewis Road and Winona Road, which historically drained to Fifty Creek, is now intercepted by the storm sewer system in the southern portion of the Winona Urban Community (Figure 3.1, subcatchment 121). These minor system flows are conveyed northerly through the community to the storm sewer outfall at the upstream end of the lined portion of Watercourse 9, south of the CN Railway. Roadside ditches and channels also contribute flow to Watercourse 9 upstream of the CN Railway from the west. Commercial lands between the CN Railway and QEW also discharge to Watercourse 9 via storm sewer. The SCUBE Central development lands, between Barton Street and Highway 8 are within this watershed. Currently none of the SCUBE East development lands drain to Watercourse 9, however "Parcel A" of the SCUBE East lands (Figure 3.1, subcatchment 1011) will ultimately be diverted from the Watercourse 10 watershed to the Watercourse 9 watershed. The storm sewer system within the existing residential development east of Winona Road just south of the CN Railway (Figure 3.1, subcatchment 98) has been sized to accommodate this future diversion.

- Watercourses 10 and 11 – These subwatersheds historically consisted of several small tributaries in the north-central portion of the study area which discharged north to Lake Ontario. These tributaries have since been manipulated and/or replaced with urban drainage systems. Just west of Fifty Road, an open channel of Watercourse 10 has recently been re-constructed through a new residential development. The remainder of the Watercourse 10 tributaries generally consist of roadside ditches through partially developed employment lands south of the QEW, which drain to storm sewer systems on

the north side of the QEW before outletting to Lake Ontario. A significant portion of the SCUBE East development lands, including "Parcel A" and the western portion of "Parcel B", are located within the Watercourse 10 Storm Sewer Tributary catchments. As noted above, the "Parcel A" lands (Figure 3.1, subcatchment 1011) will ultimately be diverted to Watercourse 9. Watercourse 11 has also been replaced by an urban storm sewer system draining north to Lake Ontario, just east of Fifty Road.

- Fifty Creek (Watercourse 12) – This watercourse originates in the escarpment as several small tributary gullies. As noted above, the storm sewer system in the southern portion of the Winona Urban Community (subcatchment 121, Figure 3.1) diverts a significant portion of the runoff between Lewis Road and Winona Road to Watercourse 9. However, the major system from this area continues to drain to Fifty Creek. The main branch of Fifty Creek drains northeast from the Highway No. 8 corridor to the QEW corridor. From here, the creek drains north through the Fifty Point Conservation Area, outletting to Lake Ontario. Currently, the majority of the stormwater flows are conveyed to Fifty Creek via overland flow routes, with the exception of a small storm sewer system servicing the southeast portion of the Winona Urban Community. The eastern portion of the SCUBE East development lands, Parcel "B", drains via Fifty Creek.

Further descriptions and photographs for the main stream reaches are provided in Section 3.5.

3.3.2 Hydrology

Hydrology is the science which deals with the interaction of water and land, and the processes by which precipitation is transformed into runoff to the receiving watercourses or infiltrated into the groundwater system. One of the most dramatic changes brought about by urbanization is the change in stream hydrology. For example, the replacement of vegetation and undisturbed terrain with impermeable surfaces (i.e., pavement, roof tops, graded surfaces and the provision of an underground storm drainage network) results in greater interception of water that would naturally infiltrate into the ground, and instead provides a direct and rapid transport of surface runoff to streams.

As a result, groundwater recharge diminishes, which in turn could potentially affect baseflows within streams which rely on groundwater discharge. A more rapid rate of stormwater runoff from rainfall events can result in an increase in the total volume, peak flow and frequency of runoff occurrences. Uncontrolled, these hydrologic changes can result in increases in flooding, channel erosion, sediment transport, and pollutant loadings. These changes can also cause deterioration in natural channel morphology, fish and wildlife habitats, recreational opportunity and aesthetics.

It is important that the existing hydrologic characteristics of the study area and its watercourses be established. This information is critical in defining existing flood characteristics, defining Regulatory floodplain limits, and providing key information on the selection and design of stormwater management facilities for future urban development lands. For this study, hydrologic modeling was undertaken to define flood flows within Watercourses 9, 10, and 12 (Fifty Creek).

3.3.2.1 Model Selection and Setup

The hydrologic model selected for application in this study was MIKE-11. The model can be used to undertake hydrologic and hydraulic simulations for both urban and rural systems. For this study, the rainfall-runoff module of the model was used to estimate flow rates in the study area watercourses. The model can be used in both "event" and "continuous" mode to estimate precipitation-runoff response.

As illustrated in Figure 3.1, the Study Area was divided into approximately 30 subcatchments in order to provide peak flow estimates at key locations. Air photos, soils and landuse mapping were used to derive the model parameters, including drainage areas, runoff coefficients, percent imperviousness, basin slopes, and channel slopes. A summary of subcatchment parameters used in the hydrologic model is provided in Appendix A**.**

3.3.2.2 Streamflow and Precipitation Monitoring

A monitoring program was undertaken to collect precipitation and streamflow data within the study area. The data was subsequently used to calibrate the hydrologic model (Section 3.3.2.3). A precipitation gauge was installed in Fifty Point Conservation Area in the Watercourse 12 (Fifty Creek) watershed, downstream of Baseline Road. Streamflow monitors were also installed in Watercourse 12 at Baseline Road and at Highway 8.

Precipitation and streamflow data was collected through the summer and fall of 2007. This year was one of the driest on record, and offered very little meaningful data with which to calibrate the hydrologic model. Therefore, discussions were held with City and Hamilton Conservation Authority staff and it was decided that the monitoring program would be extended through the summer of 2008. This year was comparatively "wet" with frequent rainfall events, offering much more reliable data for model calibration.

As part of the monitoring program, spot flow measurements were undertaken and correlated to the water level measurements at the two streamflow gauge sites in order to develop rating curves for each location. The resulting rating curves are illustrated in Figure 3.2 and Figure 3.3. These rating curves were used to translate the water level monitoring data into hydrographs for use in model calibration.

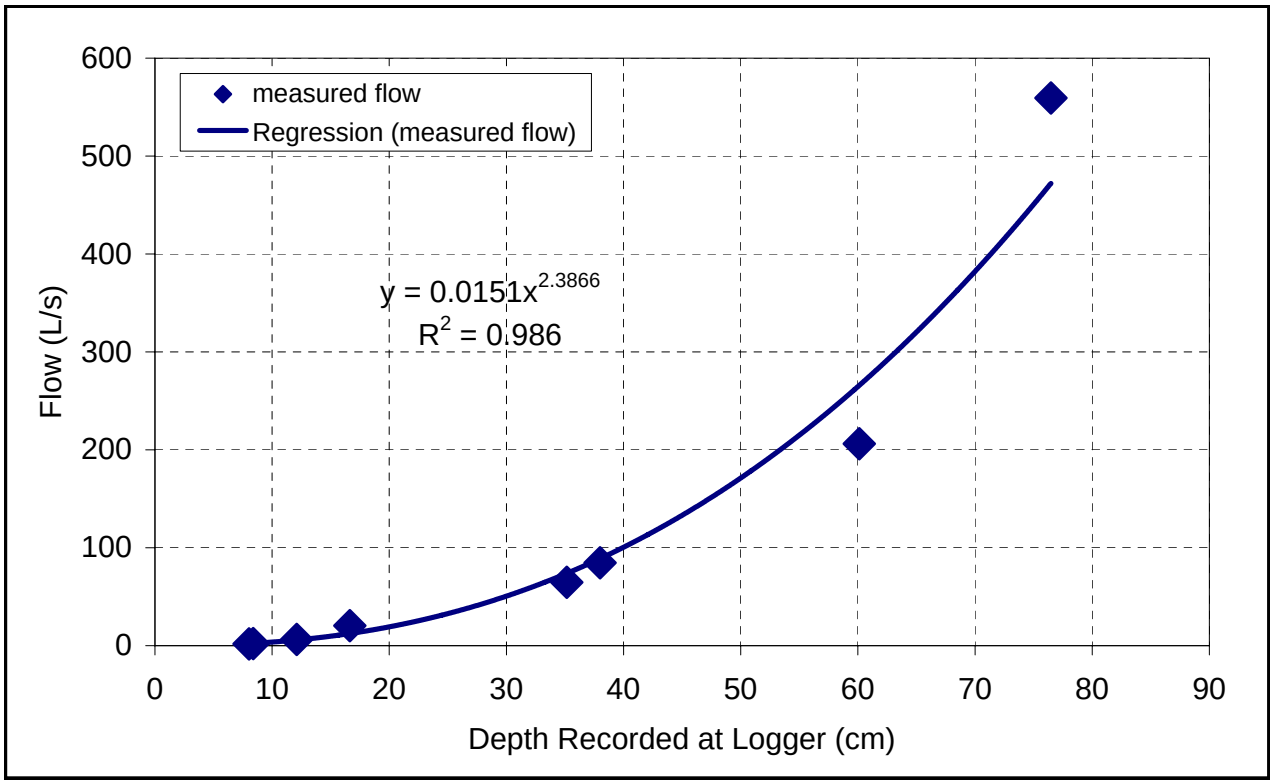


Figure 3.2 Rating Curve - Fifty Creek at HWY 8 Gauge

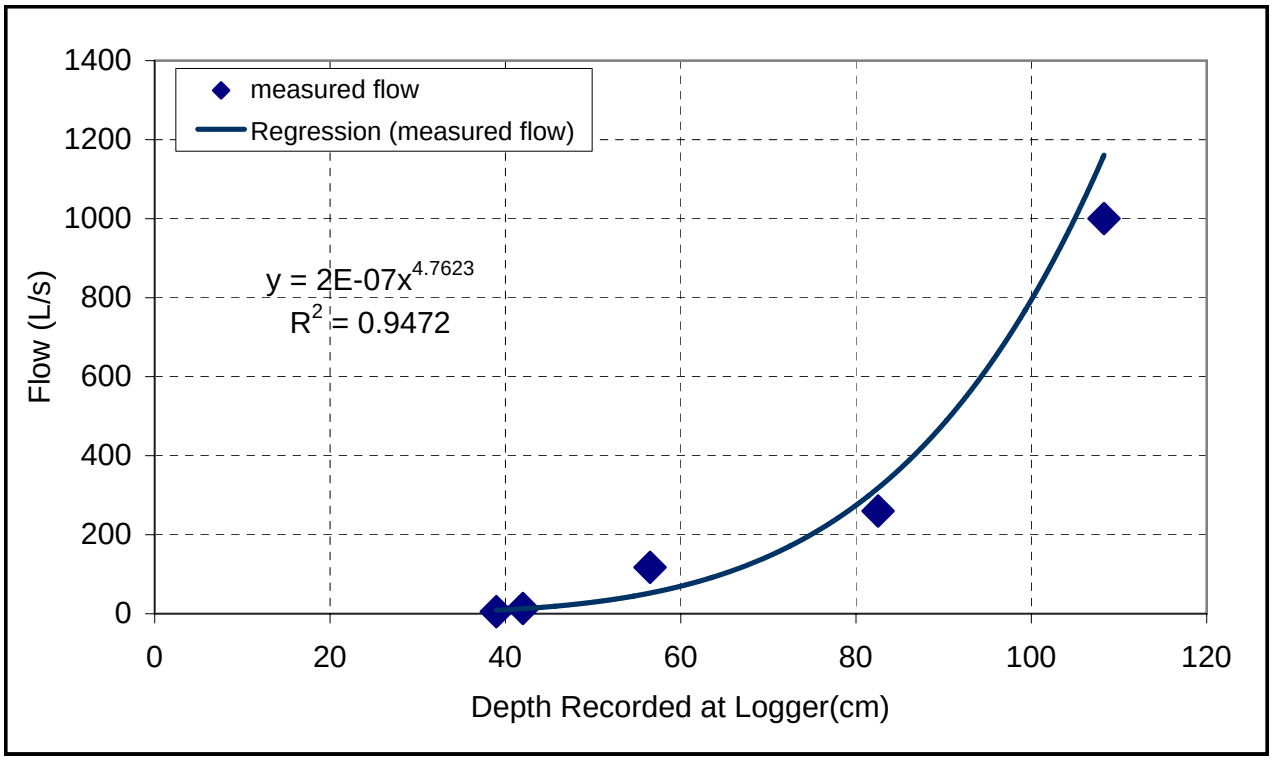


Figure 3.3 Rating Curve - Fifty Creek at Baseline Road Gauge

3.3.2.3 Model Calibration

The basic hydrologic model setup was refined through calibration to ensure that the model was representative of the study area. Observed hydrographs for July 2008 at each of the two gauge sites were used to calibrate the model. In the calibration process, emphasis was placed first on minimizing the differences between observed and simulated runoff volumes, then on minimizing the differences between observed and simulated peak flow rates, and matching the general hydrograph timing and shape. This was accomplished by varying the model parameters such as runoff coefficients, time constants for routing and for interflow, and rootzone soil moisture storage. Once a reasonable set of calibration results were obtained, the observed hydrographs from August 2008 were used to verify the model calibration.

Figure 3.4, Figure 3.5, Figure 3.6, and Figure 3.7 illustrate the results from the model calibration and verification process. As illustrated, good results were obtained with the calibrated model. In general, simulated hydrograph characteristics (i.e., volume, peak flows, shape) are reasonable given the variability associated with rainfall data and uncertainty associated with the measurement of streamflow.

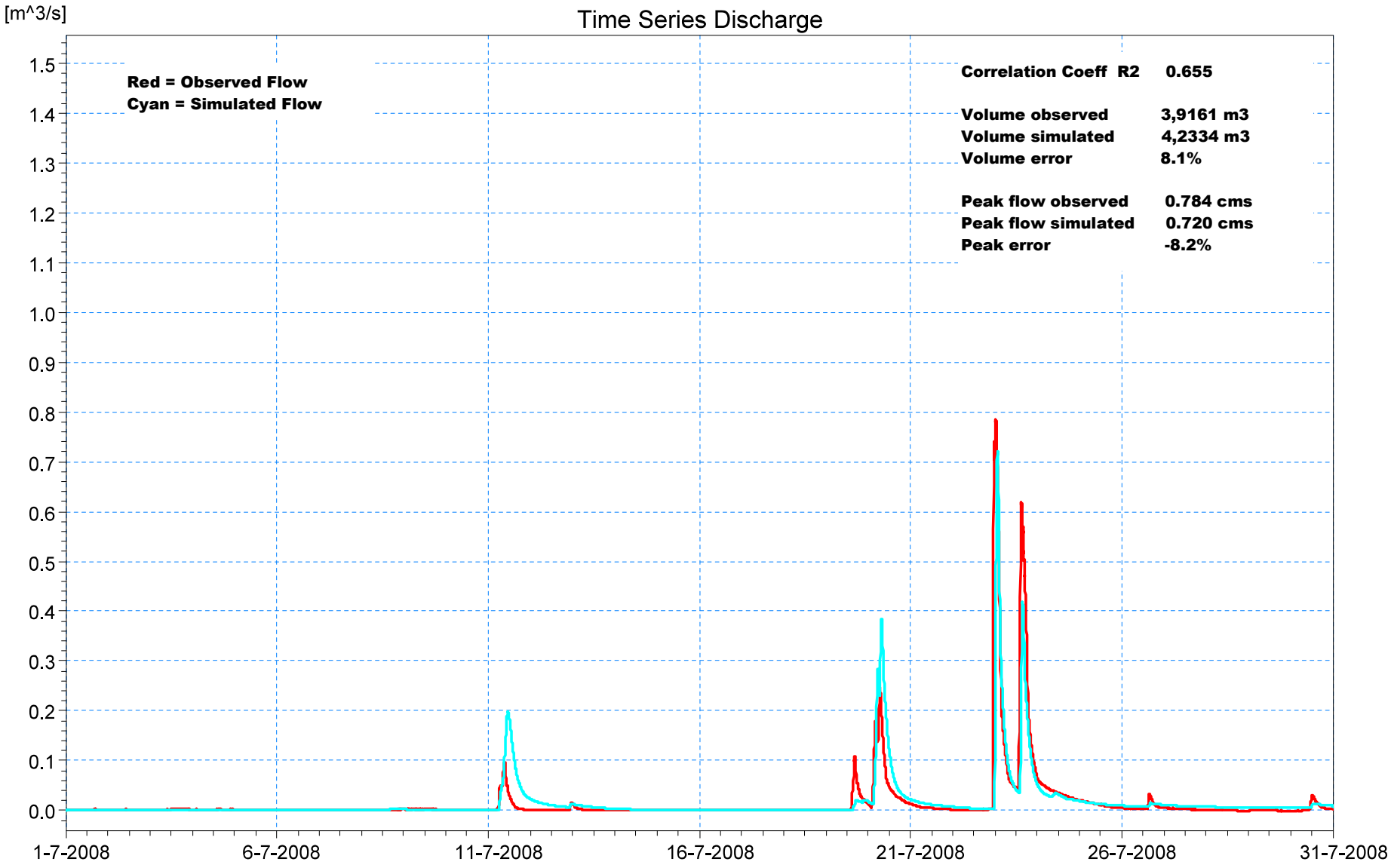


Figure 3.4 Model Calibration Fifty Creek at Highway 8 Gauge - July 08

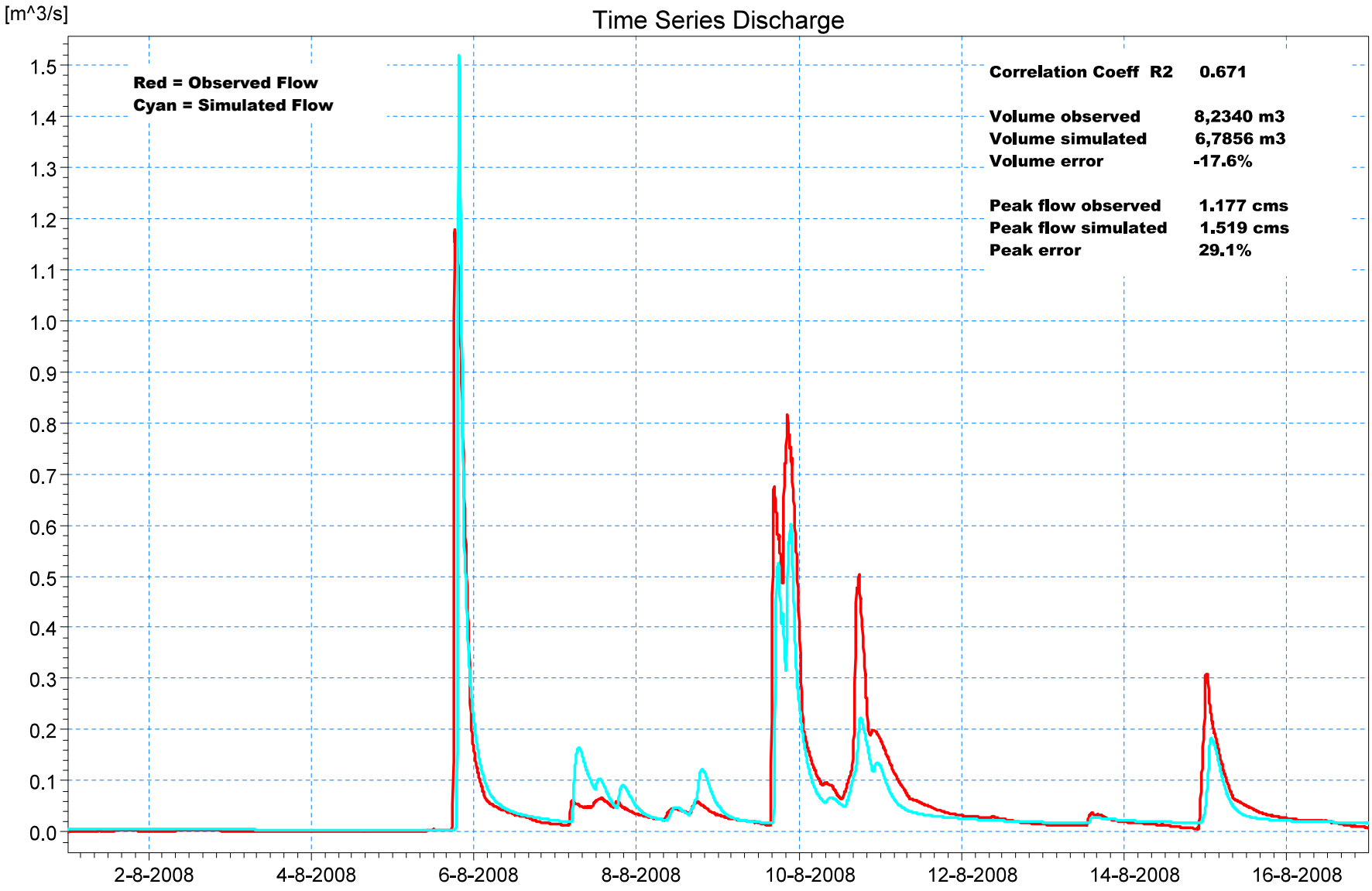


Figure 3.5 Model Verification Fifty Creek at Highway 8 Gauge - August 08

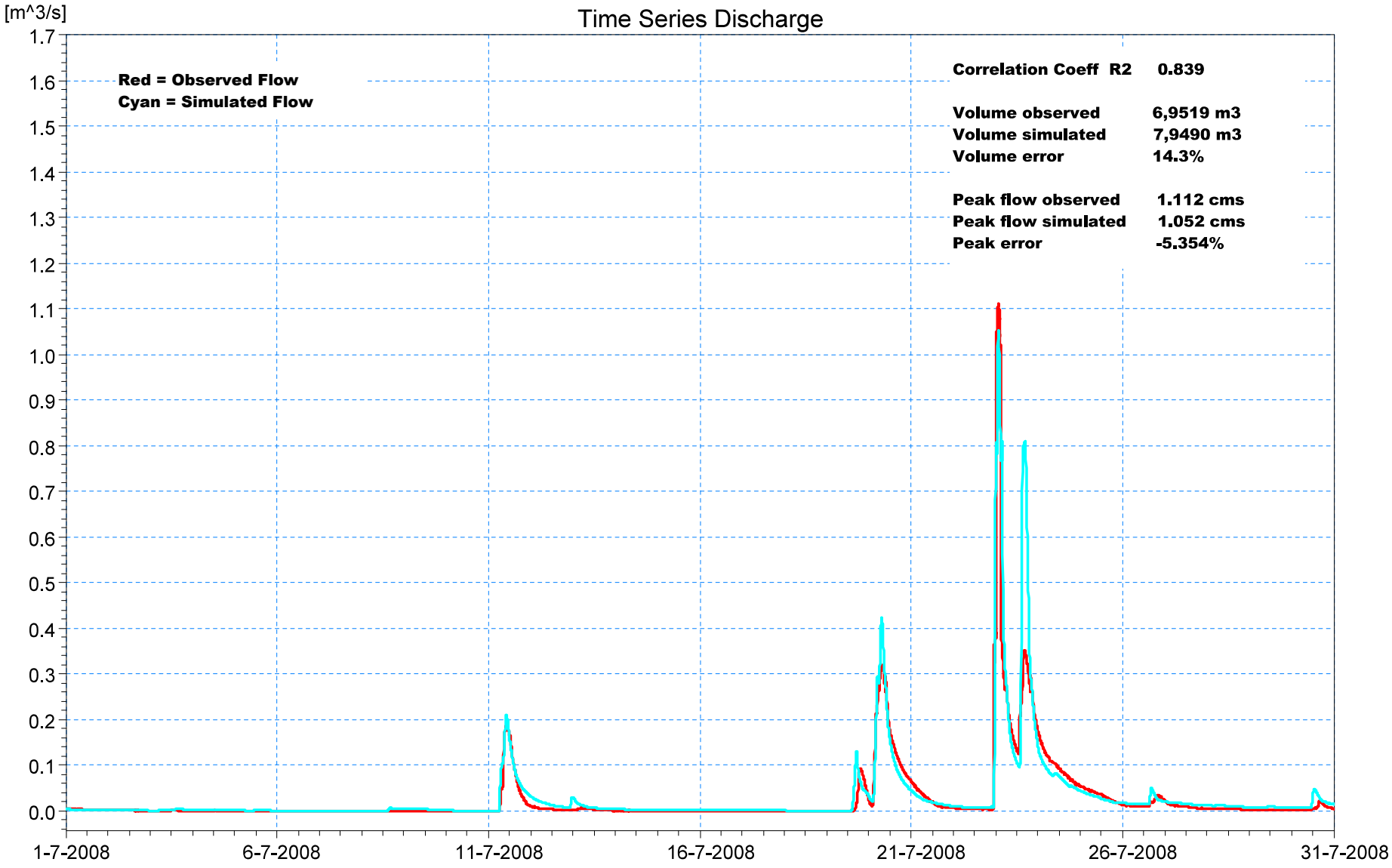


Figure 3.6 Model Calibration Fifty Creek at Baseline Road Gauge - July 08

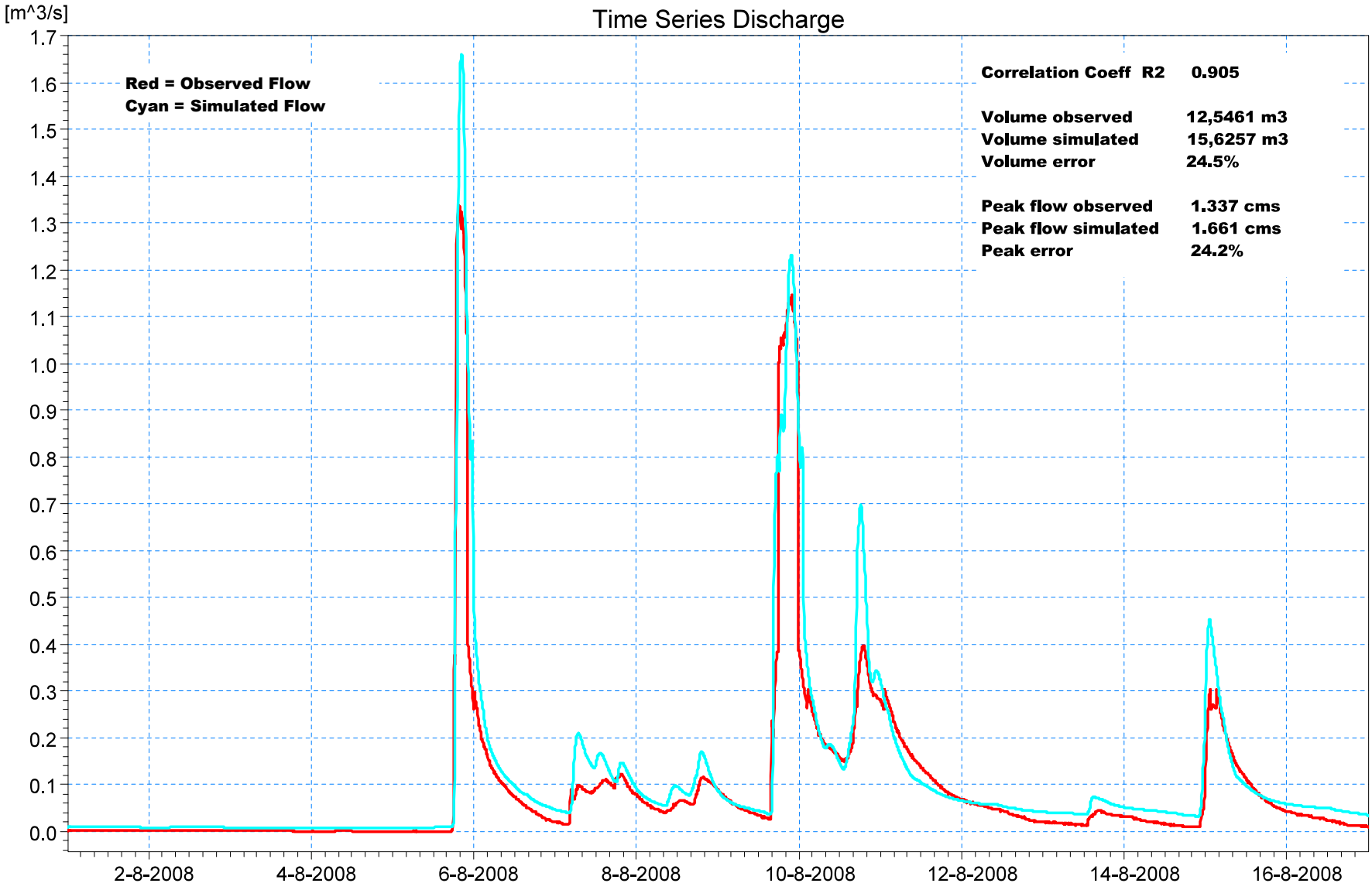


Figure 3.7 Model Verification Fifty Creek at Baseline Road Gauge - August 08

3.3.2.4 Flood Flow Estimates

Estimated flood flow rates were established at key locations in the study area for the existing landuse scenario. The Regulatory Flood event in the study area for floodplain management purposes is based on the 100-year storm event.

Flood flow rates for the 2-year through 100-year return periods were estimated using a continuous simulation of the calibrated model with long-term temperature and precipitation data from Environment Canada's Hamilton RBG gauge site. Frequency analyses were undertaken on the annual maximum flow rates from over 30 years (1962 to 1995) of model simulation. Flood flow estimates for Hurricane Hazel were also estimated by applying the calibrated model with antecedent moisture conditions adjusted to reflect saturated soils and 72 hours of rainfall recorded during the storm.

The resulting flood flow estimates at key locations in the study area for the 2-year through 100-year return periods and for the Regional Storm event (Hurricane Hazel) are summarized in Table 3.1.

Table 3.1: Flood Flow Estimates

Location	Drainage Area* (ha)	% Impervious	Design Flows (cms)						
			2-year	5-year	10-year	20-year	50-year	100-year	Regional
Watercourse 9									
Storm Outfall (9-1)	146.7	20%	0.96	1.4	1.8	2.3	3.1	4.0	12.3
West (9-6)	177.7	39%	0.79	1.5	2.1	3.0	4.5	5.9	16.5
CN Railway (node 9-2)	340.9	33%	1.7	2.8	3.8	4.9	6.7	8.4	29.8
QEW (node 9-3)	375.8	37%	1.9	3.0	4.0	5.2	7.2	9.0	32.7
Lake Ontario (node 9-4)	389.7	37%	2.0	3.1	4.2	5.4	7.4	9.3	34.0
Watershed 10									
QEW culvert (node 10-1)	18.0	80%	0.41	0.68	0.90	1.15	1.53	1.87	6.4
QEW culvert (node 10-2)	10.2	80%	0.14	0.22	0.29	0.37	0.49	0.59	2.0
QEW culvert (node 10-3)	10.4	80%	0.11	0.18	0.23	0.29	0.37	0.44	1.6
QEW culvert (node 10-4)	13.5	80%	0.13	0.20	0.26	0.33	0.43	0.51	1.9
Lake Ontario outlet (node 10-5)	85.2	64%	0.4	0.66	0.88	1.13	1.54	1.91	6.8
Lake Ontario outlet (node 10-6)	47.0	54%	0.53	0.87	1.17	1.51	2.04	2.51	8.9
Lake Ontario outlet (node 10-7)	27.9	18%	0.044	0.08	0.12	0.17	0.28	0.40	1.2
Watershed 11									
Lake Ontario outlet (node 11-1)	59.1	26%	0.19	0.32	0.44	0.58	0.82	1.05	4.8
Watercourse 12 (Fifty Creek)									
Highway 8 (node 12-1)	201.1	4%	0.8	1.4	1.8	2.4	3.3	4.2	15.1
CN Railway (node 12-2)	484.3	3%	1.4	2.2	2.9	3.7	4.9	6.1	24.1
Baseline Road (node 12-3)	564.2	11%	1.6	2.6	3.5	4.6	6.4	8.0	31.7
Lake Ontario (node 12-4)	651.0	11%	1.6	2.7	3.6	4.7	6.4	8.0	35.9

* includes 80.6 ha minor system diversion from Watercourse 12 to Watercourse 9 (catchment 121)

3.3.3 Hydraulics and Floodplain Mapping

This Section presents the findings of the hydraulic analysis for the SCUBE study area, including the hydraulic model setup and the resulting floodline mapping for Watercourses 9 and 12 (Fifty Creek).

The hydraulic analysis was undertaken using the HEC-RAS hydraulic model (Version 3.1.3) developed by the U.S. Army Corps of Engineers, which computes water surface profiles using the standard step method and routines to analyze bridge and culvert structures.

The stream and valley geometry was coded into the model using topographic mapping supplied by the City of Hamilton and supplemented with Ontario Base Map information near the outlet of Watercourse 12 (Fifty Creek). "Low flow" channel dimensions were also coded into the model based on field measurements. Bridge and culvert structures were coded into the model with data

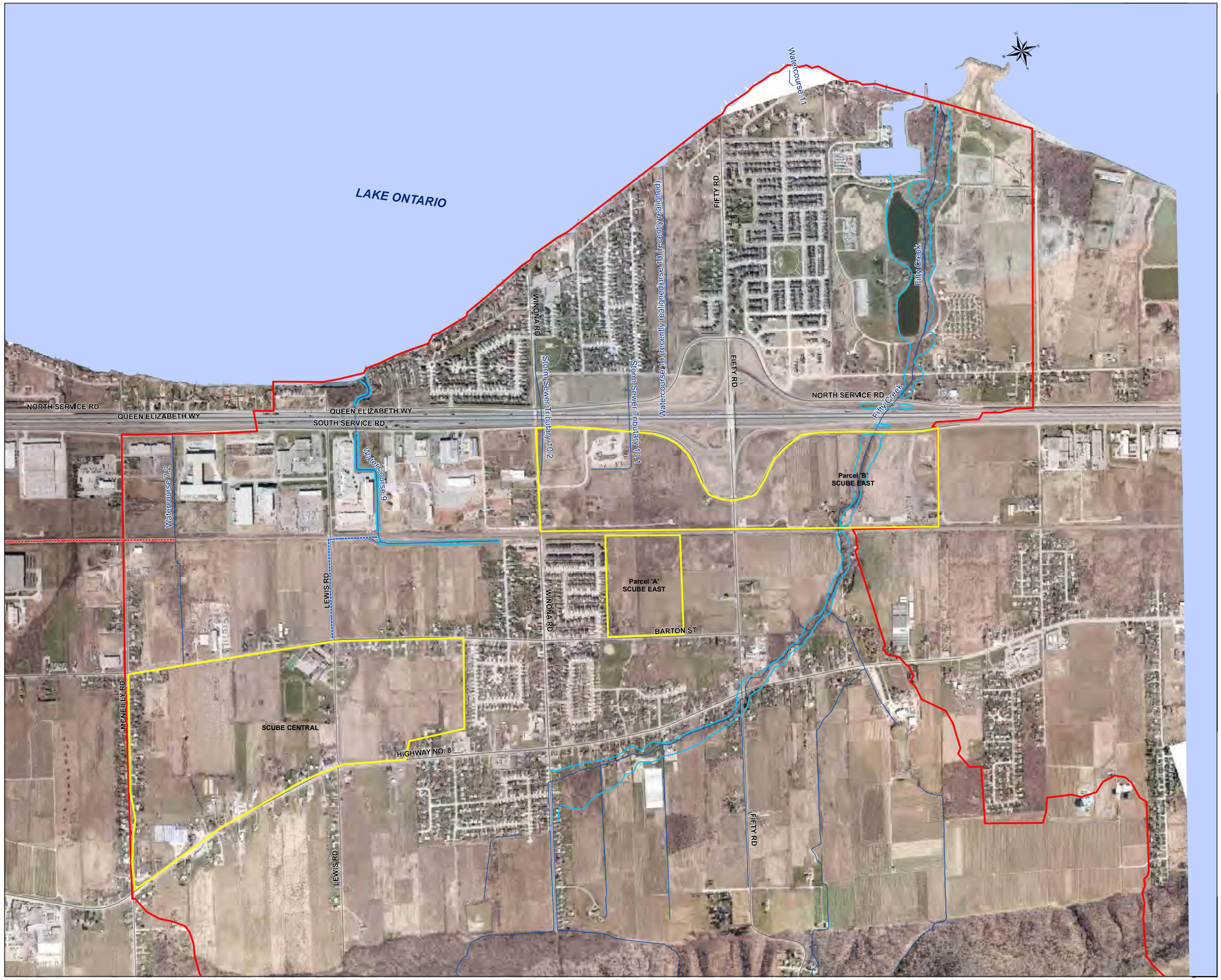
collected through field surveys including:

- bridge/culvert dimensions;
- material (i.e., concrete, steel, etc.)
- invert/obvert elevations;
- road profiles

Flood flow estimates, as determined from the hydrologic analysis (Section 3.3.2), were applied over the appropriate stream reaches to determine water surface profiles for Watercourses 9 and 12 (Fifty Creek). Hydraulic model details are provided in Appendix B. For the purposes of floodplain mapping, flood flows associated with future uncontrolled landuses were used. The model results for this scenario are discussed further in Section 5.3. The resulting flood profile for the 100-year event was used to plot the Regulatory floodplain limits through the study area based on topographic (contour) basemapping provided by the City, as illustrated in Figure 3.8. No new development would be permitted within these potentially flood-susceptible lands.

Review of the hydraulic model results indicates that the capacities of some of the existing structures (bridge/culvert) are exceeded or near capacity during the most extreme flood events. Further, although the ditches, culverts and storm sewer networks within Watersheds 10 and 7.2 were not assessed in detail at this level of study, the limited capacities of these systems also represent constraints to future upstream development that must be accounted for as part of future detailed stormwater management planning.

Future development lands within the SCUBE study area will need to consider flood (quantity) control to prevent increases in flood flow rates within the watercourse systems with downstream capacity concerns or limitations. The Ministry of Transportation and other private landowners have also asked for assurance that future development will not increase the frequency of flooding at the QEW crossings or private lands downstream. The Stormwater Quality Management Strategy for Stoney Creek (Philips, 2004) also identified combined water quantity/quality control facilities throughout the SCUBE lands.



KEY MAP

Legend

- Regulatory Floodlines
- SCUBE Development Lands
- Study Area
- Streams
- Proposed Lewis Road Channel
- Possible Watercourse 7.2 Diversion Channel

Constraints

- **No Development – Regulatory Floodplain**
- **Developable Lands – Flood (Quantity) control required (downstream capacity limitations/flood concerns)**

Opportunities

- **Developable Lands – Source and conveyance control SWM measures to minimize runoff impact and promote infiltration, where feasible.**

0 125 250 500 750

Meters

Aquafor Beech

77 James Street North
Hamilton ON
L8R 2K3
Phone: (905) 546-2424
Fax: (905) 546-4435

Hamilton

SCUBE Subwatershed Study
Constraints & Opportunities - Surface Water

FIGURE No. 3.8

DATE: November 2010

3.3.4 Water Quality

There is little background information available on the water quality for the watercourses within the study area, however, conditions were estimated, in a general manner, based on typical conditions found in other areas with similar landuses. Agricultural land uses are the dominant land use within SCUBE and the stream flow in these features is surface runoff dominated.

Fifty Creek, the largest watercourse, is a warmwater stream and is typically nutrient rich, with nutrients such as total phosphorus occurring at concentrations above the provincial water quality objective (PWQO) of 0.03 mg/l. Levels of bacteria, E.coli are also probably moderately high, in the order of 500 – 1000 cts/100 mls, well above the PWQO of 100 cts./100ml. Trace metals, such as copper, lead and zinc, are likely close to the PWQO, however it is expected that concentrations of these parameters regularly exceed their respective guidelines in the vicinity of the QEW as a result of road runoff. Chloride concentrations may also be high in the vicinity of the QEW, however, it is unlikely that concentrations would exceed the fisheries guideline of 252 mg/l.

3.3.5 Constraints and Opportunities - Surface Water

Based on the above hydrologic and hydraulic assessments, future development constraints and opportunities related to surface water resources may be summarized as follows:

- No new development will be permitted within the potentially flood-susceptible lands defined by the Regulatory (100-year) Floodplain limits.

- Throughout most of the study area future development lands will need to consider flood (quantity) control facilities to control post-development peak flows to pre-development levels due to existing downstream flooding concerns and/or capacity constraints. Water quality and erosion control requirements are discussed in Section 3.6 and 3.5, respectively.

- Source and conveyance control stormwater measures, where feasible, should be applied to preserve the existing hydrology and minimize increases in runoff volumes and flow rates. The potential to infiltrate stormwater associated with future development is discussed further in Section 3.4.

- As noted in Section 2.4, proposed improvements to Lewis Road include an opportunity to construct an open channel to convey external flows northward along the west side of Lewis Road from Barton Street to just south of the CN Railway, and then eastward to Watercourse No. 9 (Genivar Ontario Inc, 2007).

- As noted in Section 2.4, historical planning for Watercourse 7 included an opportunity to construct an open bypass channel along the south side of the CNR line which would divert the headwaters of Watercourse 7.2 to the Main Branch of Watercourse 7, west of McNeilly Road.

3.4 Groundwater Resources

Hydrogeology is the study of water movement below the ground surface. In general, rainwater infiltrates and is stored underground in sand and gravel deposits, called aquifers, which may supply drinking water to local wells or supply baseflows to adjacent streams.

Recharge areas, where water infiltrates into the groundwater system, are usually areas of highly permeable soils such as sands and gravels. Springs and seepage areas, where groundwater exits the soils, are said to be discharge areas. These discharge zones supply streams with cold baseflows which benefits aquatic life.

A review of the geology and hydrogeology of the study area was undertaken in order to gain an understanding of the groundwater resources within the study area, including potential groundwater recharge and discharge locations. Water well records, geology and soils maps were reviewed to characterize the groundwater system. In addition, a series of monitoring wells and piezometers were installed to assess groundwater levels and chemistry.

3.4.1 Physiography and Geology

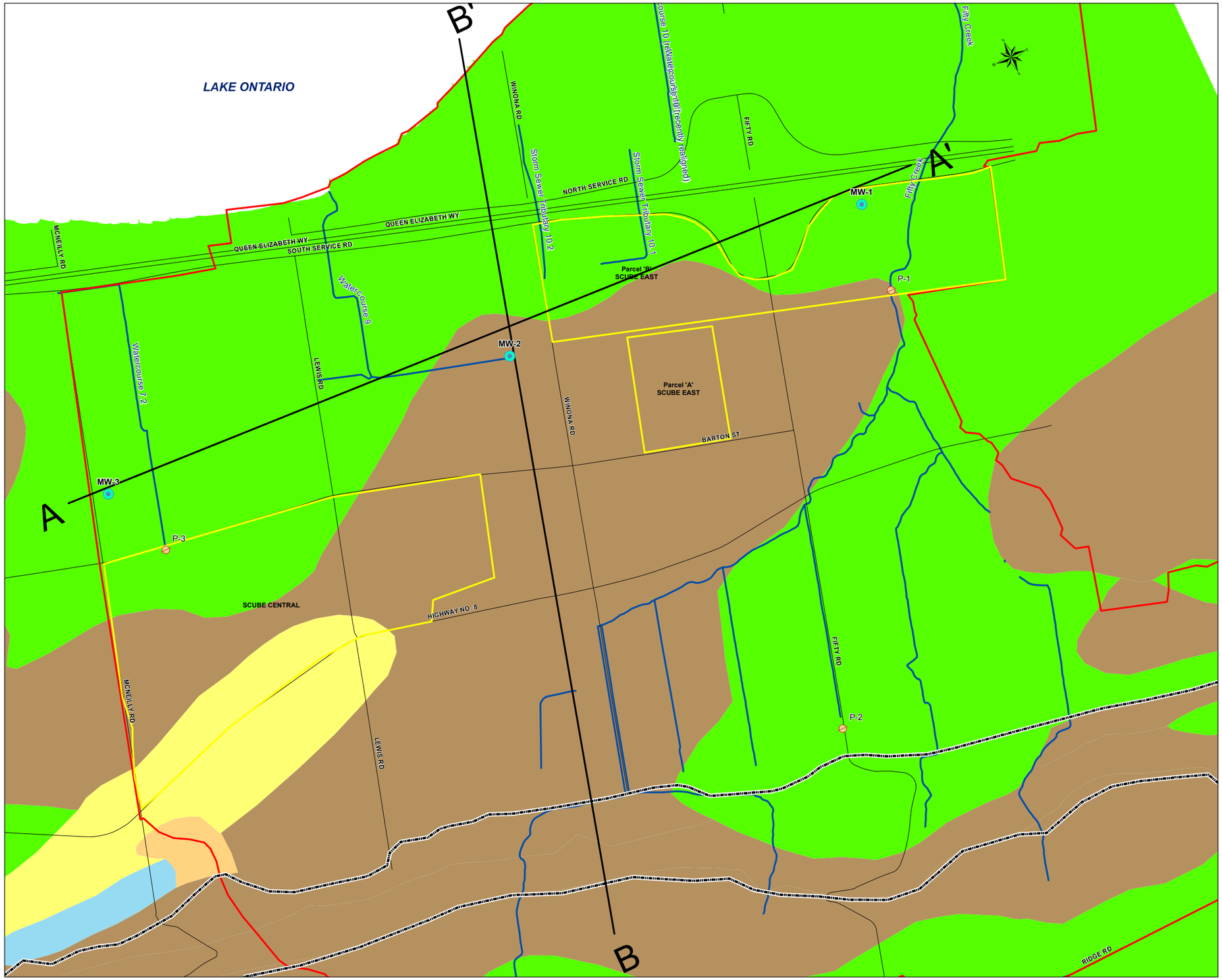
The Niagara Escarpment and Lake Iroquois Plain represent the dominant physiographic features within the study area. The Niagara Escarpment marks the ancient shoreline of Lake Iroquois, and the Iroquois Plain represents the relatively flat lowlands between the escarpment and present day Lake Ontario. The SCUBE lands are situated within the Iroquois Plain which is characterized by Queenston Shale bedrock overlain by Halton Till, consisting of a silty clay till with fine sand lenses.

The geology of the Study Area is illustrated in Figure 3.9, and geologic cross-sections are illustrated in Figure 3.10. As shown, the southern portion of the Iroquois Plain through the study area is characterized in large part by shallow bedrock with a relatively thin layer of Halton Till, often less than a metre in thickness in some areas. An isolated area of sand and gravel deposits is located within the southwest portion of the SCUBE lands, near Highway No. 8, between McNeilly Road and Lewis Road.

Within the northern portion of the study area, beginning roughly at Barton Street and extending north to the Lake Ontario shoreline, the bedrock shelf drops off rapidly. Immediately north of the QEW, the overburden thickness exceeds 20 metres of Halton Till.

3.4.2 Infiltration and Groundwater Recharge

Groundwater recharge occurs as rainwater and snowmelt infiltrate through the soils into the groundwater table. The groundwater may then, in turn, serve other important functions such as supply of baseflows to local streams or water supply to local wells. The recharge potential of an area is characterized by its soils. For example, highly permeable soils, such as sands and gravels, may have a high recharge potential of up to approximately 300 mm per year, whereas tight clay soils may have recharge potentials as low as 50 mm per year or less.



KEY MAP

Legend

- Study Area
- SCUBE Development Lands
- Streams
- Ground Monitoring Wells Location
- Mini-Piezometer Location
- Geological Cross-Section (See Figure 3.4.2)

High Groundwater Recharge

- Sand and Gravel
- Sand

Moderate Groundwater Recharge

- Shallow Bedrock

Low Groundwater Recharge

- Halton Till (Clayey silt)
- Silt and Clay

Groundwater Discharge

- Escarpment

0 125 250 500 750

Meters

77 James Street North
Hamilton ON
L8R 2K3
Phone: (905) 546-2424
Fax: (905) 546-4435

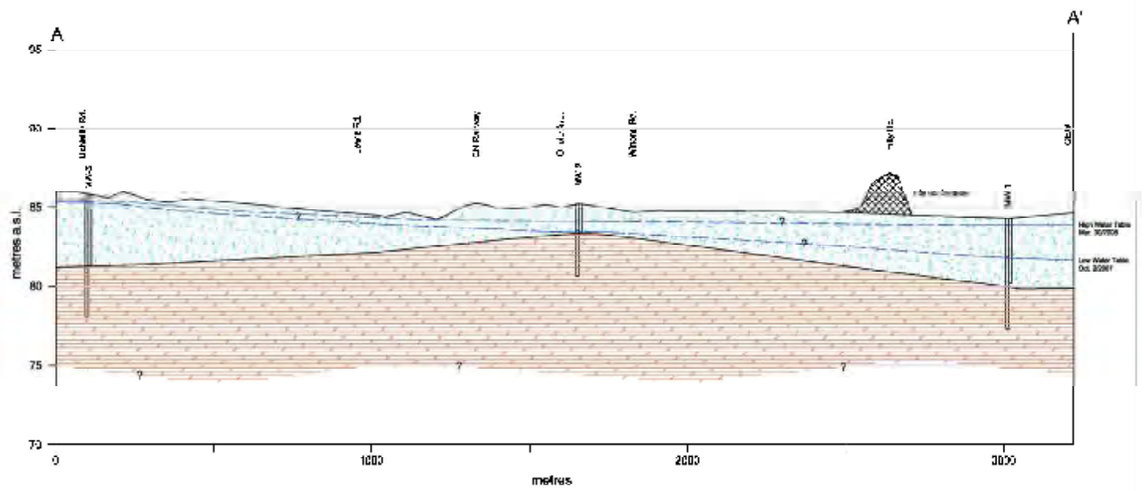
Hamilton

SCUBE Subwatershed Study
Surficial Geology

FIGURE No. 3.9

DATE: November 2010

Stoney Creek Urban Boundary Expansion (SCUBE)
Special Policy Area 'F' Subwatershed Study
Cross-Section A-A'
Vertical Exaggeration 25x

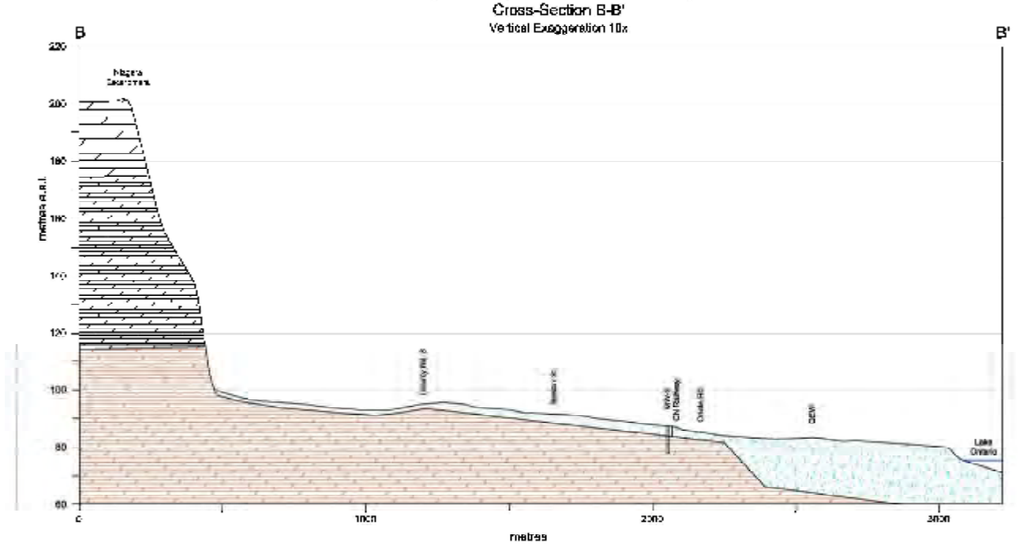


Halton Till (Clayey silt)
Queenston Shale
Water Table

KEY MAP

0 125 250 500 750
Meters

Stoney Creek Urban Boundary Expansion (SCUBE)
Special Policy Area 'F' Subwatershed Study
Cross-Section B-B'
Vertical Exaggeration 10x



Lockport Formation
Clinton/Cataract Group
Queenston Shale
Halton Till (Clayey silt)

Acuato Beech

77 James Street North
Hamilton ON
L8R 2K3
Phone: (905) 546-2424
Fax: (905) 546-4435

Hamilton

SCUBE Subwatershed Study
Geological Cross-Sections

FIGURE No. 3.10

DATE: November 2010

The clay soils over much of the SCUBE study area have a relatively low recharge potential, however, the variable depth of the overburden affects its estimated groundwater recharge potential. Figure 3.9 illustrates the generalized groundwater recharge potential over the study area. As shown, the recharge potential is classified as follows:

- low recharge potential:
  - areas of thick Halton Till overburden; and
  - silt and clay deposits
- moderate recharge potential:
  - areas of shallow bedrock with only a thin layer of Halton Till;
- high recharge potential:
  - isolated sand and gravel deposits near the base of the Niagara Escarpment, between McNeilly Road and Lewis Road.

Figure 3.9 also identifies the Niagara Escarpment as an area of groundwater discharge. A groundwater monitoring program undertaken as part of this study also identified another potential groundwater discharge zone along Watercourse 7.2 just north of the sand/gravel deposits. Findings from the groundwater monitoring program are discussed further in Section 3.4.4

3.4.3 Water Budget

To better characterize the existing infiltration rates for the study area, a basic water budget was prepared for the existing landuse condition using monthly values for precipitation and temperature for the Vineland Rittenhouse meteorological station (1971 – 2000 climate normals from Environment Canada.). As shown in Table 3.2, on average, the area receives approximately 887 mm of precipitation per year.

Table 3.2: Thornthwaite Evapotranspiration Component

Month	Average Monthly Precipitation (mm)	Average daily Temperature (^{o}C)	Potential ET (mm)	Actual ET (mm)
January	63.8	-4.0	0	0
February	55.7	-3.3	0	0
March	70.7	1.1	3.06	3.06
April	74.6	7.1	33.6	33.6
May	74.7	13.4	79.38	78.7
June	80.6	18.8	115.2	113.6
July	79.7	21.9	139.3	123.7
August	74.2	21.0	122.4	105.2
September	88.8	16.9	84.24	84.24
October	70.1	10.6	42.75	42.75
November	79.3	4.9	17.01	17.01
December	74.5	-0.8	0	0
TOTALS	**886.6**			**601.86**

Evapotranspiration (ET) was calculated according to the Thornthwaite and Mather Model (Thornthwaite and Mather, 1957) which uses an accounting procedure to analyze the allocation of water among various components of the hydrologic system. Inputs to the model are monthly temperature and precipitation. Outputs include monthly potential and actual evapotranspiration, and soil moisture storage. Using a water retention value of 250 mm (corresponding to moderately-rooted vegetation in a clay loam soil), the estimated annual evapotranspiration over the study area is approximately 602 mm (Table 3.2).

The evapotranspiration value was then used to estimate annual and monthly water surplus. The annual volume of surplus water was estimated at approximately 285 mm (Table 3.3) which was allocated between infiltration and runoff using an infiltration coefficient derived from the MOE Stormwater Management Planning and Design Manual (2003), based on the topography, soils, and vegetation cover of the area.

Table 3.3: Water Budget for the SCUBE Study Area

Water Budget Component	Source of Information	Value
Annual Precipitation (P)	Environment Canada climate normal for Vineland-Rittenhouse meteorological station	886.6 mm/year
Actual Evapotransiration (ET)	Thornthwaite & Mather monthly calculation	601.9 mm/year
Water Surplus	P – ET	284.7 mm/year
silty clay soils (Halton Till):		
Recharge	Infiltration factor of 0.5*	142 mm/year
Runoff	Water surplus – Recharge	142 mm/year
sand/gravel deposits:		
Recharge	Infiltration factor of 0.8**	228 mm/year
Runoff	Water surplus – Recharge	57 mm/year

* Infiltration factor for Halton Till with flat topography (0.3) + impervious soils (0.1) + cultivated land (0.1) = 0.5
** Infiltration factor for sand/gravel deposits with flat topography (0.3) + pervious soils (0.4) + cultivated land (0.1) = 0.8

As shown in Table 3.3, the estimated annual groundwater recharge for the silty clay soils over the majority of the study area is approximately 142 mm per year. The isolated area of sand/gravel deposits near the base of the Niagara Escarpment has a significantly higher annual recharge rate of approximately 228 mm per year. The remaining 142 mm and 57 mm of surplus water occurs as overland runoff in the clay soils and sand/gravel deposits, respectively.

3.4.4 Groundwater Monitoring

Three nested monitoring wells were advanced in the study area south of the QEW by Jagger Hims in July 2007 to depths up to 15.5 metres (Jagger Hims Limited, 2008). The locations of the monitoring wells are illustrated in Figure 3.9. The deeper of each nested well was screened in the Queenston shale bedrock, and the shallower one in the overburden. The thicknesses of overburden encountered during the installations ranged from 3.0 to 8.7 metres of silty clay Halton Till.

In addition to the monitoring wells, three streambed drive-point piezometers were installed in the study area, including two within the eastern portion of the study area near Fifty Creek, and one in

the west near Watercourse 7.2 (Figure 3.9).

Findings from the groundwater monitoring program are summarized below:

- Piezometers in Fifty Creek indicate that the groundwater table is located below the stream bed and therefore does not supply any significant baseflow to the stream. This is supported by observations of intermittent flow.
- Piezometer readings in the western portion of the study area (Watercourse 7.2) indicate that the groundwater table is located near or above the streambed, suggesting that portion of the stream, just north of the sand and gravel deposits, is a localized groundwater discharge area. This is supported by observations of perennial flow conditions in the east branch of Watercourse 7, just west of McNeilly Road (Philips Engineering Ltd., 2003).
- The water table in shallow wells was found to be 1 to 2 metres below ground surface, similar to the piezometric surface in bedrock wells.
- The water table elevations were found to vary by almost 3 metres seasonally.
- Hydraulic conductivity tests for the overburden wells in clayey silt soils ranged from 8E-9 m/s to 3E-7 m/s, while hydraulic conductivity for the deeper bedrock wells ranged from 6E-8 m/s to 3E-6 m/s (Jagger Hims Ltd., 2008).

Groundwater quality analyses were also undertaken for water samples taken from the monitoring wells in late 2007 and 2008. Results from the monitoring program indicate the following:

- both shallow and deep wells, particularly near the QEW, experience high levels of chlorides (salt) and sulphates, as well as elevated levels of hardness, conductivity, and ammonia. High sulphate levels in the groundwater is attributed to gypsum in the shale bedrock;
- heavy metals levels were generally low to non-detectable, with the exception of uranium, iron and manganese which are commonly elevated in shale and overlying soils;
- bacteria levels were generally low to non-detectable with the exception of one shallow well (MW-1S) where levels were recorded at over 200 CFU/100mL E. Coli.;
- all samples contained variable levels of nutrients (phosphorus and nitrogen).

3.4.5 Constraints and Opportunities - Groundwater

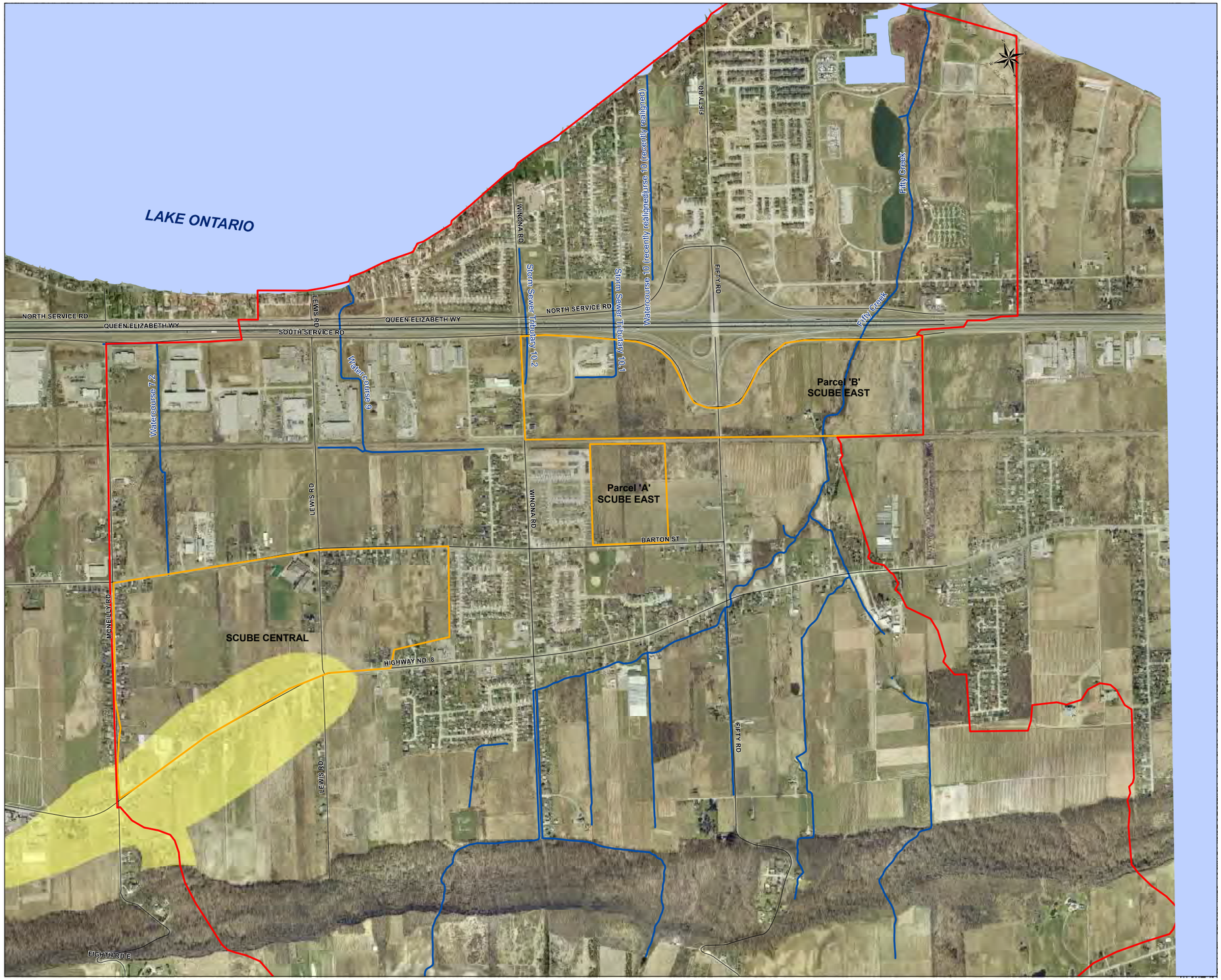
Based on the above groundwater assessment, future development constraints and opportunities are illustrated in Figure 3.11, and are summarized below:

Sand/Gravel Deposit: These granular soils, situated near the base of the escarpment between McNeilly Road and Lewis Road represent a zone of high groundwater recharge potential. Given its function as a potential contributor of baseflow to stream reaches to the north, the existing recharge potential of approximately 230 mm per year from this feature should be protected through future source and conveyance control stormwater management measures which promote the infiltration of clean runoff.

Silt/Clay Till: Although the groundwater recharge potential for the majority of the developable SCUBE lands have been classified as "moderate" to "low", future stormwater management planning should include measures, where feasible, to minimize changes to the existing groundwater recharge rate of approximately 140 mm per year. This will, in turn, help to minimize future increases in runoff rates.

3.5 Fluvial Geomorphology

A geomorphic field investigation was completed in order to assess existing conditions and channel characteristics on Fifty Creek and Watercourses 7.2, 9, and 10 in the vicinity of the SCUBE development area. The watercourses generally flow north within the study area from the Niagara Escarpment, outletting to Lake Ontario (Figure 3.12). Surficial geology and watershed characteristics were also reviewed to document the watercourse environment and to evaluate stream reaches.



Legend

- Study Area
- SCUBE Development Lands
- Streams

Constraints:

Sand and Gravel Deposits - Protect groundwater recharge area (approx. 230 mm/yr)

Opportunities:

All Other Lands - Silt/Clay - Promote SWM measures to maintain groundwater recharge (140 mm/yr.), where feasible.

0 125 250 500 750

Meters

Aquatic Beech

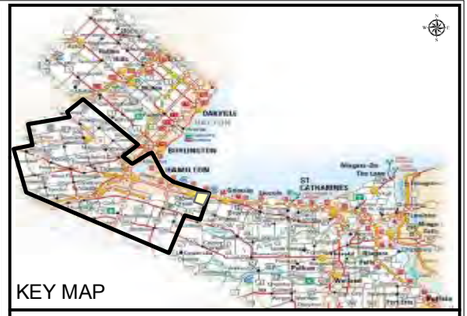
77 James Street North
Hamilton ON
L8R 2K3
Phone: (905) 546-2424
Fax: (905) 546-4435

Hamilton

SCUBE Subwatershed Study Constraints and Opportunities - Groundwater

FIGURE No. 3.11

DATE: November 2010



Legend

- Study Area
- Streams
- SCUBE Development Lands
- B Geomorph Field Station
- Geomorphic Reaches
- Reach Break
- Photo Location

NOTES:

0 125 250 500 750 1,000 1,250 1,500
Meters

77 James Street North
Hamilton ON
L8R 2K3
Phone: (905) 546-2424
Fax: (905) 546-4435

SCUBE Subwatershed Study
Existing Stream Morphology - Tributary Characteristics

FIGURE No. 3.12

DATE: November 2010

3.5.1 Physiography, Drainage Network, Landuse, and Surface Geology

As the Niagara Escarpment represents the dominant physiographic feature within the watershed, surface drainage patterns originate from the escarpment and uplands. The study area is situated within the relatively flat lowlands between the escarpment and Lake Ontario. Fifty Creek represents the largest watercourse flowing through the study area, draining from south-to-north off the escarpment, turning to the northeast and then ultimately flowing north into Lake Ontario (Figure 3.12). Approximately 7 tributaries of Fifty Creek have been identified from mapping and field investigations. Despite the influence of the linear escarpment, the natural drainage pattern of Fifty Creek within the lowlands is typically dendritic; however, most tributaries have been straightened and channelized by agricultural practices and roadway ditches.

The unnamed watercourses (No. 7.2, No. 9 and No. 10) are small drainage features contained within the lowlands, generally flowing in a northerly direction into the lake. The drainage networks of the unnamed tributaries are highly altered and have been realigned historically and/or integrated into stormwater infrastructure from recent developments. Landuse in the lowlands has been historically agricultural, however, recent residential and commercial developments have continued to result in modified drainage patterns and hydrology on all watercourses within the study area.

Surface geology mapping (Sharpe *et al.* 2001) indicates that the study area sediments primarily consist of clayey silt from Halton Till materials or other fine glacio-lacustrine deposits. These sedimentary units represent fluctuations of glacial ice and meltwater during deglaciation of the Lake Ontario basin. Generally, this sedimentary environment imparts fine and cohesive characteristics to both valley and upland soils, however channel bed material within the valleys is somewhat variable due to local alluvial accumulations of coarse material and artificial fill/debris.

Apparent “valley walls” were noted sporadically on Fifty Creek, particularly between the QEW and Hwy 8. These features may represent some degree of post-glacial incision which created locally defined valley corridors; however, historical artificial fill placement has likely redefined

or emphasized the valley corridor in some areas.

3.5.2 Reach Delineation

Reach delineation is an approach whereby a watercourse is spatially grouped by channel characteristics and processes. Stream reaches are lengths of channel that display relative homogeneity with respect to the controlling and modifying influences of channel form. As such, channel characteristics, functions and processes are relatively constant within a reach, and reaches can be used to help identify management objectives and restoration opportunities.

Reaches were defined by key factors, including hydrology, gradient, geology, valley setting, sinuosity, and riparian vegetation (Table 3.4). Reach verification was completed through a synoptic-level field investigation to document channel morphology, prominent channel processes, and channel stability. Figure 3.12 also provides photos illustrating typical conditions along various channel reaches.

Table 3.4: Reach Characteristics and Field Observations.

Reach	Channel Form	Dimensions (m)		Channel Boundary**	Riparian Vegetation
		Width	Depth		
50-1A & 1B	Escarpment gullies	-	-	Weathered Bedrock, variable	Forest
50-2A	Roadside Ditches, straightened	~3	~0.5	Vegetated, FG	Grasses
50-2B	Agricultural Swale, straightened	~5	~1	Vegetated, FG	Grasses, marsh
50-3A	Ditch-like in yards, straightened	2.5-3.0	0.7-1.3	Bare (dry), FG & debris	Variable, wooded & grasses
50-3B & 3C	Agricultural Ditch, straightened	-	-	Vegetated, FG	Grasses, marsh
50-4A	Designed channel, yard & road-crossing	3.0-4.0	0.8-1.2	Mixed FG, Gr, Cb, Vegetated	Grass, trees, marsh
50-4B	Roadside Ditch, straightened	-	-	Vegetated, FG	Grasses, marsh
50-5	Curving channel, locally modified	2.5-4.0	0.6-0.8	FG, local Gr,Cb debris, tree roots	Wooded

50-6A & 7A	Escarpment gullies	-	-	Weathered Bedrock, variable	Forest
50-6B & 7B	Agricultural Ditch, straightened	-	-	Vegetated, FG	Grasses, marsh
50-8	Curving channel, locally modified	1.8-3.0	0.6-1.0	FG, local Gr,Cb, tree roots	Wooded
50-9A*	Curving channel, tree root controlled	**BF-2.2 ET-8.2**	**BF-0.4 ET-1.2**	FG, local Gr,Cb tree roots	Wooded
50-9B	Curving channel, tree root controlled	2.0-3.0	0.5-1.5	FG, local Gr,Cb, tree roots	Wooded
50-10*	Slightly curving channel, flat bottom.	**BF-3.0 ET-6.5**	**BF-0.5 ET-0.9**	Bare (dry), FG	Wooded, local riverine meadow
10-1	Agricultural & Road Ditches, straightened	1.7	0.5	Vegetated, FG	Grasses, Marsh
10-2	Variable, Ditch-like (recently re-constructed)	~6	~1.6	Variable, FG, Vegetated	Variable, wooded, grasses
9-1	Trapezoidal drainage channel - engineered	BF~3.0 TZ~24	BF~1.0 TZ~5	Variable, vegetated, interlocking brick	Grasses, marsh
9-2	Entrenched, engineered channel	ET 3.0-5.0	ET 1.0-2.0	Armourstone, vegetated	Variable, grasses, wooded
7-1	Variable, Ditch-like	-	-	Variable, FG, Vegetated	Variable, wooded, grasses

Notes: **Geomorphic Field Stations – see Section 3.5.4; BF = Bankfull; ET = Entrenched Channel; TZ = Trapezoidal*
***Boundary Material*: FG = Fine-grained (silt, sand, clay, organics); Cb = Cobble; Gr = Gravel;

Supplementary Note: The bankfull channel (BF) is the channel which can generally be identified by well defined banks which represent the channel capacity of flows with a return period between 1 to 2 years (i.e., similar to the mean annual flood – 2.33 year flood frequency). Greater-than-bankfull flows spill into the floodplain where the additional flood energy is dissipated. An entrenched channel (ET) is incised or confined where greater-than-bankfull flows do not access the wider floodplain, and thus flood energy is concentrated with the channel. Channel entrenchment may be due to natural processes (e.g., reach degradation, gully erosion), or can be due to channel enlargement (landuse change) and artifical fill placement in floodplain Degree of entrenchment can be measured as the ratio of the width at twice the bankfull depth divided by the bankfull width. Channels are typically considered entrenched at ratios of less than 1.4, or are moderately entrenched at ratios of 1.4 – 2.2 (Rosgen, 1996).

3.5.3 Existing Channel Conditions

3.5.3.1 Fifty Creek – Channel Characteristics and Influences

Although some reaches of Fifty Creek hold water year-round (e.g., standing pools in reaches 4A, 5, 8, and 9A), portions of the stream display some minor evidence of intermittent tendencies, particularly in dry years (i.e., generally dry between storm events, but occasional base-flow may

locally seep into the subsurface downstream). Although the entire watercourse has likely been modified over the historic settlement period, the main channel downstream has regained some natural channel tendencies; however, the relatively small drainage area and occasionally intermittent flow regime allows for strong influences by tree roots, woody debris, and grasses, which largely control natural channel processes.

Fifty Creek Escarpment Gullies: The headwaters of Fifty Creek drain numerous small gullies over the escarpment [*Reaches 50-1A, 1B, 6A, & 7A*]. Some of these features identified also collect some minor drainage from agricultural areas above the escarpment. These features are ephemeral and highly controlled by the weathered bedrock topography and geology. Drainage from the gullies is generally collected by agricultural drains and ditches at the base of the escarpment.

Fifty Creek Agricultural Drains and Ditches: Numerous agricultural drains and ditches (including some roadside ditches) represent the primary drainage network feeding into the Fifty Creek watercourse [*Reaches 2A, 2B, 3B, 3C, 4B, 6B, and 7B*]. Most of the significant tributary features are mapped in Figure 3.12, however, there are likely other more subtle depressions in the landscape which operate within the Fifty Creek drainage network during storm/runoff events. The majority of these features are straightened and maintained ditches constructed for agricultural and transportation activities (past and present). Given the nature and origin of these features, most are highly vegetated with grass and marsh species established on a fine-grained organic soil channel boundary. Ditch construction and maintenance imparts inherently entrenched channel characteristics and generally limits the establishment of natural channel processes.

Fifty Creek Main Branch Upstream of Hwy 8: The main branch of Fifty Creek upstream (and immediately downstream) of Hwy 8 appears highly modified within private residential lots and in the vicinity of the culvert crossings. The channel planform within Reach 3A is generally straight or slightly curving. Channel bed morphology is generally not present (i.e., ditch-like) with variation between fine-grained sediments, artificial debris, woody debris, and tree roots within the channel bottom. Although bank riparian vegetation is dominantly wooded, bank

variability is also imparted locally by the landscaped yards and driveway crossings. In the vicinity of the Hwy 8 and Fifty Rd. culverts [*Reach 50-4A*], HCA has completed channel works, with a particularly sinuous channel constructed downstream of Hwy 8.

Fifty Creek Main Branch and East Tributary downstream of Hwy 8: Downstream of Hwy 8, both the main branch and east tributary of Fifty Creek enter a well forested and defined valley corridor. Prior to the confluence (in the vicinity of Bridgeman Ln.), the both watercourse appear partially confined by locally narrow corridors [Reaches 50-5 and 8]. In a few locations, there is evidence that this narrow corridor has been emphasized by historic placement of artificial fill.

Downstream of the confluence, the watercourse is situated in a broader valley, however, the channel is aligned adjacent to the apparent valley wall in a few locations [Reach 50-9A]. The watercourse between Hwy 8 and QEW is highly controlled by tree roots and woody debris. The channel planform is generally slightly curving, but the local influences of woody roots and material have imparted a more sinuous pattern in some sections. The bed morphology is also highly irregular due to these influences, which tend to limit or modify channel processes (i.e., pools tend to be created as local bed scour occurs at or just downstream of tree roots). Bank vegetation is dominantly trees and shrubs, with local areas of dense grasses or herbaceous vegetation. Boundary material is dominantly fine-grain (**see Section 3.5.1**), either as dry flat bottom channels or sedimentation in idle pools. Local accumulations of alluvial coarse grained materials are apparent (which possibly operate as riffle-like features), however their occurrence is irregular. No widespread source of coarse material was noted in the field, with the exception of local artificial sources at crossings and areas with evidence of artificial fill.

Accumulations of woody debris (sometimes “jams”) also tend to influence local channel morphology and processes. The highly variable channel influences in these reaches also impart variable cross-section characteristics. Some generalized measurements of channel dimensions are provided in Table 3.4, and relatively representative detailed cross-section measurements were collected at a Geomorphic Field Station in Reach 50-9A (Figure 3.12, Section 3.5.4). Processes and channel characteristics observed in Reach 50-9A (and described above) continue south of the QEW into Reach 50-9B. This reach immediately downstream of the QEW exhibits some local

scour issues around tree roots and woody debris, however, the processes are localized do not pose risks to the public.

Fifty Creek Main Branch Downstream of QEW: Fifty Creek downstream of the QEW, particularly downstream of Baseline Rd., is less influenced by tree roots and wood debris compared to upstream reaches [Reach 50-10]. The corridor is dominantly forested with some local sections of grass, herbaceous, and riverine meadow. The planform is slightly curving, but the channel lacks bed morphology with a continuous flat bottom of fine-grained materials. Relative to upstream reaches the channel cross-section is less variable and likely represents some geometric measure of frequent flow capacity (i.e., bankfull). Detailed cross-section measurements were collected at a Geomorphic Field Station in Reach 50-10 (Figure 3.12, Section 3.5.4).

3.5.3.2 Watercourse # 10 – Channel Characteristics and Influences

The sub-watershed of watercourse #10 exhibits highly modified ephemeral drainage channels outletting to Lake Ontario [*Reaches 10-1 and 2*]. These tributaries include a variety of agricultural drains, ditches, and local storm sewers, primarily north of Barton Street. The open section of Watercourse 10 was recently constructed through a residential subdivision just west of Fifty Road [Reach 10-2]. Locally, this feature exhibits a defined channel and narrow wooded riparian corridor just upstream of the lake outlet. The remainder of the Watercourse 10 tributaries generally consist of roadside ditches south of the QEW, which drain to storm sewer systems on the north side of the QEW before discharging to Lake Ontario. Given the nature and origin of these features, most are highly vegetated with grass and marsh species established on a fine-grained organic soil channel boundary. Ditch characteristics impart inherently entrenched channel characteristics and generally limit the establishment of natural channel processes.

3.5.3.3 Watercourse # 9 – Channel Characteristics and Influences

The sub-watershed of watercourse #9 exhibits primarily engineered channels north of the CNR draining agricultural areas south of the CNR, ultimately outletting to Lake Ontario [Reaches 9-1 and 2]. Engineered sections include a trapezoidal channel with interlocking brick (CNR to

QEW) and an entrenched armourstone channel (QEW to Lake Ontario) (Figure 3.12, Table 3.4). The engineered channels provide hardened boundaries (bed and banks), but have generally filled in with grasses and marsh species established on a fined-grained organic soil channel bed. The highly vegetated and hardened channel boundaries generally limit the establishment of natural channel processes. Upstream of the CNR, the engineered channel extends east, along the south side of the tracks to a storm sewer outfall from the existing Winona community. Other roadside and railside ditches contribute to watercourse #9 from the west.

3.5.3.4 Watercourse #7.2 – Channel Characteristics and Influences

The subwatershed of watercourse #7.2 is dominated by straight agricultural drains and ditches, with a narrow catchment extending north towards the QEW. Given the nature and origin of these features, most are highly vegetated with grass, shrubs, and trees established on a fine-grained organic soil channel boundary. Ditch characteristics and vegetation controls generally limit the establishment of natural channel processes.

3.5.4 Geomorphic Field Stations

Detailed cross-section and sediment measurements were collected at 2 field stations on Fifty Creek (Figure 3.12). Field measurements allowed for a detailed characterization of channel properties and relatively representative locations in Reaches 50-9A and 10. Rapid Geomorphic Assessments (RGA) were conducted for each reach and analysis of channel measurements allowed for estimates of critical discharge (Table 3.5).

Table 3.5: Geomorphic Field Station Results

Reach	Field Station	Slope (m/m)	Bankfull Area (m2)	Critical Area (m2)	Critical V (m/s)	Critical Q (m3/s)	RGA Score[†]
50-9A	ABL#1	~ 0.008	1.16	0.91	1.26	1.15	0.25 (A, P^M)
50-10	ABL#2	~ 0.005	1.18	0.91	1.33	1.21	0.17 (A, W^M)

References:
[†]*RGA Stability Index* (modified from MOEE, 1999): Stable (0.0 – 0.2); Transitional (0.2 – 0.4); In Adjustment (0.4 – 1.0). Dominant Processes: A = Aggradation; D = Degradation; W = Widening; P = Planform Adjustment; ^{M} = Minor process.

Results of the RGA scores for these reaches indicate that lower Fifty Creek is generally stable to transitional. Table 3.6 provides guidelines for interpreting the RGA stability index (SI) values. Channels scoring in the transitional (T) category exhibit some processes which may lead to channel adjustments, but can include both natural processes and landuse impacts. In summary, the detailed geomorphic field assessments indicate that the channels exhibit evidence of some natural to transitional adjustments.

Table 3.6: Guidelines for the Interpretation of RGA Stability Index (SI) Values

SI Value	Interpretation	Comment
$0 \leq SI \leq 0.2$	Stable (S)	The morphological features do not show evidence of the progressive alteration and type. Variance in the dimensions of the morphological features is within acceptable levels
$0.2 \leq SI \leq 0.4$	Transition (T)	The type and variance of observed morphological features indicates that the stream channel is in, or about to begin, the initial stages of adjustment.
$0.4 \leq SI \leq 1.0$	In Adjustment (A)	The type of morphological features suggests that the channel system has been de-stabilized and is in adjustment.

Critical discharge is a measure of the threshold at which erosion of the channel boundary may begin. It should be noted that erosion is a natural processes and the critical discharge is normally exceeded several times annually, even in natural and stable systems.

In order to protect against increased rates of erosion, and thus unstable channel adjustments, stormwater management facilities will be a necessary part of future development to prevent increased peak flow rates. Erosion control facilities are therefore recommended for future development lands draining to Fifty Creek, Watercourse 7.2 and the west tributary of Watercourse 9. Erosion control facilities would not be necessary for future development lands draining to the hardened, engineered section of Watercourse 9 upstream of the CN Railway, or for those lands draining to the storm sewer systems of Watercourse 10.

3.5.5 Restoration Opportunities and Considerations - Geomorphology

One of the objectives of the Sub-watershed Study is to minimize erosion and ensure stability of the streams as future development occurs. As such, during the geomorphic field investigation, areas of higher sensitivity were identified for the focus of future management or restoration efforts. Within the study area, no existing erosion hazards were identified for mitigation through natural channel design approaches, however, three types of management opportunities were identified for consideration during future development processes (Figure 3.13):

Reach Monitoring – based on observed evidence of natural scour and the abundance of fine-grained channel boundary materials, these areas may be sensitive to future changes in stream flow and sediment movement. Restoration opportunities are largely limited by the established riparian forest (i.e., value of terrestrial resources) and no immediate risks to the public are apparent. However, these areas should be monitored to ensure any potential negative impacts in the future are mitigated in a timely manner.

Slope Considerations – based on observed evidence of valley slope steepness (e.g., soil creep) and the close proximity of the active channel to the valley wall(s), these areas may be sensitive to slope instability under future land use conditions. Special consideration should be given to these areas during future development or re-development (e.g., stable slope setbacks, erosion buffers). In particular, narrow corridor conditions due to historic fill placement may be alleviated with widened development buffers.

Legend

- Study Area
- SCUBE Development Lands
- Streams
- B Geomorph Field Station

Constraints:

- Slope Consideration – Future studies to establish stable slope/erosion buffers
- Developable Lands – Future SWM measures to include erosion control facilities for lands draining to:
  - Watercourse 7.2
  - Watercourse 9 from the west
  - Fifty Creek

Opportunities:

- Monitor Channel
- Artificial Debris Removal (all reaches).

0 125 250 500 750

Meters

77 James Street North
Hamilton ON
L8R 2K3
Phone: (905) 546-2424
Fax: (905) 546-4435

Hamilton

SCUBE Subwatershed Study Constraints and Opportunities - Stream Morphology

FIGURE No. 3.13

DATE: November 2010

Minor Restoration through removal of artificial debris – throughout the watercourse corridor numerous areas are littered with artificial debris and garbage. Removal of this material during development phases will improve aquatic habitat and locally reduce potential erosion impacts.

3.6 Aquatic Resources

This, and the terrestrial section summarizes work which was undertaken as part of the Phase 1 and 2 reports. Subsequent to the completion of the Phase 1 and 2 reports additional meetings with HCA, MNR and the City were held to address items relating to rare and endangered species. The findings from these discussions are provided in Chapter 8 Natural Heritage System.

Field studies were limited to 4 field visits in August, September and October. During each field visit, all watercourses were assessed at strategic locations to confirm flow characteristics and general habitat characteristics. All watercourses were dry during the field season and, as a result, no fish or benthic invertebrates were collected. With the exception of Fifty Creek, the other small drainage features are highly altered both north and south of the QEW, and have been channelized or piped. There are a few remnant channels and some small wetland/upland habitats adjacent to Lake Ontario.

3.6.1 Stream Classifications

Fifty Creek

Fifty Creek supports a tolerant warmwater fish community consisting of golden shiner, white sucker and fathead minnow. These species were captured downstream of the QEW by Hamilton Conservation Authority. Upstream of the QEW, only fathead minnow were captured. In addition to these species, other species may also be present such as creek chub, blacknose/longnose dace and bluntnose minnow, however it would appear that the culvert under the QEW may represent a partial or complete barrier to fish movement. While this could not be confirmed, there are a number of other stream crossings along the QEW where sloped culverts or drop structures in the culverts obstruct fish movement. These fish species are tolerant of a wide range of habitat and water quality conditions. As noted in Section 3.3.4, watercourses in this

area are limited by lack of flow, nutrient enrichment from agricultural and urban land use activities, and lack of riparian vegetation.

Aquatic habitat in Fifty Creek is largely limited by low flow conditions. The channel downstream of Highway 8 below the confluence of the two branches is a meandering channel with a coarse substrate consisting of embedded sand, gravel and cobble with a variable thickness of silt. Pools and some stream margins have an organic or mud substrates overlying coarser, embedded material. The riparian habitat along the creek is generally wooded with some open areas.

The Westerly Tributary has been altered in the vicinity of Highway 8 to create an online wetland feature and much of the tributary upstream of this location is a shallow gradient riparian wetland feature. No fish were collected by Hamilton Conservation Authority in this tributary.
The Easterly Tributary has been altered for agricultural drainage purposes and there is a perched culvert where it crosses Highway 8 representing a barrier to fish movement. Only fathead minnow were collected at this location. Substrates are generally fine grained to organic in nature.

Watercourse 9

Watercourse 9 has been altered throughout its length as a wide trapezoidal channel upstream of South Service Road. Downstream it has also been altered as a wide armour stone channel discharging through a small wetland feature into Lake Ontario. The reach downstream of the QEW is classified as direct fish habitat. Watercourse 9 is considered a perennial channelized stream and is considered a high priority for rehabilitation (AECOM 2008).

Watercourse 10

The Watercourse 10 tributaries have also been altered throughout their lengths, including ditched and piped reaches. A portion of Watercourse 10, located just west of Fifty Road and north of the North Service Road, was classified as warmwater fish habitat. This reach was actually being re-aligned through a new urban development during the field investigation.

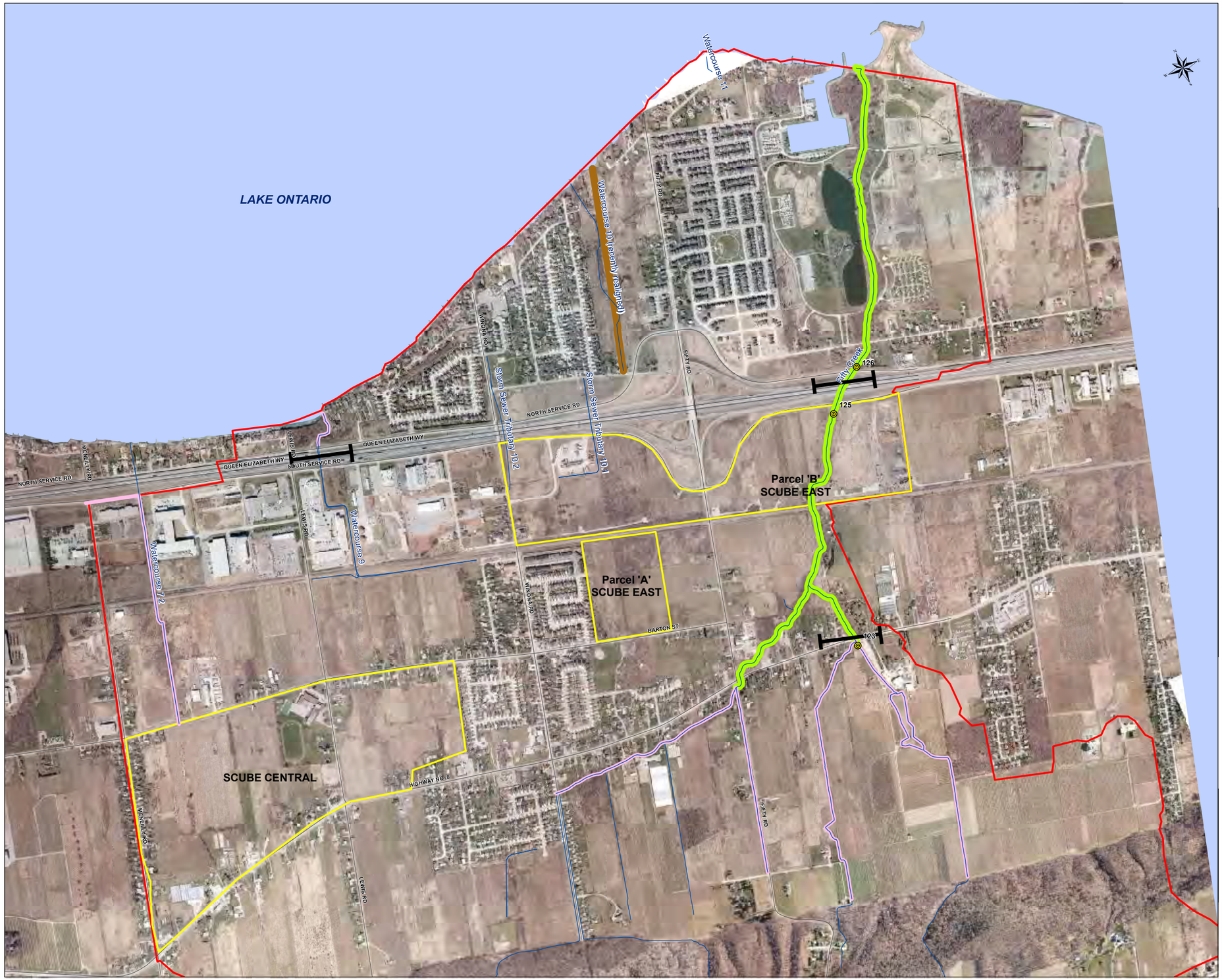
Other Stream Reaches

The remaining watercourse features are poorly defined on the landscape and generally have either been piped and incorporated into the urban built up areas, altered by agricultural tile drainage, or incorporated into roadside ditches.

3.6.2 Constraints and Opportunities – Aquatic Resources

The streams in the Study Area have been field verified and identified as warmwater. A warmwater watercourse is defined as a watercourse, whether permanent, intermittent, or ephemeral, which supports or contributes to the support of fish habitat or species associated with warmwater such as carp, bass, warmwater benthic invertebrates, or have thermal characteristics of a warmwater stream such as designated by the Ministry of Natural Resources. Warmwater species that are best adapted to prefer or usually occur at water temperatures greater than 25° C (Hamilton Urban OP, 2009).

The classification of warmwater watercourses in the Study Area have been further divided into permanent, intermittent and ephemeral streams that provide direct, indirect or no fish habitat (Table 3.7; Figure 8.7). Fish habitat refers to spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes (Fisheries Act, 2007). Permanent and intermittent streams are a high and medium constraint to development, respectively. Aquatic community types found within the study area are shown on Figure 3.14.



Legend

- Study Area
- SCUBE Development Lands
- Streams
- 125 HCA Fish Collection Record
- Potential Fish Barriers
- Intermittent Tolerant Warmwater (seasonal) Fish Community (15 m buffer both sides)
- Intermittent Tolerant Warmwater (seasonal) Fish Community (recently constructed)
- Supporting Habitat for Downstream Fish Communities (7.5 m buffer both sides)
- Developable Lands - Level 2 (normal) Water quality Control

NOTES:

0 125 250 500 750
Meters

Aquafor Beech

77 James Street North
Hamilton ON
L8R 2K3
Phone: (905) 546-2424
Fax: (905) 546-4435

Hamilton

SCUBE Subwatershed Study
Aquatic Resources

FIGURE No. 3.14

DATE: November 2010

Table 3.7: Fish habitat and flow regime identified in the study area of the SCUBE East Subwatershed Study

	Zone A		Zone B		Zone C	
Watercourse	**Fish Habitat**	**Flow**	**Fish Habitat**	**Flow**	**Fish Habitat**	**Flow**
7.2	Indirect	Intermittent	NA	NA	NA	NA
9.0 – Upstream of QEW	Indirect	Permanent	NA	NA	NA	NA
9.0 – Downstream of QEW	Direct	Permanent	NA	NA	NA	NA
10.0	Direct	Intermittent	NA	NA	NA	NA
10.1	Not Fish Habitat	Ephemeral	Not Fish Habitat	Ephemeral	NA	NA
10.2	Not Fish Habitat	Ephemeral	Not Fish Habitat	Ephemeral	NA	NA
11	Not Fish Habitat	Ephemeral	NA	NA	NA	NA
12 (Fifty Creek)	Direct	Permanent	Direct	Permanent	Indirect	Intermittent

Within the watershed, direct fish habitat is considered to exist in Fifty Creek downstream of Highway 8 and also in a small tributary of Watercourse 10, recently constructed west of Fifty Creek downstream of the North Service Road, and Watercourse 9, downstream of the QEW. The remaining drainage features are either considered to represent supporting habitat for downstream fish communities or not fish habitat (Table 3.7; Figure 8.7). All direct fish habitat on Fifty Creek should be protected by a 15m Vegetation Protection Zone (both sides). As noted, the warmwater fish habitat within Watercourse 10 is within a recently-constructed subdivision and the preferred buffer of 15m is not available through this development. Other stream reaches were identified as contributing to downstream fish habitat, and under HCA regulations would be assigned a similar 15 m Vegetation Protection Zone.

Given that several of the study area steams are classified as direct fish habitat or supporting downstream communities, stormwater management planning for future development should include water quality control. The Hamilton Conservation Authority requires that stormwater management facilities provide “Level 2” or “normal” level of protection as defined in the MOE

Manual.

Other opportunities related to aquatic resources include:

- removal of fish barriers;
- improved baseflow through stormwater management; and
- re-vegetating the riparian areas with woody vegetation.

3.7 Terrestrial Resources

Natural Resources Solutions Incorporated (NRSI) staff undertook fieldwork on August 22, 2007 and again in early September, 2007 to document the existing natural features of the study area through vegetation community mapping, plant species inventory and incidental observations of wildlife. At the request of the City of Hamilton, additional wildlife surveys were completed within the study area in 2010. Aquafor Beech Limited staff completed surveys of spring breeding amphibians on April 25, May 20 and June 21, 2010. Staff of North-South Environmental Incorporated conducted breeding bird surveys on May 26, June 7 and June 12, 2010. The following outlines the findings of this fieldwork.

3.7.1 Vascular Plants

A total of 85 species were recorded in the study area. According to the Natural Heritage Information Centre (NHIC) the Cucumber Tree (*Magnolia acuminate*) is known to be in the study area. This species is ranked as S2, Imperiled. This species was not found during vegetation surveys.

3.7.2 Vegetation Community Descriptions

Vegetation community mapping was undertaken using the Ecological Land Classification System for Southern Ontario (Lee et al.1998). The following descriptions are for all vegetation community types found within the study area and are shown on Figure 3.15.

Inset 1

Cultural

Mineral Cultural Meadow (CUM 1-1)
Cultural Savannah (CUS1)
Mineral Cultural Woodland (CUW1)
Cultural Deciduous Plantation (CUP1)
White Spruce Coniferous Plantation (CUP3-8)
Grey Dogwood Cultural Thicket (CUT1-4)

Upland

Deciduous Forest Ecosite (FOD)
Dry-Fresh Oak-Maple-Hickory Deciduous Forest Type (FOD2-2)
Dry-Fresh Deciduous Forest Ecosite (FOD4)
Dry-Fresh White Ash Deciduous Forest Type (F0D4-2)
Dry-Fresh Sugar Maple-White Ash Deciduous Forest Type (FOD5-8)
Fresh - Moist Lowland Deciduous Forest Ecosite (FOD7)

Wetland

Mineral Meadow Marsh (MAM2)
Reed-canary Grass Mineral Meadow Marsh Type (MAM2-2)

Other

LAKE ONTARIO
Watercourse 11
Watercourse 10 (recently realigned)
Storm Sewer Tributary 10-2
Storm Sewer Tributary 10-1
Fifty Creek
Fifty Creek ESA
FIFTY RD
WINONA RD
LEWIS RD
McNELLY RD
NORTH SERVICE RD
SOUTH SERVICE RD
QUEEN ELIZABETH WY
BARTON ST
HIGHWAY NO. 8
Watercourse 12
Watercourse 9
Ditch 001 - MAM2-2
Parcel 'A' SCUBE EAST
SCUBE CENTRAL
Ball Park
Vineyard
Aggregate
Ag-Wheat
Residential
Pond
Work Yard
Apple Orchard
Orchard
Cleared Land
Lawn
Ag
Link
FOD2-2
FOD4
FOD5-8
FOD7
FOD
CUM1-1
CUW1
CUT1
CUT1-4
CUP3-8
CUS1
MAM2

Legend

- Link Opportunities
- Niagara Escarpment Protection Area
- Niagara Escarpment Commission Planning Area
- SCUBE Development Lands
- Terrestrial Resources
- Enhancement Opportunity
- Area to be Protected
- Study Area
- Streams
- FOD Ecological Land Classification (see inset 1)

NOTES:

0 125 250 500 750
Meters

77 James Street North
Hamilton ON
L8R 2K3
Phone: (905) 546-2424
Fax: (905) 546-4435

Hamilton

SCUBE Subwatershed Study
Terrestrial Resources

FIGURE No. 3.15

DATE: November 2010

Cultural

Mineral Cultural Meadow (CUM 1-1) **-** Mineral cultural meadow is found in approximately 20 locations throughout the project area. Cultural meadow is typically composed of early successional pioneer species that are commonly found in disturbed areas. The most common species found are Wild Carrot (*Daucus carota*), Chicory (*Cichorium intybus),* Hawksweed (*Hieracium aurantiacum),* Ox-eye daisy (*Chrysanthemum leucanthemum),* Canada Goldenrod (*Solidago Canadensis)* and Grass species (*Poa spp*).

Cultural Savannah (CUS1) **-** In the study area cultural savannah was found in only two locations. The sites consist of open cultural meadow with 25-30% tree cover. The dominant tree species are young Red Ash *(Fraxinus pennsylvanica var. pennsylvanica)* and White Ash (*Fraxinus Americana)* approximately 10-12 cm dbh intermixed with a few Pear trees (*Pyrus communis).*

Mineral Cultural Woodland (CUW1) **-** Cultural woodland is found in one location in the study area. The site is dominated by mature well established White Ash and White Elm trees in the overstorey with a mix of Hawthorn Species, Apple species, and various Dogwood species in the understorey. The groundcover is fairly dense and thick consisting of Blue Vervain (*Verbena hastate),* Beggarticks (*Bidens tripartite),* Tartarian Honeysuckle *(*Lonicera tatarica*),* Burdock and Poison Ivy.

Cultural Deciduous Plantation (CUP1) **-** This deciduous plantation is dominated by White Ash of the same age and size (~20 cm dbh), planted in evenly spaced rows.

White Spruce Coniferous Plantation (CUP3-8) **-** This ecosite is dominated by young White Spruce (*Picea glauca)* with a few White Pine (*Pinus strobus)* ranging in size from <10 -15cm dbh. The ground cover is intermixed with meadow species such as Hawkweed, Common Milkweed (*Asclepias syriaca),* Chicory, Wild Carrot, Daisy Fleabane (*Erigeron annuus)* and Grass species.

Grey Dogwood Cultural Thicket (CUT1-4) - The dominant species is Grey Dogwood intermixed with Hawthorn species, European Buckthorn (*Rhamnus cathartica)* and Red-osier dogwood (*Cornus stolonifera)* with a few Shagbark Hickory (*Carya ovata*) and White Oak (*Quercus alba).* This area is very dense and overgrown with small openings throughout that are composed of goldenrod, and other cultural meadow species.

Upland

Deciduous Forest Ecosite (FOD) - Many of the deciduous forest ecosites in the study area do not have a dominant tree species. Typically, sugar maple is found in combination with a variety of deciduous trees including Bur Oak (*Quercus macrocarpa),* Manitoba Maple (*Acer negundo),* Silver Maple (*Acer saccharinum),* Common Apple (*Malus pumila),* White ash and European Buckthorn. However some of the locations are dominated by Silver Maple and White Ash. Riverbank Grape is very dense in many of the locations. The understorey is composed primarily of Red-osier dogwood. In a few places the groundcover consists of common cultural meadow species such as Milkweed and Goldenrod species. The topography is generally flat with fresh to moist soils.

Dry-Fresh Oak-Maple-Hickory Deciduous Forest Type (FOD2-2) - This ecosite is dominated by White Oak (*Quercus alba)* and Shagbark Hickory (*Carya ovata)* with White Ash intermixed throughout.

Dry-Fresh Deciduous Forest Ecosite (FOD4) - The dominant species is White Ash with a few Manitoba Maple (*Acer negundo),* Black Walnut (*Juglans nigra)* and Willow Species (*Salix sp).* The soils are moist to wet. This ecosite type is usually the result of disturbance or management.

Dry-Fresh White Ash Deciduous Forest Type (F0D4-2) - The dominant species is white ash intermixed with poplar species such as Trembling Aspen and Largetooth Aspen. In a few locations Red Ash (Fraxinus pennsylvanica var. pennsylvanica) is dominant, intermixed with White Ash, European Buckthorn, and Pear species. Open patches of cultural meadow species are scattered throughout the ecosite, including large patches of Posion Ivy (Rhus radicans ssp. Negundo).

Dry-Fresh Sugar Maple-White Ash Deciduous Forest Type (FOD5-8) - This site is dominated by Sugar Maple and White Ash. This ecosite is typically heavily managed, grazed or disturbed and tends to lack shrub cover.

Fresh - Moist Lowland Deciduous Forest Ecosite (FOD7) - This lowland deciduous forest ecosite is found in low-lying areas along creeks, drains and floodplains. The overstorey is dominated by Crack Willow (*Salix fragilis)* and Black Walnut *(Juglans nigra*) with red raspberry *(Rubus idaeus)* in the understorey and Clearweed (*Pilea Fontana),* Burdock (Arctium minus, Hog Peanut (*Amphicarpaea bracteata)* and Virginia Creeper (*Parthenocissus inserta)* as groundcover.

Wetland

Mineral Meadow Marsh (MAM2) - Mineral Meadow Marsh was found in two small pockets. The dominant species was Common Reed (*Phragmites australis).*

Reed-canary Grass Mineral Meadow Marsh Type (MAM2-2) - This wetland vegetation community is dominated by reed-canary grass (*Phalaris arundinacea),* grass and sedge species with purple loosestrife (*Lythrum salicaria), common reed (Phragmites australis),* Canada Goldenrod, Smooth Brome Grass *(Bromus inermis ssp. Inermis),* and aster species

Hedgerow - Deciduous - The dominant species in the deciduous hedgerows are Red and White Ash intermixed with Hawthorn species, European Buckthorn, Basswood (*Tilia Americana),* Common Apple and other cultivated fruit trees. The hedgerows are overgrown and dense with Riverbank Grape (*Vitis riparia).*

Orchards – Non Active - The project area has many old orchards that are overgrown with cultural meadow species. The dominant orchard species are apple and pear.

Orchards-Active - The project Area includes several small to medium sized active orchards with

species such as Golden Delicious and other apple varieties, Plum, and Pear.

3.7.3 Wildlife

3.7.3.1 Mammals

Six species of mammals were observed in the study area during surveys. All of the species observed are considered secure in the province. NHIC records do not indicate any rare or endangered mammals in the study area.

3.7.3.2 Spring Breeding Amphibians

Aquafor Beech Limited identified 22 candidate sites for spring breeding amphibian surveys within the SCUBE Subwatershed Study Area. Candidate sites consisting of potentially suitable amphibian habitat were selected using aerial photographs from across the study area, with a focus on lands in and immediately adjacent to SCUBE East (Parcels A and B) and SCUBE Central. The 22 candidate sites were reviewed in the field on April 25, 2010. Twelve of the 22 sites (Sites 1, 3A, 5, 6, 8, 10, 11, 15-17, 20 and 25) were considered to be suitable for spring breeding amphibian surveys. The other 10 candidate sites were found to be unsuitable for surveys because (i) they no longer contain potentially suitable amphibian habitat and/or (ii) landowner permission to access private property could not be obtained.

Aquafor Beech Limited staff completed spring breeding amphibian surveys using the methodology of the Marsh Monitoring Program (Environment Canada 2003). Briefly, surveys were conducted at the 12 selected sites on still nights starting at least a half an hour after sunset. Each site was visited three times with a minimum of 15 days between surveys. Since amphibian activity is strongly influenced by ambient temperature and moisture conditions, surveys were conducted when air temperatures were above 5 °C. In addition, whenever possible, surveys were completed during or immediately after periods of rain.

At each site, Aquafor Beech Limited staff recorded the intensity of amphibian calling detected over a three minute period using Call Level Codes. Codes distinguish between instances where

(i) calls are not simultaneous and calling individuals can be counted (Level 1), (ii) some calls are simultaneous but individual calls are distinguishable (Level 2) and (iii) calls are continuous and overlapping (Level 3). Aquafor Beech Limited staff also recorded the following at each site: time, air temperature, level of precipitation (if any), degree of cloud cover (%) and wind strength as measured by the Beaufort scale.

Surveys were conducted on three days between April 25 and June 21, 2010 (Table 3.8). Calling amphibians were detected from eight of the 12 survey sites. Four species were detected (Table 3.9). All four species are considered to be common and secure in Ontario (NHIC 2010).

Table 3.8: Spring breeding amphibian surveys completed by Aquafor Beech Limited

Survey Date	Survey Period	Weather Conditions	Investigator(s)
April 25, 2010	8:45 pm – 12:00 am	7–9 °C; overcast; occasional light rain	C. Parent
May 20, 2010	9:20 pm – 12:30 am	17–20 °C; partly cloudy to overcast	C. Parent, L. Lucyk
June 21, 2010	9:35 pm – 1:00 am	22–25 °C; partly cloudy to overcast	L. Lucyk, M. Craig

3.7.3.3 Breeding Birds

North-South Environmental Limited completed breeding bird surveys throughout the of the SCUBE Subwatershed study area. Surveys focused on SCUBE East (Parcels A and B) and SCUBE Central: all lands within these areas were surveyed. Beyond these areas, breeding bird surveys generally focused on lands in the vicinity of the spring breeding amphibian survey sites, but, with the exception of the Niagara Escarpment, all habitat types within the remainder of the study area were sampled. Two landowners on the west end of the study area, between the railway and Barton Street, refused permission for surveyors to access their lands and these were therefore not surveyed.

Breeding birds within the study area were surveyed on May 26, June 7 and June 12, 2010. All surveys were conducted in accordance with Canadian Wildlife Service recommendations for seasonal timing (between May 24th and July 10th), weather (fair, with little or no wind) and time

of day (between dawn and 0930) for breeding bird surveys. Surveys began around dawn (5:00 am) and continued until approximately 9:30 am on each of the three days. All surveys were conducted in fair weather with little wind. Surveys were focused on identifying species for which there was at least "possible" breeding evidence: mainly based on the presence of a singing male or a bird in suitable breeding habitat. The approximate number of territories within each area was recorded by noting the number of singing males heard and seen during 10-minute point counts.

Additional breeding bird surveys were conducted in 2012 by Stantec Consulting Limited, with a specific focus on avian speies at risk previously identified by North-South Environmental. The methodology, results, and discussion of the findings of the breeding bird studies are contained within the *Report on Four Avian Species At Risk and Other Breeding Bird Species* (Stantec 2012), in addition to relevant agency correspondence, are located in Appendix I.

Table 3.9: Amphibians detected during surveys completed by Aquafor Beech Limited.

Survey Date	Survey Site	Location Amphibians Detected	Species Detected	Number of Individuals
April 25	5	Deciduous forest block east of Leawood Drive	Spring Peeper	2
May 20, 2010	1	Deciduous forest block east of Lewis Road	American Toad	1
	5	Deciduous forest block east of Leawood Drive	American Toad	3
	6	Deciduous forest block west of Fifty Road	Grey Treefrog	4
June 21, 2010	6	Deciduous forest block west of Fifty Road	Grey Treefrog	6
	8	Fifty Creek adjacent to Bridgman Lane immediately south of CN Rail line	Green Frog	5
	16	Ditch immediately north of CN Rail line	Green Frog	1
	17	Cultural meadow/agricultural field north of Highway 8	Grey Treefrog	Indeterminate
	20	South of Barton Street	Grey Treefrog	5
	25	Cultural meadow southeast of intersection of Lewis Road and CN Rail line	Green Frog	Indeterminate

Altogether 50 species of birds were recorded from the study area (Table 3.10). Figure 3.16 illustrates the locations of significant species observed. Of the 50 species observed, 13 were observed within SCUBE East (Parcel A), 30 within SCUBE East (Parcel B), 25 within SCUBE Central and 47 beyond these three areas but within the larger study area. Differences in the number of bird species observed reflect the diversity of habitat and the size of each area; results are described in greater detail below.

SCUBE East (Parcel A)

This area is bordered by a residential subdivision in the west and farmland to the east and north. The northern and western parts of the parcel consist of dense gray dogwood thicket and old cherry orchards, respectively, while the southern portion consists of croplands. Birds noted in this area include mainly adaptable species common in small and large remnants of successional habitat within both agricultural and urban habitats, including abundant red-winged blackbirds (approximately 10 singing males), yellow warbler (approximately 7 singing males), gray catbird (2 males) and willow flycatcher (2 males), as well as abundant house sparrows that likely nested in the adjacent residential development. No regionally rare or uncommon species were found in this parcel.

SCUBE East Parcel B

This parcel lies between the Queen Elizabeth Way and the CNR railway line. The quality of this area as breeding bird habitat is likely affected by the noise of traffic on the Queen Elizabeth Way, which can be heard loudly throughout the entire area. It consists primarily of overgrown vineyards, hedgerows (particularly along the railway line) and cultural woodlands and thickets, with a narrow swath (approximately 50-75 m wide) of riparian habitat along Fifty Creek. A small hayfield occupies the corner of Fifty Road and South Service Road, and other open fields occur east of the creek course. A ditch along the railway line contains small areas of cattails, willows and other wetland species.

Table 3.10: Species recorded during breeding bird surveys. X indicates a species for which there was evidence of breeding; * indicates an introduced species; ** indicates an area-sensitive species.

Scientific Name	Common Name	S Rank	COSEWIC	MNR	HCA	Watershed	SCUBE Central	SCUBE East (Parcel B)	SCUBE East (Parcel A)	Cropland	Bluff	Thickets and Young Forest	Mature Forest	Grassland	Meadow Marsh	Urban park
Branta canadensis	Canada Goose	S5				**ü**						x				
Anas platyrhynchos	Mallard	S5				**ü**						x				
*Phasianus colchicus**	Ring-necked Pheasant	SNA					**ü**					x				
Buteo jamaicensis	Red-tailed Hawk	S5	NAR	NAR		**ü**		**ü**				x	x			
Charadrius vociferus	Killdeer	S5B, S5N				**ü**	**ü**	**ü**				x		x		x
Actitis macularia	Spotted Sandpiper	S5				**ü**	**ü**			x						x
*Columba livia**	Rock Pigeon	SNA				**ü**								x		
Zenaida macroura	Mourning Dove	S5				**ü**		**ü**	**ü**			x	x	x		x
Ceryle alcyon	Belted Kingfisher	S4B			h	**ü**					x		x			
Melanerpes carolinus	Red-bellied Woodpecker	S4			h	**ü**							x			
Picoides pubescens	Downy Woodpecker	S5				**ü**							x			
Contopus virens	Eastern Wood-pewee	S4B				**ü**						x	x			
Empidonax traillii	Willow Flycatcher	S5B				**ü**	**ü**	**ü**	**ü**			x		x	x	
Tyrannus tyrannus	Eastern Kingbird	S4B				**ü**	**ü**	**ü**				x	x	x		x
Myiarchus crinitus	Great Crested Flycatcher	S4B				**ü**							x			
Vireo gilvus	Warbling Vireo	S5B				**ü**	**ü**	**ü**				x	x			
Cyanocitta cristata	Blue Jay	S5				**ü**	**ü**	**ü**	**ü**			x	x	x		
Eremophila alpestris	Horned Lark	S5B				**ü**							x			
Progne subis	Purple Martin	S4B			h	**ü**						x	x			
Tachycineta bicolor	Tree Swallow	S4B				**ü**	**ü**					x	x			
Stelgidopteryx serripennis	Northern Rough-winged Swallow	S4B				**ü**							x			
Hirundo rustica	Barn Swallow	S4B				**ü**		**ü**	**ü**			x	x	x		
Riparia riparia	Bank Swallow	S4B			h	**ü**					x					

Scientific Name	Common Name	S Rank	COSEWIC	MNR	HCA	Watershed	SCUBE Central	SCUBE East (Parcel B)	SCUBE East (Parcel A)	Cropland	Bluff	Thickets and Young Forest	Mature Forest	Grassland	Meadow Marsh	Urban park
Poecile atricapillus	Black-capped Chickadee	S5				ü	ü	ü			x	x	x			x
Troglodytes aedon	House Wren	S5B				ü		ü				x	x			
*Polioptila caerulea***	Blue-gray Gnatcatcher	S4B			h	ü						x	x			
Sialia sialis	Eastern Bluebird	S5B	NAR	NAR	h	ü						x		x		
Hylocichla mustelina	Wood Thrush	S4B						ü				x				
Turdus migratorius	American Robin	S5B				ü	ü		ü			x	x	x	x	x
Dumetella carolinensis	Gray Catbird	S4B				ü	ü	ü	ü			x	x	x		
Mimus polyglottos	Northern Mockingbird	S4			h	ü		ü				x	x			
*Sturnus vulgaris**	European Starling	SNA				ü	ü	ü	ü		x	x	x			
Bombycilla cedrorum	Cedar Waxwing	S5B				ü	ü	ü		x		x	x	x		x
Dendroica petechia	Yellow Warbler	S5B				ü	ü	ü	ü	x		x	x	x	x	
Dendroica pensylvanica	Chestnut-sided Warbler	S5B			h	ü							x			
Geothlypis trichas	Common Yellowthroat	S5B				ü						x				
Spizella passerina	Chipping Sparrow	S5B				ü	ü	ü				x	x			x
Spizella pusilla	Field Sparrow	S4B				ü		ü				x	x			
*Passerculus sandwichensis***	Savannah Sparrow	S4B				ü	ü	ü	ü	x		x		x		
Melospiza melodia	Song Sparrow	S5B				ü	ü	ü		x	x	x	x	x		x
Cardinalis cardinalis	Northern Cardinal	S5				ü	ü	ü	ü			x	x	x		x
*Dolichonyx oryzivorus***	Bobolink	S4B	THR (no schedule, no status)			ü	ü	ü						x		
Agelaius phoeniceus	Red-winged Blackbird	S5				ü	ü	ü	ü		x	x	x	x	x	x
*Sturnella magna***	Eastern Meadowlark	S4B				ü	ü	ü				x		x		
Quiscalus quiscula	Common Grackle	S5B				ü						x	x			

Scientific Name	Common Name	S Rank	COSEWIC	MNR	HCA	Watershed	SCUBE Central	SCUBE East (Parcel B)	SCUBE East (Parcel A)	Cropland	Bluff	Thickets and Young Forest	Mature Forest	Grassland	Meadow Marsh	Urban park
Molothrus ater	Brown-headed Cowbird	S4B				**ü**	**ü**	**ü**				x	x	x		
Icterus spurius	Orchard Oriole	S4B			h		**ü**					x				
Icterus galbula	Baltimore Oriole	S4B				**ü**		**ü**				x	x			x
Carduelis tristis	American Goldfinch	S5B				**ü**	**ü**	**ü**	**ü**			x	x	x		x
*Passer domesticus**	House Sparrow	SNA				**ü**	**ü**	**ü**	**ü**			x	x			x

NOTES:

0 125 250 500 750
Meters

Acadia Beech

77 James Street North
Hamilton ON
L8R 2K3
Phone: (905) 546-2424
Fax: (905) 546-4435

Hamilton

SCUBE Subwatershed Study
Significant Species observed during Breeding Bird Surveys

FIGURE No. 3.16

DATE: November 2010

Birds in this area include primarily species adapted to mid-successional habitats, with the most abundant being red-winged blackbird (over 20 males), generally a species that prefers moist and wet habitat, and yellow warbler (approximately 18 singing males), with other abundant species including willow flycatcher, house wren, gray catbird and eastern kingbird (each with 3-10 males). One savannah sparrow and one eastern meadowlark, area-sensitive species of grassland habitat, were noted within the open field east of Fifty Creek. A wood thrush, which, though not area-sensitive is often associated with larger, higher quality woodlands in urban areas, was noted within the area of cultural woodland on the south side of the study area just north of the railway. This species was not noted in any other location in the study area. The only regionally significant species noted within this area was a northern mockingbird, considered Regionally uncommon, along the rail line.

SCUBE Central

This parcel consists mainly of large areas of hayfield, with smaller areas of overgrown orchards, thickets and hedgerows, as well as some croplands. Fields east of Lewis Road were more diverse in structure and species, with more shrubs, than fields west of Lewis Road. Abundant red-winged blackbirds (over 20 males) occurred in this parcel, with other abundant species including song sparrow, house sparrow, song sparrow, gray catbird, and yellow warbler (each with 5-10 males).

Three area-sensitive species of grassland habitats were noted in hayfields in this area, all east of Lewis Road, including savannah sparrow (5 males), eastern meadowlark (2 males) and bobolink (3 males). Bobolink has recently been designated as Threatened in Canada by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and has also been added to the list of Species at Risk in Ontario, with a status of Threatened. Habitat for Bobolink is thus protected by the Ontario's Endangered Species Act. This species is discussed further in Section 8 and Appendix I. One other regionally uncommon species of successional habitat, orchard oriole, was noted in this study area.

Subwatershed Study Area

This area includes the entire study area of the SCUBE Subwatershed Study beyond the urban expansion areas (i.e., SCUBE East (Parcels A and B) and SCUBE Central). It is larger in area

than the urban expansion areas, and encompasses not only habitat very similar to that in the SCUBE East and SCUBE Central lands (mainly fields, hedgerows, cultural thickets and small successional woodlands), but also habitat not found in those areas.

Small blocks of mature forest and swamp are found in the SCUBE East Subwatershed; they are found nowhere else in the study area. One block is situated at the north end of Fifty Creek, within the Fifty Creek Environmentally Significant Area, and two blocks, separated by a subdivision, are located at the southeast corner of the study area at the south end of Kelson Avenue. Fifty Point Conservation Area also contains a large pond, which provides the only open water habitat in the study area. It is likely frequently used by migrant waterfowl, but has only a narrow fringe of wetland along the edge and so has very little function as breeding bird habitat for wetland-dependent species.

An unvegetated bluff, also not found elsewhere within the study area and providing additional nesting habitat for birds, was also noted along the Lake Ontario shore, between Winona Road and McNeilly Road. Two bank hole-nesting species uncommon in Halton Region, belted kingfisher and bank swallow, nest on the bluff.

As with the other surveyed areas, the SCUBE East Subwatershed mainly supports species that are ubiquitous in small patches of habitat within both urban and rural settings, with the most abundant being red-winged blackbirds (too numerous to count), yellow warbler (12 males) and willow flycatcher in open areas, American robin (approximately 30 males), song sparrow, gray catbird and warbling vireo (each with approximately 5-10 males). Despite the presence of mature forest and swamp, very few forest habitat-dependent species were found in this habitat: the only ones noted were red-bellied woodpecker and eastern wood-pewee. One Regionally uncommon species noted is dependent on bluff habitat (it excavates nest cavities in bluffs): bank swallow.

The SCUBE East Subwatershed (outside the proposed urban expansion areas) supports eight species uncommon in Halton Region (Table 3.10). Four of these were noted at Fifty Point Conservation Area. Three area-sensitive species dependent on grassland habitats were found in

the subwatershed: savannah sparrow (approximately 7 males), bobolink (four males) and eastern meadowlark (2 males). Blue-gray gnatcatcher, another area-sensitive species uncommon in Hamilton Region, is dependent on late-successional habitats like open woodlands.

3.7.4 Summary

Ecological Land Classification mapping was completed for the study area and in general natural communities are sparsely distributed and limited to a few woodlots, some hedgerows and some riparian communities. Bobolink is the only species at risk observed in the study area.

There is potential to protect a riparian corridor along Fifty Creek that would link the ESA located in the Fifty Mile Creek Conservation Area (along the Lake Ontario Shoreline) with the Niagara Escarpment Protected Area (Figure 3.15)

Forest communities are generally young to mid-age deciduous forests dominated by sugar maple, white ash, Manitoba maple, black walnut, buckthorn, willow and aspen. There are a number of pine plantations and orchards.

The majority of features in the study area are cultural meadows, plantations, savannahs and woodlands that exist in a highly disturbed and/or early successional state. The most dominant community type is mineral cultural meadow, of which old field communities are a typical example.

Overall, the natural communities within the study area are cultural in nature and generally have limited value as wildlife habitat, typical of an intensive agricultural area.

3.7.5 Opportunities and Constraints – Terrestrial Resources

Based on the above findings, future development constraints and opportunities related to the terrestrial resources of the study are illustrated in Figure 3.15 and are summarized as follows:

- no new development within the Niagara Escarpment Protection Area or Fifty Creek ESA;
- riparian woodlots and adjacent deciduous woodlots should be preserved;
- other terrestrial features and hedgerows represent terrestrial enhancement opportunities; and
- terrestrial linkage opportunities exist along the Fifty Creek corridor between the Fifty Creek ESA and the Niagara Escarpment.
- Final setbacks from the features identified for protection, and the final treatment of features identified for enhancement should be established through a scoped EIS study at the site planning stage.

3.8 Summary of Existing Conditions, Constraints and Opportunities

The existing environmental resources within the study area were defined in order to identify key features and functions, to establish baseline conditions for the assessment of potential impacts from future urban development, and to identify development constraints and potential future opportunities. A summary of the key environmental features and functions to be considered is provided below, and development constraints and opportunities for the study area have been summarized and mapped as illustrated in Figure 3.17.

CONSTRAINTS

Preservation (No Development)

- Niagara Escarpment Protection Area
- Terrestrial Area to be Protected (Riparian vegetation, adjacent woodlots, Fifty Creak ESA)
- Bobolink Occurences

Stream Corredor

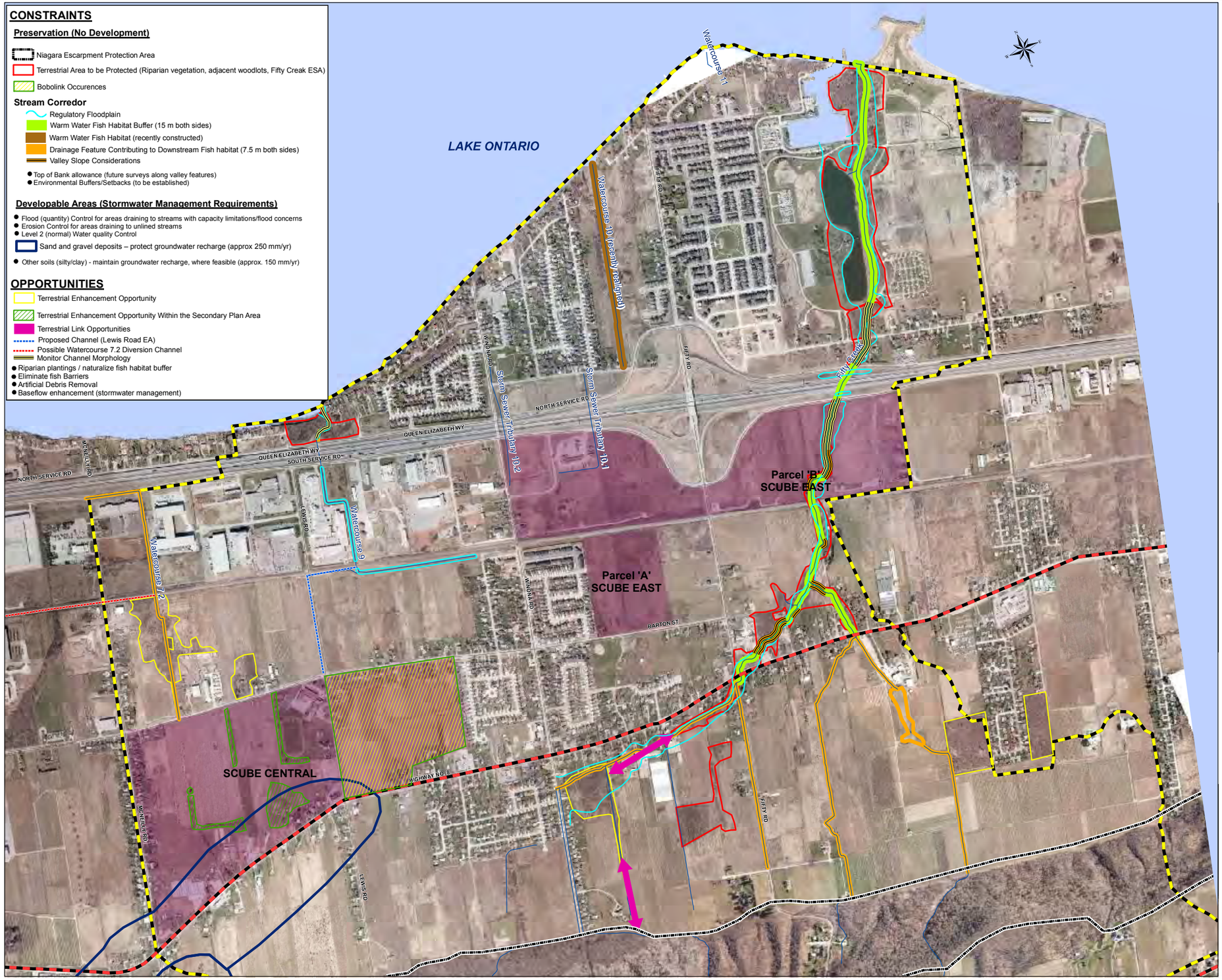
- Regulatory Floodplain
- Warm Water Fish Habitat Buffer (15 m both sides)
- Warm Water Fish Habitat (recently constructed)
- Drainage Feature Contributing to Downstream Fish habitat (7.5 m both sides)
- Valley Slope Considerations
- Top of Bank allowance (future surveys along valley features)
- Environmental Buffers/Setbacks (to be established)

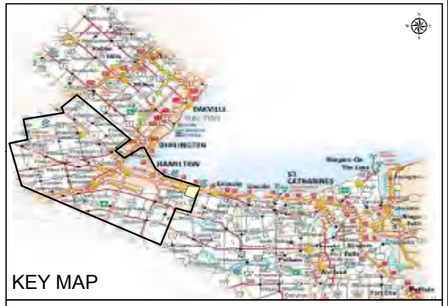
Developable Areas (Stormwater Management Requirements)

- Flood (quantity) Control for areas draining to streams with capacity limitations/flood concerns
- Erosion Control for areas draining to unlined streams
- Level 2 (normal) Water quality Control
- Sand and gravel deposits – protect groundwater recharge (approx 250 mm/yr)
- Other soils (silty/clay) - maintain groundwater recharge, where feasible (approx. 150 mm/yr)

OPPORTUNITIES

- Terrestrial Enhancement Opportunity
- Terrestrial Enhancement Opportunity Within the Secondary Plan Area
- Terrestrial Link Opportunities
- Proposed Channel (Lewis Road EA)
- Possible Watercourse 7.2 Diversion Channel
- Monitor Channel Morphology
- Riparian plantings / naturalize fish habitat buffer
- Eliminate fish Barriers
- Artificial Debris Removal
- Baseflow enhancement (stormwater management)





Legend

- Niagara Escarpment Commission Planning Area
- Study Area
- SCUBE Development Lands
- Streams

NOTES:

0 125 250 500 750
Meters

77 James Street North
Hamilton ON
L8R 2K3
Phone: (905) 546-2424
Fax: (905) 546-4435

Hamilton

SCUBE Subwatershed Study
Opportunities and Constraints

FIGURE No. 3.17

DATE: November 2010

- Hydrologic and hydraulic modeling were undertaken to establish the existing flood characteristics of Watercourse 9 and Fifty Creek. The Regulatory (100-year) floodplain limits of these watersheds were identified as constraints to future development. Also, the MTO and private landowners have asked for assurance that future development will not increase the frequency of flooding at the QEW crossings or private lands downstream. Therefore, flood (quantity) control facilities will need to be considered to prevent increases in downstream flows and flood frequency. Proposed improvements to Lewis Road also include an opportunity to construct a new open channel along the west side of Lewis Road from Barton Street to just south of the CN Railway. Proposed works to Watercourse 7.2 include a possible diversion channel along the CN Railway line to the Main Branch of Watercourse 7, west of McNeilly Road.

- The SCUBE lands are situated within the Iroquois Plain, just north of the Niagara Escarpment. An isolated area of sand and gravel deposits is located within the southwest portion of the SCUBE lands. Given its function as a potential contributor of baseflow to stream reaches to the north, the existing recharge potential of approximately 230 mm per year from these deposits should be protected through future source and conveyance control stormwater management measures which promote the infiltration of clean runoff. The remainder of the study area is overlain with silt/clay soils of variable depth which have moderate or low groundwater recharge potential. Nonetheless, future stormwater management planning should include measures, where feasible, to minimize changes to the existing groundwater recharge rate of approximately 140 mm per year from the silt/clay soils. This will, in turn, help to minimize future increases in runoff rates.

- The existing stream morphology of the study area watercourses was characterized. Most stream reaches have been modified through historical agricultural practices and urban development, including straightening, construction of ditches, engineered channels and storm sewers. Detailed field measurements along the Main Branch of Fifty Creek indicate that the watercourse is generally stable to transitional. Although no specific erosion sites were identified, stormwater management for erosion control is recommended for areas draining to unlined watercourses. Locations were also identified where slope stability

and/or erosion buffers require consideration. Other opportunities related to channel monitoring and debris removal were also identified.

- A tolerant warmwater fish community exists in Fifty Creek downstream of Highway 8 and should be protected through a 15m Vegetation Protection Zone applied to each side of the stream. A recently re-aligned portion of Watercourse 10 through a new residential development was also classified as warmwater fish habitat. Other stream reaches were identified as contributing to downstream fish habitat, and under HCA regulations would be assigned a similar 15 m Vegetation Protection Zone. Reaches classified as Not Fish Habitat do not require a buffer. Given the above aquatic habitat findings, stormwater management planning for future development should include water quality controls. The Hamilton Conservation Authority requires that stormwater management facilities provide a "Level 2" or "normal" level of protection as defined in the MOE Manual. Opportunities could also be pursued to enhance baseflow through stormwater management, re-vegetate riparian areas with native woody vegetation, and, where possible, enhance some of the drainage features supporting indirect habitat to allow them to support seasonal use by fish. There are also a number of barriers in Fifty Mile Creek that could be mitigated.

- The majority of the terrestrial features in the study area are cultural meadows, plantations, savannahs and woodlands that exist in a highly disturbed and/or early successional state. The most dominant community type is mineral cultural meadow, of which old field communities are a typical example. Terrestrial features identified for protection include the Fifty Creek ESA, the Fifty Creek riparian vegetation and adjacent woodlots, in addition to the Niagara Escarpment Protection Area. Other woodlot and hedgerow features represent enhancement opportunities if they can be accommodated into future block planning for the area. There is also potential to protect a riparian corridor along Fifty Creek that would link the ESA located in the Fifty Creek Conservation Area (along the Lake Ontario Shoreline) with the Niagara Escarpment Protected Area. At the current time, the eastern portion of the SCUBE Central lands are also identified for protection given the presence of a species at risk, Bobolink, within the area.

- Future development limits along stream corridors identified for protection would incorporate several of the constraints listed above, including flood hazards, slope/erosion hazards, fisheries buffers, and riparian woodlots. In addition, future field surveys would be required to identify the top-of-bank location along any defined valley features. An environmental buffer/setback, typically in the order of 5 to 10 metres, is then normally applied to the outermost feature or hazard in order to establish the limits of future development along the stream corridor. Final setbacks from the features identified for protection, and the final treatment of features identified for enhancement should be established through a scoped EIS study at the site planning stage.

4.0 SUBWATERSHED GOALS AND OBJECTIVES

Subwatershed goals and objectives represent the vision for the subwatershed. Typically the goals focus on opportunities to ensure that the natural features within the watershed are sustained as land use changes and existing land use practices continue into the future. In this regard goals and objectives are established to protect, enhance and/or restore natural features in the long term. In general protection refers to implementing measures which will ensure that further degradation of the feature does not occur. Enhancement measures are actions which, when implemented will improve upon the existing condition of a feature, providing for an overall healthier state. Restoration measures are actions that will restore a feature to a prior, healthier state. In most watersheds restoration measures are the most difficult to achieve, while protection and enhancement measures are more easily implemented.

Subwatershed plans typically put forth an overall subwatershed goal and then specific environmental goals and objectives pertaining to, for example:

- groundwater resources;
- the hydrologic regime/flooding;
- surface water quality;
- erosion and stream morphology; and
- aquatic and terrestrial resources

Outlined below is the subwatershed goal and specific environmental goals and objectives. These goals and objectives were formulated after the natural features and functions of the study area were inventoried in Phase 1 of the study (refer to Section 3).

<u>Subwatershed Goal</u>

To identify natural environmental resources and to establish appropriate strategies for the protection, enhancement and restoration of these important features under present conditions and as land use changes occur.

Environmental Goals/Objectives

1. *Goal*: Ensure the groundwater recharge function provided by the soils of the study area is maintained in order to:

   Objectives:

   - protect baseflows to the study area streams, such as the groundwater discharges to Watercourse 7;
   - reduce stormwater runoff volumes; and
   - protect groundwater quality.

2. *Goal*: Provide a safe hydrologic regime and stable stream systems which:

   Objectives:

   - minimizes flood and erosion risks;
   - restricts future development from flood prone areas; and
   - promotes infiltration to reduce stormwater runoff volumes.

3. *Goal*: Protect the quality of surface water in streams to:

   Objectives:

   - maintain healthy aquatic and terrestrial communities; and
   - aesthetics and support reasonable human uses.

4. *Goal*: Establish a healthy aquatic ecosystem which supports warmwater fisheries both within and downstream of the study area streams by:

   Objectives:

   - protecting critical reaches with healthy fish communities;
   - preserving and enhancing existing aquatic habitat;
   - removal of barriers to fish migration
   - protecting groundwater baseflows; and
   - protecting/restoring natural streamside vegetation.

5. *Goal*: Establish a healthy terrestrial ecosystem by:

Objectives:

- protecting and valued terrestrial features within the Niagara Escarpment Protection Area and Fifty Creek ESA;
- protecting the riparian woodlots and adjacent woodlots;
- preserving and enhancing hedgerows and other isolated riparian features;
- providing habitats suitable for native plant and animal communities; and
- enhancing terrestrial linkages along the Fifty Creek corridor between the Fifty Creek ESA and the Niagara Escarpment.

5.0 POTENTIAL IMPACTS FROM FUTURE DEVELOPMENT

Environmental baseline conditions were defined in Section 3, and subwatershed goals and objectives were defined in Section 4. This chapter will review the potential impacts of future urban development on each of the subwatershed resources. This, in turn, will assist in the identification and selection of appropriate measures and management practices to mitigate these impacts and meet the selected objectives (Section 6).

Existing and proposed landuses within the SCUBE East study area were reviewed in Section 2. As noted, the lands within the SCUBE Central area between Barton Street and Highway No. 8 will be developed primarily with residential landuses. Within the SCUBE East lands, Parcel B (i.e., north of the CN Rail corridor) will be developed as an employment area with a mix of commercial and industrial uses. Parcel A (i.e., south of the CN Rail corridor) will be developed with residential landuses. Outside of the SCUBE East and SCUBE Central lands, the lands bounded by Barton Street and the QEW west of Winona Road are designated as employment lands and are already partially developed. These lands will continue to experience future urban development as the remaining vacant/agricultural lands are converted to urban landuses.

5.1 Surface Water Quality

The protection of surface water quality within the study area watercourses was identified as a key objective of the study (Section 4, goal no.3). Water quality has a strong influence on the health of the existing fish communities, and also determines the suitability of water for drinking, recreation, fishing, wildlife and general aesthetics.

Stormwater runoff from urban sources typically contains elevated levels of contaminants such as sediment (ie. suspended solids), nutrients (eg. phosphorous, etc.), metals (eg. copper, lead, zinc, etc.), and bacteria. Therefore, without controls, future urban development will result in increased pollutant loadings to the area streams. This, in turn, can contribute to degraded fish

habitat and increased health risks associated with various recreation activities.

Various methods and levels of water quality control are specified in the MOE's Stormwater Management Planning Manual (2003). For the SCUBE study area watercourses, Hamilton Conservation Authority requires "Level 2" or "normal" level of protection, defined as 70% long-term suspended solids removal.

Figure 5.1: Water Quality Impacts

5.2 Groundwater Impacts

As discussed in Section 3, sand and gravel deposits situated near the base of the escarpment

near McNeilly Road represent a zone of high groundwater recharge potential and function as a potential contributor of baseflow to stream reaches to the north. The silt/clay soils throughout the remainder of the future development lands have a lower groundwater recharge potential. However, they cover a majority of the study area and therefore still contribute a large percentage of the annual groundwater infiltration. Maintaining the existing groundwater recharge volumes in the SCUBE study area was identified in Section 4 as a study objective (Section 4, goal no.1).

Without controls, the impervious surfaces associated with future urban development will reduce the capacity of the site to infiltrate rainfall events into the groundwater system, creating an increase in the volume of surface water runoff instead (Figure 5.2). This alteration to the water budget, in turn can contribute to increased rates of flooding, erosion, and pollutant loadings. The corresponding reduction in groundwater levels can also result in reduced supplies of clean, cool baseflows to area streams, thereby negatively impacting downstream fish communities.

For the SCUBE study area, basic spreadsheet water balance calculations were completed to estimate the potential impacts of development on the amount of groundwater infiltration. Details are provided in Appendix C. Two general levels of development were considered:

- Residential development – assumed 50% impervious; and
- Employment lands development – assumed 80% impervious.

Based on the above, without stormwater controls, the estimated future annual infiltration deficit could range between 70 mm per year and 115 mm per year, depending on the soil and proposed future landuses, as summarized in Table 5.1.

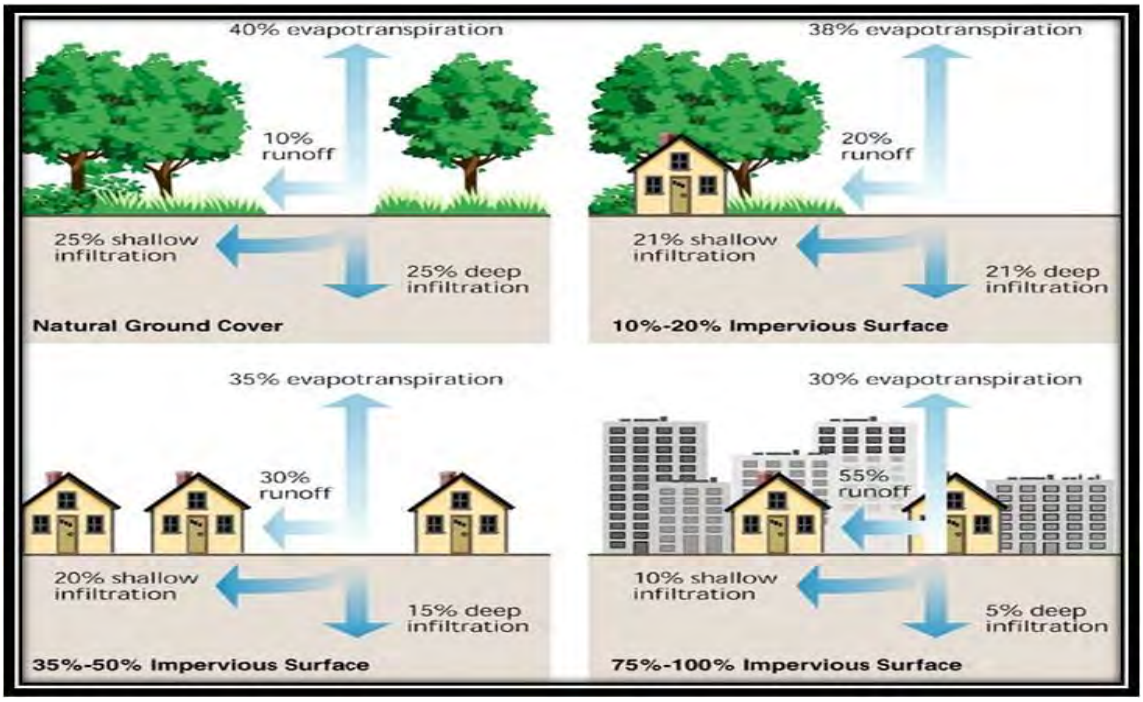


Figure 5.2: Water Budget Impacts of Development

Table 5.1: Summary of Potential Groundwater Recharge Impacts

Soils	Existing Annual Infiltration (mm/yr)	Future Annual Infiltration (without stormwater controls) (mm/yr)		Potential Deficit (mm/yr)
Silt/clay	140	Residential landuses (50% impervious)	70	70
		Employment landuses (80% impervious)	28	112
Sand/gravel	230	Residential landuses (50% impervious)	115	115

5.3 Flood and Erosion Impacts

With urbanization there is a typical hydrologic response from the developed land. This generally involves an increase in peak flow rates and runoff volumes, and a decrease in the time-to-peak flow. These effects commonly occur with increased impervious surface areas and improved stormwater drainage systems which are typical of the change from rural to urban land use. The increased runoff volumes and flow rates can result in increased rates of erosion and flooding (Figure 5.3).

Figure 5.3: Flooding and Erosion Impacts

Portions of some watercourses are not expected to be impacted by erosion, including the Watercourse 10 Tributaries which discharge to concrete storm sewer systems and the lined portion of Watercourse 9. Although the remaining unlined watercourse reaches are not currently experiencing any significant ongoing erosion, they may be susceptible to increased

rates of erosion without future controls. This includes Watercourse 7.2, Fifty Creek, and the West branch of Watercourse 9 (Future Lewis Road channel).

With respect to flooding impacts, the hydrologic model developed in Section 3.3.2 was modified to include the proposed future urban development within the SCUBE East study area. Future residential landuses were modelled with 50% imperviousness and future employment landuses were modelled with 80% imperviousness. The model was also adjusted to include the planned diversion of catchments No. 1011 and 1012 from the Watercourse 10-2 storm sewer tributary to the lined eastern tributary of Watercourse 9 via the storm sewer system within the existing residential development to the immediate west (catchment No.98).

The same continuous modelling approach and frequency analysis used to estimate existing 2-year through 100-year flow rates was applied again for the future model scenario. Flood flow estimates for Hurricane Hazel were also estimated for the future model scenario. The resulting flood flow estimates associated with the existing and uncontrolled future development scenarios are compared in Table 5.2. As shown, flood flows are predicted to increase at many of the flow node locations downstream of the proposed future development sites.

Table 5.2: Comparison of Flood Flow Estimates

Location	Landuse Scenario	Drainage Area* (ha)	% Impervious	Design Flows (cms)						
				2-year	5-year	10-year	20-year	50-year	100-year	Regional
Watercourse 9										
Storm Outfall (9-1)	Existing	128.2	17%	0.8	1.1	1.3	1.6	1.9	2.2	10.1
	Future uncontrolled	146.7	20%	1.0	1.4	1.8	2.3	3.1	4.0	12.3
CN Railway (node 9-2)	Existing	322.4	10%	1.2	1.8	2.4	3.0	4.1	5.1	20.2
	Future uncontrolled	340.9	33%	1.7	2.8	3.8	4.9	6.7	8.4	29.8
QEW (node 9-3)	Existing	357.3	16%	1.5	2.1	2.6	3.2	4.2	5.2	23.3
	Future uncontrolled	375.8	37%	1.9	3.0	4.0	5.2	7.2	9.0	32.7
Lake Ontario (node 9-4)	Existing	371.2	16%	1.5	2.2	2.7	3.4	4.6	5.7	24.6
	Future uncontrolled	389.7	37%	2.0	3.1	4.2	5.4	7.4	9.3	34.0
Watershed 10										
QEW culvert (node 10-1)	Existing	18.0	13%	0.26	0.43	0.58	0.76	1.07	1.36	4.7
	future uncontrolled	18.0	80%	0.41	0.68	0.90	1.15	1.53	1.87	6.4
QEW culvert (node 10-2)	Existing	28.7	4%	0.06	0.10	0.15	0.21	0.31	0.43	1.3
	future uncontrolled	10.2	80%	0.14	0.22	0.29	0.37	0.49	0.59	2.0
QEW culvert (node 10-3)	Existing	10.4	16%	0.04	0.07	0.10	0.12	0.17	0.22	0.9
	future uncontrolled	10.4	80%	0.11	0.18	0.23	0.29	0.37	0.44	1.6
QEW culvert (node 10-4)	Existing	13.5	36%	0.06	0.10	0.14	0.19	0.27	0.35	1.2
	future uncontrolled	13.5	80%	0.13	0.20	0.26	0.33	0.43	0.51	1.9
Lake Ontario outlet (node 10-5)	Existing	85.2	24%	0.35	0.58	0.81	1.08	1.55	2.02	7.3
	future uncontrolled	85.2	64%	0.40	0.66	0.88	1.13	1.54	1.91	6.8
Lake Ontario outlet (node 10-6)	Existing	47.0	28%	0.38	0.63	0.85	1.12	1.56	1.98	7.2
	future uncontrolled	47.0	54%	0.53	0.87	1.17	1.51	2.04	2.51	8.9
Lake Ontario outlet (node 10-7)	Existing	27.9	18%	0.05	0.08	0.11	0.16	0.24	0.34	1.2
	future uncontrolled	27.9	18%	0.04	0.08	0.12	0.17	0.28	0.40	1.2
Watercourse 12 (Fifty Creek)										
Highway 8 (node 12-1)	Existing	201.1	4%	0.8	1.4	1.8	2.4	3.3	4.2	15.1
	future uncontrolled	201.1	4%	0.8	1.4	1.8	2.4	3.3	4.2	15.1
CN Railway (node 12-2)	Existing	484.3	3%	1.4	2.2	2.9	3.7	4.9	6.1	24.1
	future uncontrolled	484.3	3%	1.4	2.2	2.9	3.7	4.9	6.1	24.1
Baseline Road (node 12-3)	Existing	564.2	4%	1.5	2.4	3.2	4.1	5.6	7.0	28.6
	future uncontrolled	564.2	11%	1.6	2.6	3.5	4.6	6.4	8.0	31.7
Lake Ontario (node 12-4)	Existing	651.0	5%	1.6	2.5	3.3	4.2	5.6	6.9	32.9
	future uncontrolled	651.0	11%	1.6	2.7	3.6	4.7	6.4	8.0	35.9

* includes existing 80.6 ha minor system diversion from Watercourse 12 to Watercourse 9 (catchment 121), and future 18.5 ha diversion from Watercourse 10-2 to Watercourse 9 (catchments 1011, 1012)

The potential flooding impacts and concerns of each of the study area watercourses are discussed below.

Fifty Creek

As shown in Table 5.2, without controls, the proposed urban development within the SCUBE lands upstream of the QEW will result in moderate increases in flood flows in the downstream reach to Lake Ontario. Given the Ministry of Transportation requirement that future development not increase the flood-susceptibility of the QEW, the hydraulic model developed in Section 3.3.3 was applied to determine if uncontrolled future flood flows would result in increased frequency of flooding of the freeway. The results of the hydraulic model are provided in Appendix B and indicate the following:

- the QEW and Service Road culverts have sufficient capacity to convey the future uncontrolled flows without flooding the roadway(s);
- approximately 3m of freeboard is available for the future uncontrolled 100-year flood flow;
- approximately 1m of freeboard is available for the future Regional storm event.

Therefore, the QEW and Service Road culvert structures have sufficient capacity to convey future uncontrolled flows. However, through the public consultation process, downstream landowner concerns were expressed regarding increased runoff rates due to the proposed future upstream urban development. Without future controls to prevent these increases, an increase in the frequency of flooding of private lands within the Fifty Creek floodplain may occur, which would be unacceptable.

Watercourse 10 Storm Sewer Tributaries

Although the Watercourse 10 Tributaries were not assessed in detail, the downstream storm sewer systems, ditches, and culverts have limited capacities. Therefore, without flood (quantity) controls, the future urban development lands in the SCUBE study area would result in increased flood frequencies at the hydraulic structures within these systems.

Watercourse 9

As shown in Table 5.2, without controls, the proposed urban development within the SCUBE lands will result in increased flood flows in the lined Watercourse 9 channel. Given the Ministry of Transportation requirement that future development not increase the flood-susceptibility of the QEW, the hydraulic model developed in Section 3.3.3 was applied to determine if uncontrolled future flood flows would result in increased frequency or intensity of flooding of the freeway. The results of the hydraulic model are provided in Appendix A and indicate the following:

- the QEW culvert has sufficient capacity to convey the future uncontrolled flows without flooding the highway;
- approximately 3.5m of freeboard is available for the future uncontrolled 100-year flood flow;
- approximately 2.5m of freeboard is available for the future Regional storm event.

The upstream CNR culvert structure also has sufficient capacity to convey the uncontrolled future 100-year and Regional storm flood flows. Floodline mapping also indicates that the flood flows are contained within the lined Eastern Tributary upstream of the CNR and the Main Channel downstream of the CNR.

The unlined Western Tributary of Watercourse 9 exists as a drainage ditch along the south side of the CNR line and drains a significant amount of the future urban development lands within the SCUBE study area via the existing roadside ditch and culvert system along Lewis Road. The 2007 Lewis Road EA Study recommended the construction of a new open channel along Lewis Road to convey flows to Watercourse 9. The design and ultimate capacity of this proposed future channel are unknown at this time. Therefore, it is assumed that flood controls will be necessary within the future development lands draining to the unlined West Tributary of Watercourse 9.

Watercourse 7.2

Although Watercourse 7.2 was not assessed in detail, the downstream roadside ditches and

culverts have limited capacities and could potentially be impacted by increased flood flows from the future development of the surrounding employment lands.

Discussions with City of Hamilton staff indicate that previous historical plans had suggested a possible diversion of the headwaters of Watercourse 7.2 to the west of McNeilly Road via a new channel along the south side of the CNR line, draining to the Main Branch of Watercourse 7. Currently, other capacity improvements are being undertaken within the downstream Main Branch of Watercourse 7 to the West of McNeilly Road, but are incomplete. At this time the design and ultimate capacity of the downstream works, including the possible diversion channel are unknown. Therefore, it is assumed that flood controls will be necessary within the future development lands draining to Watercourse 7.2.

5.4 Aquatic and Terrestrial Resource Impacts

Healthy aquatic and terrestrial ecosystems were identified as key objectives of the subwatershed study (Section 4, goal no. 4, 5). Human activities such as urban development may weaken or destroy aquatic habitats, fragment wildlife corridors, degrade water quality, increase streambank/channel erosion, increase sedimentation, reduce baseflows and increase storm flows.

Consequently, these activities can cause a reduction in the abundance and number of species represented in the fish community to the point where some watercourses no longer support fish. The disappearance of a species may result from a change in a single habitat requirement, for example, when riparian vegetation is removed, some species may disappear due to the resulting increase in stream temperature. On the other hand, several factors in combination may cause a species to disappear, for example, by reducing food supplies, overwintering habitat, or protective cover from predators.

6.0 REVIEW AND EVALUATION OF SUBWATERSHED MANAGEMENT ALTERNATIVES

Environmental baseline conditions were defined in Section 3, and subwatershed goals and objectives were defined in Section 4. Section 5 outlined the potential impacts from future development. This chapter will review and evaluate alternative measures, referred to as Best Management Practices (BMP=s), to mitigate the potential impacts and meet the selected objectives. The term Best Management Practice is defined as a measure that, when implemented will assist in protecting, enhancing, or restoring the environmental features.

6.1 Alternative Measures

In keeping with the Environmental Assessment process, several alternative techniques have been identified to address the potential environmental impacts resulting from the proposed future development lands within the SCUBE study area:

- Do nothing;
- Traditional Source Control Measures;
- Low Impact Development (LID) Source Control Measures;
- LID Conveyance Control Measures;
- End-of-pipe controls including wet ponds, wetlands, and dry ponds; and
- Stream Restoration.

The above alternative measures focus primarily on the development of a stormwater management strategy, which is the key component of an overall Subwatershed Strategy. A description of each of the above options is discussed in more detail below.

Do Nothing

This measure involves developing the SCUBE study area lands without stormwater

management. This alternative would result in a substantial increase in runoff, flooding, erosion and also water quality degradation both within the future development lands and the lands downstream.

Traditional Source Controls

These measures are typically used at the "lot-level" within high-density forms of development such as commercial or industrial landuses. Rooftops, parking lots, or oversized storm sewers can be used to temporarily store rainfall from large storm events. The storm runoff is then released at controlled rates to avoid increased rates of erosion and flooding in the receiving streams. In terms of water quality control, oil-grit separator devices are commonly used to remove select pollutants and improve water quality before runoff is released from industrial or commercial development sites.

Figure 6.1: Traditional Source Controls
(Clockwise, from top left: Rooftop Storage, Parking Lot Storage, Oil-Grit Separator)

Low Impact Development (LID) Source Controls

This technique involves addressing SWM using lot-level source controls that encourage the infiltration of water into the ground and reduce stormwater runoff. These systems can be integrated into the design of future urban developments and can include:

- Rainwater Harvesting;
- Green Roofs;
- Downspout Disconnection;
- Soakaway Pits,
- Bioretention and Special Bioretention:
- Compost Amendments;
- Tree Clusters;
- Filter Strips;
- Permeable Pavement.

Figure 6.2: Example LID Source Controls
(from L to R: Bioretention, Downspout Disconnection, Permeable Pavement, Green Roofs)

The suite of 9 landscape-based, decentralized, lot-level, micro-control Best Management Practices (BMPs) are collectively known as Low Impact Development (LID). There are many definitions that have been developed in an attempt to define Low Impact Development, with the most widely accepted definition being that used by the United States Environmental Protection Agency (EPA, 2007):

Low Impact Development (LID) is a stormwater management strategy that

> *seeks to mitigate the impacts of increased runoff and stormwater pollution. LID comprises a set of site design approaches and small scale stormwater practices that promote the use of natural systems for infiltration, evapotranspiration, and reuse of rainwater. These practices can effectively remove nutrients, pathogens and metals from stormwater, and they reduce the volume and intensity of stormwater flows.*

LID techniques mimic natural systems as rain travels from the roof to the stream by applying a series of practices across the entire development site before discharge to receiving water body. Real-world LID designs typically incorporate a series of LID BMPs in a 'treatment train' approach to provide integrated treatment of runoff from development sites. An example is provided in Figure 6.3.

LID practices are considered at the earliest stage of site design, are installed during construction and sustained in the future as a low maintenance natural system. Each LID practice incrementally reduces the volume of stormwater on its way to the stream. In doing so, LID practices can be applied to meet stormwater management targets for water quality, geomorphic and water balance objectives.

LID practices, together with traditional stormwater BMP's can be applied to achieve an overall stormwater management system which provides better performance, is more cost effective, has lower maintenance burdens, and is more protective during extreme storms than conventional stormwater practices alone. Several LID practices may be needed on each site to get all the required storage and attenuation.

Figure 6.3: Example Landscape-Based LID Stormwater Management Strategy

It should also be noted that LID practices may be beneficial in order to meet objectives beyond the field of stormwater management such as energy/water conservation, reduce-reuse of materials, ozone protection and reduction of the effects of Urban Heat Island.

LID Conveyance Controls

Conveyance controls are linear stormwater transport systems that are often located within the road right-of-way. LID conveyance controls not only provide a conveyance function, but also encourage infiltration of water into the ground, improve water quality and reduce runoff volume. They can include bio-swales, grassed channels and subsurface perforated pipe systems.

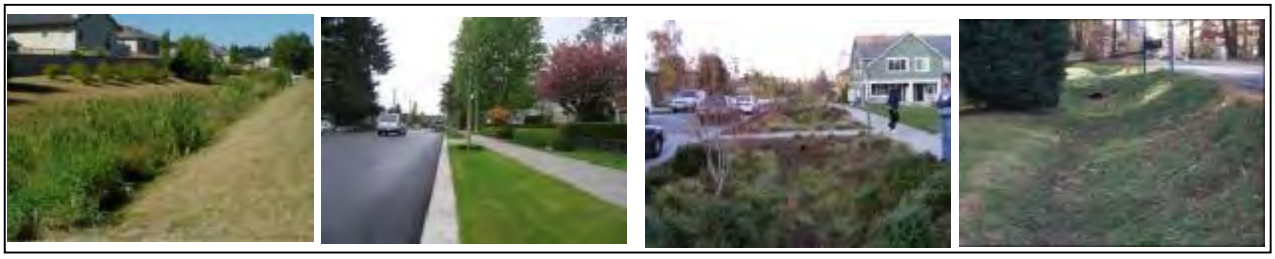


Figure 6.4: Example LID Conveyance Controls
(From L to R: Vegetated Channel, Subsurface Perforated Pipe, Bio-swale, Grass Channel)

End-of-Pipe Controls

End-of-pipe measures involve addressing stormwater management using conventional stormwater facilities such as wet ponds, wetlands and dry ponds at the end of the flow conveyance system (Figure 6.5). These facilities may be utilized for any combination of erosion, water quantity and quality control applications.

Figure 6.5: Example End-of-Pipe Controls
(clockwise from top left: Constructed Wetland, Dry Pond, Wet Pond)

Stream Restoration

This option involves the replanting of floodplain and native stream side vegetation to improve stream corridor functions and water quality, slows runoff, moderates stream temperatures, reduces erosion and improves aquatic and terrestrial habitat conditions. It also includes the reconstruction of the stream's natural characteristics including morphology of the channel and its floodplain which may also improve fish habitat.

Figure 6.6: Stream Restoration Examples
(From L to R: Created Channel, Wetland Feature, Linear Wetland, & Naturalize Corridor)

6.2 Evaluation of Alternative Measures

In order to ensure a transparent selection process (as part of the EA) that considers all possible alternatives, a two-phased evaluation process has been used to assess the alternative measures discussed in the previous Section. The two-phased approach (Figure 6.7) is composed of a screening level assessment followed by a detailed assessment.

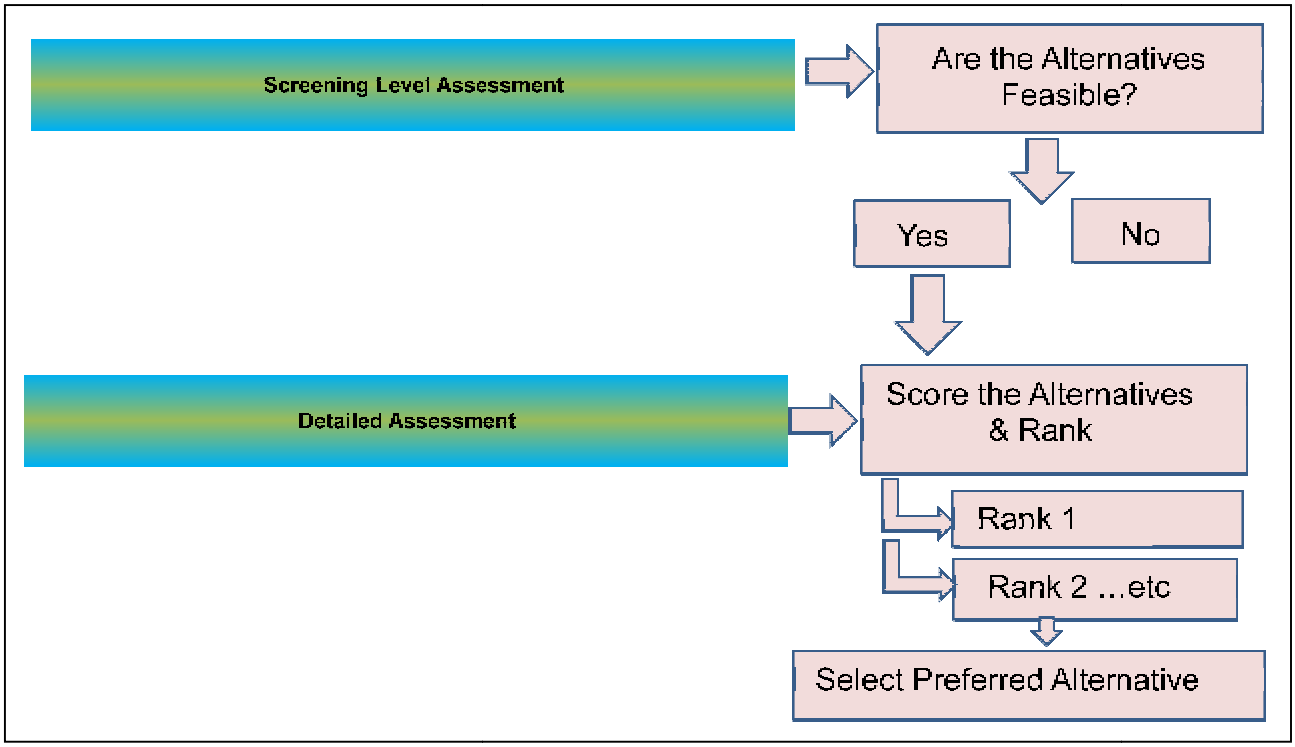


Figure 6.7: Evaluation Process Flow Chart

6.2.1 Phase 1: Screening Level Assessment

The screening level assessment is intended as a coarse screening tool, used to review the stormwater measures that are feasible (and infeasible) for use in the SCUBE study area. To this end nine (9) screening level assessment criteria have been utilized to determine which stormwater alternatives are to be carried forward to the more detailed assessment phase. The primary criteria include:

1) Technical feasibility;
2) Ability to meet targets for flooding,
3) Ability to meet targets for water quality,
4) Ability to meet targets for erosion and
5) Ability to meet targets for water balance;
6) Cost effectiveness;

7) Land requirements;
8) Public acceptance; and
9) Regulatory agency approval.

A description of the individual screening level assessment criteria and measures for assessment are provided in Table 6.1, and Table 6.2 presents the results of the screening level (Phase 1) assessment. As shown, the following techniques were found to meet the screening-level criteria and were carried forward to the detailed assessment:

- traditional source controls;
- LID source controls;
- LID conveyance control measures;
- end-of-pipe wet ponds; and
- stream restoration meet

As shown in Table 6.2, the "Do Nothing" option does not meet flooding, water quality, erosion, or water balance objectives and would also not be acceptable to regulatory agencies. End-of-pipe wetlands tend to be inconsistent with higher-density urban settings due to the relatively large land area requirements, while dry ponds rank poorly in several categories and are not generally favoured by the public or regulatory agencies. These techniques, together with the "Do Nothing" option, were not carried forward to the second, detailed assessment phase.

Table 6.1: Primary Criteria used in Screening Level Assessment (Phase 1)

Criteria	Description of Criteria	Measures for Assessment
Technical feasibility	• Ability of the SWM technique to be constructed given the known constraints.	The assessment of the individual stormwater control measures ranges from Excellent to Poor in its ability to meet the identified criteria. Stormwater management techniques that fail to meet primary criteria will be deemed to be an unacceptable option and will <u>not</u> be carried forward to the detailed assessment (scored NA – Not acceptable).
Ability to meet targets for flooding	• Ability of the SWM technique to meet flood control criteria. Technique must control peak outflows for the site to pre-development rates for design storms with return period up to 100yrs. • Cannot increase flooding risks to infrastructure and private property.	
Ability to meet targets for water quality	• Ability of the SWM technique to meet water quality criteria as per Table 3.2 of the 2003 MOE Stormwater Management Manual.	
Ability to meet targets for erosion	• Ability of the SWM technique to control water course erosion in accordance with the 2003 MOE Stormwater Management Manual.	
Ability to meet targets for water balance	• Ability of the SWM technique to maintain the pre-development water balance and prevent adverse changes to site hydrology.	
Cost effectiveness	• Cost effectiveness of the SWM technique in relation to the overall benefit and the collective criteria.	
Land requirements	• A measure of the amount of land required to construct the SWM technique in relation to the overall benefit.	
Public acceptance	• General public acceptance of the individual stormwater management technique.	
Regulatory agency approval	• Ability of the SWM to meet the requirements of Municipal, Provincial, Federal agencies and the respective Conservation Authorities.	

Table 6.2: Phase 1 Screening-Level Evaluation Matrix

	Technical Feasibility	Flooding	Water Quality	Erosion	Water Balance	Cost Effectiveness	Land Requirements	Public Acceptance	Regulatory Agency Approval	Overall
Do Nothing	E	NA	NA	NA	NA	E	E	NA	NA	**NA**
Source Control Measures										
Traditional Source Control (storage)	E	E	P	G	P	G	G	G	F	**G**
LID Source Control (infiltration / filtration)	E	P	E	E	E	P	F	G	E	**G**
Conveyance Control Measures										
LID Conveyance (infiltration / filtration)	E	F	G	G	G	G	G	G	G	**G**
End-of Pipe Measures										
Wet pond	E	E	G	F	P	G	F	E	E	**G**
Wetland	E	E	E	G	P	P	NA	G	G	**NA**
Dry Pond	E	E	P	G	P	G	F	NA	P	**NA**
Stream Restoration	G	P	G	E	F	P	G	G	E	**G**
	E=Excellent, G= Good, F = Fair, P=Poor, NA = Not Acceptable									

6.2.2 Phase 2: Detailed Assessment

The stormwater management techniques carried forward from screening level assessment (traditional source control, LID source control, LID conveyance control, end-of-pipe wet ponds, and stream restoration) have been used to develop a set of ten (10) stormwater management alternatives for the SCUBE study area. The alternatives are made up of both individual approaches (e.g., traditional source control alone) and combinations of approaches (consistent with the MOE's treatment train approach to stormwater management). The ten (10) stormwater management alternatives include:

1. Traditional Source Controls only;
2. LID Source Controls only;
3. LID Conveyance Controls only;
4. End-of-pipe Wet Ponds only;
5. Combination of Traditional Source Controls and LID Source Controls;
6. Combination of Traditional Source Controls and LID Conveyance Controls;
7. Combination of LID Source Controls and LID Conveyance Controls;
8. Combination of LID Source Controls and end-of-pipe Wet Ponds;
9. Combination of LID Source Controls, LID Conveyance Controls and end-of-pipe Wet Ponds; and
10. Stream Restoration Measures

It should be noted that Alternative 10, Stream Restoration, is not intended as a stand-alone measure. Instead, it is common to all other alternatives as it is recommended as part of the Natural Heritage Strategy (Section 8). Therefore, it will be recommended regardless of which alternative is preferred.

The Detailed Assessment is a much more rigorous and thorough assessment of each alternative, and is based on a set of 19 evaluation criteria under 4 groupings, as described below:

Physical and Natural Environment Criteria

- Ability to meet targets for water balance and mitigate impacts to groundwater recharge and runoff volumes;
- Ability to meet criteria for flooding, water quality and erosion;
- Impact on terrestrial and aquatic habitat.

Social, Economic and Cultural Environment Criteria

- Impact on existing and proposed development;
- Aesthetic value;
- Potential benefit to the community and public acceptance;
- Coordination with proposed roadway design; and

Technical Criteria

- Level of service and proven effectiveness;
- Regulatory agency acceptance (Municipal, Provincial, Federal and Conservation Authority);
- Impact on existing infrastructure;
- Constructability; and
- Maintenance requirements.

Financial Criteria

- Capital costs;
- Operation and maintenance costs;
- Land requirements;
- Impact on property value; and
- Phasing considerations.

A description of the individual Phase 2-Detailed Assessment criteria and measures for assessment are provided in Table 6.3a to Table 6.3d. As shown, each stormwater management alternative is given a score of 1 (poor) to 4 (excellent) for each of the evaluation criteria. These scores are then applied and an aggregate score is assigned to each alternative. A matrix

illustrating the results of the detailed assessment for each of the ten (10) stormwater management alternatives is presented in Table 6.4.

Table 6.3a-c

Table 6.3a: Description of the Physical and Natural Environment Criteria used in the Phase 2 Detailed Assessment

Criteria	Description of Criteria	Measures for Assessment
Ability to meet targets for Water balance	• Ability of the SWM alternative to mitigate undesired impacts to the pre-development water balance and prevent adverse changes to site hydrology (surface drainage, groundwater recharge, soils and geology).	Scoring ranges from 4 if the potential to mitigate changes to the pre-development is high, to 1 if the potential to mitigate water balance changes are low and post-development changes are anticipated.
Ability to meet targets for Flooding	• Ability of the SWM alternative to meet flood control criteria. Alternative must control peak outflows for the site to pre-development rates for design storms with return period up to 100yrs. • Cannot increase flooding risks to infrastructure and private property.	Scoring ranges from 4 if the potential to meet flooding criteria is high, to 1 if the potential is low and downstream flooding is anticipated.
Ability to meet targets for Water quality	• Ability of the SWM alternative to meet water quality criteria as per Table 3.2 of the 2003 MOE Stormwater Management Manual.	Scoring ranges from 4 if the potential to meet water quality criteria is high, to 1 if the potential is low and water quality impacts are anticipated.
Ability to meet targets for Erosion	• Ability of the SWM alternative to control water course erosion in accordance with the 2003 MOE Stormwater Management Manual.	Scoring ranges from 4 if the potential to erosion criteria is high, to 1 if the potential is low and erosion impacts are anticipated.
Impact on terrestrial and aquatic habitat: Connectivity, Diversity and Sustainability	• Potential for the SWM alternative to mitigate impacts to terrestrial and aquatic habitat. • Ability for the SWM alternative to provide opportunities for connectivity, diversity and sustainability for terrestrial and aquatic habitats.	Scoring ranges from 4 if the potential to mitigate impacts to terrestrial and aquatic habitat and provide additional opportunities for connectivity, diversity and sustainability is high, to 1 if the potential is low and impacts are anticipated.

Table 6.3b: Description of the Social and Cultural Environment Criteria used in the Phase 2 Detailed Assessment

Criteria	Description of Criteria	Measures for Assessment
Impact on existing and proposed development	• Potential for the SWM alternative to be integrated with the existing and proposed land uses within the SCUBE study area.	Scoring ranges from 4 if the potential for land use integration is high, to 1 if the potential is low.
Aesthetic value	• Potential for the SWM alternative to provide an aesthetic benefit to the existing and proposed community.	Scoring ranges from 4 if the SWM alternative has potential aesthetic value, to 1 if the potential is low.
Potential benefit to community and public acceptance;	• Potential benefit to the community with respect to integration into natural areas, passive use areas, trails, as well as general public acceptance of the SWM alternatives.	Scoring ranges from 4 if the potential for integration in public areas and public acceptance is high, to 1 if the potential for integration and public acceptance is low.
Coordination with proposed roadway design	• Potential for the proposed SWM alternative to be integrated into the proposed standard roadway cross-sections.	Scoring ranges from 4 if the potential for integration with the proposed roadway design is high, to 1 if the potential for integration is low.

Table 6.3c: Description of the Technical Criteria used in Phase 2 Detailed Assessment

Criteria	Description of Criteria	Measures for Assessment
Level of service and proven effectiveness	• Degree to which the SWM alternative has been proven effective through scientific literature and long-term implementation and monitoring.	Scoring ranges from 4 if the SWM alternative has been proven effective, to 1 if the alternative is unproven.
Regulatory agency acceptance	• General level of acceptance of the SWM alternative by the various regulatory agencies (Municipal, Provincial, Federal and CA)	Scoring ranges from 4 if the SWM alternative is generally accepted by the various regulatory agencies, to 1 if the alternative is generally not accepted.
Impact on existing infrastructure	• Potential disruption to existing infrastructure (services, roads, etc)	Scoring ranges from 4 if the potential for disruption is low, to 1 if the potential for disruption is high.
Constructability	• Degree of difficulty in constructing the SWM alternative given the existing site conditions and constraints.	Scoring ranges from 4 if the general constructability is high, to 1 if it is low.
Maintenance Requirements	• Degree of anticipated future effort required to maintain the SWM alternative in good working order.	Scoring ranges from 4 if the level of anticipated future maintenance is low, to 1 if the alternative requires extensive future maintenance.

Table 6.3d: Description of the Financial Criteria used in the Phase 2 Detailed Assessment

Criteria	Description of Criteria	Measures for Assessment
Capital costs	• The relative cost of constructing the SWM alternative.	Scoring ranges from 4 if the relative cost is low, to 1 if the relative cost is high.
Operations and Maintenance Costs	• The relative cost of operating and maintaining the SWM alternative	Scoring ranges from 4 if the relative cost of maintenance is low, to 1 if the relative cost is high.
Impacts on property value	• Potential impacts (positive or negative) to local property value, based on aesthetic benefits, potential land-use synergies and general economic incentives.	Scoring ranges from 4 if the potential benefit to property value is high, to 1 if the potential benefit is low.
Phasing Considerations	• Degree to which the SWM alternative can be effectively implemented as per the proposed construction phasing plan.	Scoring ranges from 4 if the potential to implement to SWM alternative as per the construction phasing plan is high, to 1 if the potential is low

Table 6.4: Phase 2 Detailed Assessment Matrix for Selecting the Preferred Alternative

		Physical and Natural Environment					Social and Cultural Environments				Technical Criteria					Financial Criteria					
Alternative #		Water Balance	Flooding	Surface Water Quality	Erosion	Terrestrial & Aquatic Habitat	Existing Land Uses	Aesthetic Value	Benefit to Community & Public Acceptance	Coordination with proposed roadway design	Level of service-proven effectiveness	Regulatory agency acceptance	Impact on existing infrastructure	Constructability	Maintenance Requirements	Capital costs	Operations and Maintenance Costs	Land Requirements	Impacts on property value	Phasing Considerations	**Aggregate Score**
	Sole-measure Alternatives																				
1	Traditional Source Controls Only	1	3	1	3	1	2	1	1	3	3	3	3	3	3	3	4	4	1	4	47
2	LID Source Controls Only	3	1	3	2	3	3	3	3	3	3	2	2	3	2	3	2	3	3	4	51
3	LID Conveyance Controls Only	2	1	2	2	3	2	2	2	2	3	2	2	2	2	3	2	3	2	2	41
4	end-of-pipe Wet Pond Only	1	4	3	3	2	3	3	3	4	4	4	3	4	3	2	3	1	3	2	55
	Combined Source Control Alternatives																				
5	Traditional Source Controls and LID Source Controls	3	3	3	3	3	3	3	3	4	3	2	4	3	2	2	2	3	3	4	56
	Combined Source & Conveyance Alternatives																				
6	Traditional Source & LID Conveyance Controls	2	3	2	3	3	2	2	2	2	3	2	3	3	2	2	2	3	2	2	45
7	LID Source & LID Conveyance Conrtols	4	1	3	2	3	3	3	3	2	3	2	2	2	2	2	2	3	3	2	47
	Combined Source & End-of-pipe Alternatives																				
8	LID Source Controls & end-of-pipe Wet Pond	3	4	4	3	4	3	4	4	4	4	3	3	3	2	2	2	1	3	2	**58****
	Combined Source, Conveyance and End-of-pipe Alternatives																				
9	LID Source Controls, LID Conveyance Controls & end-of-pipe Wet Pond	4	4	4	4	4	3	4	4	4	4	3	2	2	2	1	1	1	3	1	55
10*	**Stream Restoration ***	3	2	3	3	4	3	4	4	3	3	3	3	1	3	2	2	4	3	3	**56***

1 = Poor
2 = Fair
3 = Good
4 = Excellent

* Note - this alternative is not intended as a stand-alone measure. Instead, it is common to all other alternative as it is recommended as part of the Natural Heritage Strategy. Therefore, it will be recommended regardless of which alternative is preferred.

**The preferred alternative for the SCUBE study area is Option 8 – LID Source Controls in combination with end-of-pipe Wet Ponds, along with Stream Restoration measures.

6.3 Selection of the Preferred Alternative

As shown in Table 6.4, the preferred alternative for the SCUBE study area is Option 8, which consists of LID source controls combined with end-of-pipe wet ponds, along with stream restoration measures. This alternative ranks highly under the physical and natural environment criteria, and the social-cultural criteria. It also ranks relatively well under the technical criteria.

In terms of stormwater management objectives, the use of LID source controls as part of this strategy would provide water balance, water quality, and erosion benefits. And the use of wet ponds as part of the strategy would provide further water quality, erosion and flood control benefits. These benefits, together with the stream restoration component of the strategy, would also have a positive impact on the aquatic and terrestrial habitat of the study area.

It should be noted that the feasibility of an end-of-pipe stormwater pond is constrained somewhat by the size of the area it services. In general, the MOE Stormwater Management Planning Manual suggests that the service area for a stormwater pond should be at least 10 hectares, and not less than 5 hectares. Through a review of the location of future development lands together with drainage patterns, it is understood that some future development sites may not be large enough to be serviced by a stormwater pond. In this case, as shown in Table 6.4, the next best alternative which does not include end-of-pipe ponds, is Option 5. Unlike Option 8, Option 5 uses traditional on-site source controls for water quality, erosion and flood control, rather than end-of-pipe stormwater ponds. Under Option 5, these traditional source controls are combined with LID source controls and stream restoration to provide additional water balance and water quality benefits, as well as aquatic and terrestrial habitat benefits.

Therefore, in summary, the preferred stormwater management strategy for the SCUBE lands is Option 8, however, Option 5 is a suitable alternate for special circumstances where the development/service area is less than 5 hectares:

***Preferred* Stormwater Management Strategy (for sites > 5ha):**

- LID source controls;
- end-of-pipe wet ponds; and
- stream restoration.

***Alternate* Stormwater Management Strategy (for sites < 5ha):**

- traditional source controls;
- LID source controls; and
- stream restoration

7.0 STORMWATER MANAGEMENT STRATEGY AND TARGETS

Environmental baseline conditions for SCUBE were defined in Section 3. The preceding sections outlined potential impacts from future development and identified a set of preferred stormwater management alternatives to meet the identified subwatershed goals and objectives. This chapter summarizes the overall Stormwater Management Strategy for SCUBE, including the recommended control measures and stormwater targets to be applied.

7.1 Water Balance Targets

As noted in Section 5.2, without controls, the impervious surfaces associated with future urban development will reduce the capacity of the site to infiltrate rainfall events into the groundwater system, creating an increase in the volume of surface water runoff instead. For the SCUBE study area, basic spreadsheet estimates indicate that, without stormwater controls, the estimated future annual infiltration deficit could range between 70 mm per year and 115 mm per year, depending on the soil and proposed future landuses (Table 5.1).

In order to estimate infiltration targets to overcome these potential deficits and maintain existing groundwater recharge rates, further spreadsheet estimates were completed using a typical range of annual rainfall events. Details are provided in Appendix C, and indicate the following:

- To overcome the anticipated recharge deficit resulting from residential development within areas underlain by sand/gravel soils, future infiltration measures would be required to capture and infiltrate a volume of runoff equivalent to the first 3 mm *over the total catchment area*;
- To overcome the anticipated recharge deficits within areas underlain by silt/clay soils, future infiltration measures would be required to capture and infiltrate a volume of runoff equivalent to the first 1.5 mm to 3 mm *over the total catchment area*, for future residential and employment landuses, respectively.

The above groundwater recharge targets can be achieved by incorporating appropriate LID source control techniques within future urban development, as recommended as part of the preferred alternative (Section 6.3). As noted above, the LID techniques should be selected and designed to infiltrate target volumes ranging from 1.5 mm to 3 mm *over the total catchment area*. However, with lot-level source control techniques, groundwater recharge is typically accomplished by infiltrating runoff from only a portion of the site.

For example, runoff from residential roofs and rear yards may be used to maintain groundwater recharge through a variety of LID techniques. Assuming that the rooftops and rear lots account for approximately 50% of the development area, then the target infiltration depth *over the contributing area* would range from 4 mm to 9 mm for residential developments underlain by silt/clay soils, and sand/gravel soils, respectively. Example calculations are provided in Appendix C.

7.2 Water Quality Targets

The MOE Stormwater Management Planning Manual defines specific water quality control storage targets for stormwater facilities. The targets are based on:

- the type of facility (i.e., stormwater pond, infiltration facility, etc.);
- the landuse within the contributing area (in terms of an impervious component); and
- the level of control required.

Regarding the last point, the Hamilton Conservation Authority requires that stormwater management facilities provide “Level 2” or “normal” level of protection as defined in the MOE Manual (i.e., 70% long-term suspended solids removal). Regarding the first point, both the *preferred* and *alternate* stormwater management strategies (Section 6.3) offer various water quality control techniques which can be used to achieve the water quality control target.

Wet Ponds

Wet ponds utilize a permanent pool of water for quality control by settling pollutants (i.e., suspended sediment) from stormwater runoff. A typical stormwater management pond was illustrated in Figure 6.5. In addition to providing water quality control, stormwater ponds may also provide temporary detention storage above the permanent pool to attenuate runoff, thereby lowering outflow rates for flood and erosion control. Flood and erosion control is discussed in Section 7.3.

To provide control for the anticipated future residential and employment developments within the SCUBE study area, the MOE Stormwater Management Planning Manual indicates the following target storage volumes for Level 2 water quality control:

- residential development (approx. 50% impervious) - 105 m^3/hectare, of which:
  - 65 m^3/ha is permanent pool storage; and
  - 40 m^3/ha is extended detention, or "active" storage.

- Employment (industrial/commercial) development (approx. 80% impervious) - 145 m^3/hectare, of which:
  - 105 m^3/ha is permanent pool storage; and
  - 40 m^3/ha is extended detention, or "active" storage.

For ponds which, in addition to providing water quality control, also provide erosion and/or flood control, the "active" water quality control storage requirement can be incorporated into the larger erosion/flood control extended detention storage requirements.

Traditional Source Controls

For small development sites less than 5 hectares in size, the *alternate* stormwater management strategy (Section 6.3) recommends the use of traditional on-site controls to meet water quality targets. For example, within future industrial/commercial developments, oil-grit separator devices may be used to treat stormwater runoff from parking lots and driveways where many urban pollutants tend to accumulate. These devices are also effective in trapping fuel and

chemical spills that may take place in these areas.

LID Source Controls

LID source controls are recommended primarily to achieve the water balance objectives (Section 7.1). However, many of the LID source control techniques also provide water quality control benefits through the reduction of runoff volumes and/or filtration of runoff. Most substances within urban stormwater are in the form of suspended solids which can be filtered and trapped when stormwater infiltrates through a pervious media such as sand. Therefore, the use of LID source controls which promote infiltration for groundwater recharge, will also provide additional water quality benefits. By providing some water quality treatment at the source, LID techniques will help to reduce the maintenance requirements at other downstream treatment facilities such as stormwater ponds (sites > 5 hectares) and/or oil-grit separator devices (sites < 5 hectares).

7.3 Flood and Erosion Control Targets

As noted in Section 5.3, several of the stream reaches located downstream of the SCUBE future development lands have capacity constraints and may be susceptible to future erosion, including Fifty Creek, the Watercourse 10 storm sewer tributaries, the unlined western tributary of Watercourse 9, and Watercourse 7.2. Therefore, it is understood that future landuse changes within the SCUBE development lands will require storage facilities to control future runoff rates to pre-development levels.

Exceptions to this erosion/flood control requirement are the lands draining directly to the lined eastern tributary of Watercourse 9, which is not susceptible to erosion and has sufficient capacity to convey future flood flow rates without controls. Table 7.1 summarizes the erosion and flooding considerations and requirements for each of the study area watercourses.

For those lands requiring flood and erosion control, the necessary stormwater detention

storage can be provided within the end-of-pipe stormwater ponds as recommended as part of the preferred stormwater strategy (Section 6.3), or within traditional on-site controls for small sites less than 5 hectares (***alternate*** stormwater management strategy).

The hydrologic model used to estimate flow rates within the SCUBE study area (Section 3) was also applied to estimate storage requirements for future stormwater detention facilities. For this analysis, a design storm approach was applied. Various storm distributions from the City of Hamilton's Criteria and Guidelines for Stormwater Infrastructure (2007) were tested. The SCS 24-hour storm distribution derived from the RBG gauge site was found to produce the highest runoff rates and was therefore used in the stormwater facility sizing analysis.

The modelling steps used in the stormwater facility sizing analysis are summarized below:

- The hydrologic model was used to estimate the pre-development flows for catchments within the future development lands.
- The model was then adjusted to include proposed future development, assuming 50% imperviousness for residential and 80% imperviousness for employment lands.
- Reservoir routing was added to the model to simulate future stormwater facilities.
- The type of control required varies from watercourse to watercourse, and depends on the presence of existing downstream erosion and/or capacity constraints (Table 7.1).
- For areas requiring erosion control, outflows for the 2-year storm were controlled to pre-development rates, and outflows less than the 2-year storm were overcontrolled to minimize potential in-stream erosion from the most frequent storm events. On average, approximately 200 m^3/ha of storage is required for erosion control.
- For areas requiring flood (quantity) control, storage volumes were increased within the model reservoirs until the runoff rates for the 100-year storm events were controlled back to pre-development rates. On average, approximately 550 m^3/ha of storage is required for flood control.

In some cases, downstream capacity improvements have been recommended which may ultimately alleviate some of the downstream flood capacity constraints, and thereby possibly

relax the storage requirements for the future stormwater ponds. These future works were reviewed briefly in Section 5.3 and include:

- capacity improvements on the Main branch of Watercourse 7 downstream of Watercourse 7.2, to the west of McNeilly Road;
- Potential future diversion of the headwaters of Watercourse 7.2 via a new channel along the south side of the CNR line;
- Construction of a new channel along Lewis Road to the West Branch of Watercourse 9

However, these improvements have not yet been constructed, and it is unclear whether the future works will result in sufficient capacity to accommodate all of the increased flood flows from future urban development in the SCUBE study area. Upon future completion of these downstream conveyance improvement works, future detailed studies may be undertaken to assess the upgraded capacities and re-evaluate the amount of flood (quantity) control storage which is required within the SCUBE stormwater ponds.

Table 7.1: Summary of Flood and Erosion Control Considerations and Requirements

Watercourse	Erosion and Flooding Constraints and Considerations	Recommended Erosion and Flood Control Requirements
WC 7.2	- no significant existing erosion, however existing unlined channel may be susceptible to future erosion - channel discharges via existing ditch and culverts along S. Service Road.	- extended detention for erosion control - control post-development flows to pre-development rates for storms up to the 100-year event.
WC 9	- no significant existing erosion - potential exists for future erosion upstream of the lined channel reach (i.e., west tributary upstream of CNR) - CNR and QEW culverts have capacity to convey future uncontrolled flows.	- no erosion or flood (quantity) control required for facilities discharging directly to lined channel - extended detention for erosion control required for facilities discharging to unlined western channel upstream of CNR - control post-development flows to pre-development rates for storms up to the 100-year event for facilities discharging to the unlined western channel.
WC 10	- no significant existing erosion - no future erosion anticipated (existing channels discharge to storm sewer systems) - capacity limitations of downstream storm sewer systems	- no erosion control required for facilities discharging to downstream storm sewer systems - control post-development flows to pre-development rates for storms up to the 100-year event to prevent increased frequency of flooding in downstream storm sewer systems
Fifty Creek	- no significant existing erosion, however channel may be susceptible to future erosion - downstream private landowner concerns about increased flows and frequency of flooding - QEW culverts have capacity to convey future uncontrolled flows	- extended detention for erosion control - control post-development flows to pre-development rates for storms up to the 100-year event to address downstream landowner concerns.

7.4 Aquatic and Terrestrial Habitat

The preceding Sections have outlined alternative stormwater management measures which would also provide direct benefit to the aquatic and terrestrial communities and their habitats. For example, water quality control measures were identified (Section 7.2) to minimize potential future impacts from urban pollutants. The aquatic communities would also benefit from the use of erosion control facilities (Section 7.3), which would reduce the potential for downstream erosion and related suspended solids loadings. In the case of a stormwater management pond with extended detention storage, the capture and gradual release of storm runoff may also benefit in terms of baseflows within the downstream creek reaches. Further baseflow and temperature benefits would also be provided with the LID measures to maintain groundwater recharge as identified in Section 7.1.

Further measures to protect the existing aquatic and terrestrial communities are identified as part of the Natural Heritage strategy, discussed in Section 8.

7.5 Stormwater Management Strategy

The Stormwater Management Strategy for the SCUBE Study Area has been formulated through consideration of the proposed future urban development, its impact on the existing environmental resources of the area, together with input from the City, relevant agencies and the public. As outlined in the proceeding sections, the strategy consists of three key measures:

- Low Impact Development (LID) source controls;
- Wet ponds for catchment areas 5 ha or more, *OR* traditional source controls for catchment areas of less than 5 ha.
- Stream restoration.

The respective benefits and stormwater targets for each of these measures is outlined in Table 7.2.

In addition to the above, additional proposed future channel construction works have been recommended as part of previous studies upstream of the CNR line on Watercourse 7.2 and along Lewis Road to the Western Tributary of Watercourse 9. Although these proposed future channels are conceptual in nature and their ultimate characteristics and capacities are not known at this time, these works do represent potential capacity improvements over the existing systems.

The above works are illustrated conceptually, together with the most up-to-date Regulatory floodplain limits in Figure 7.1. With respect to the stormwater ponds, it is noted that the illustrated locations of the ponds are conceptual in nature. Table 7.3 provides a summary of the conceptual sizing characteristics of the stormwater ponds. The ultimate location and size of any stormwater ponds will be dependent upon several factors to be examined during the future stages of development, including:

- Development phasing / timing;
- Land ownership;
- Topography and proposed subdivision grading;
- Road layouts / grades;
- Storm sewer outlets and elevations; and
- Stream corridor definition through future top-of-bank surveys and setbacks.

Stormwater Management Strategy

Regulatory Floodplain (no development)

LID Source Controls for Groundwater Recharge/Baseflow Targets (assumes silt/clay soils):

1.5 mm (residential lands)

3.0 mm (residential lands over sand/gravel soils)

3.0 mm (employment lands)

Stormwater Management Ponds for Water Quality and Flood Control

Proposed Wet Pond* - Quality and Quantity

Proposed Wet Pond* - Quality only

*Note: Size and location subject to detailed grading, servicing, constraints, top-of-bank surveys and development phasing.

Targets :
- Level 2 water quality control (approximately 65 – 105 m3/ha permanent pool)
- Flood control and erosion control (approximately 550 m3/ha active storage)

Traditional Source Controls for Small (infill) Catchments (<5 ha)

Stream Restoration

Stream Restoration

Eliminate Fish Barriers

LAKE ONTARIO

Watercourse 11

Watercourse 10 (recently realigned)

Storm Sewer Tributary 10-2

Storm Sewer Tributary 10-1

FIFTY RD

QUEEN ELIZABETH WY

NORTH SERVICE RD

SOUTH SERVICE RD

Fifty Creek

10-3

10-2

10-1

12-2

12-1

Parcel 'B'
SCUBE EAST

Watercourse 7.2

7-2-3

7-2-4

7-2-1

7-2-2

Watercourse 9

9-4

9-5

LEWIS RD

9-1

Parcel 'A'
SCUBE EAST

BARTON ST

MCNEILLY RD

9-2

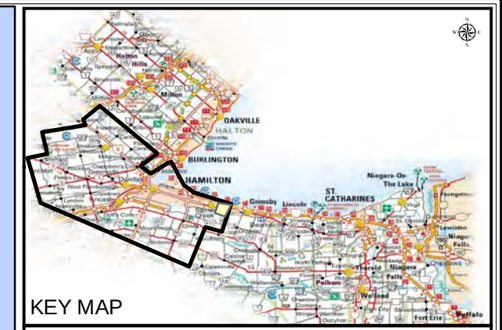
9-3

SCUBE CENTRAL

HIGHWAY NO. 8

WINONA RD

KEY MAP



Legend

- Study Area
- SCUBE Development Lands
- Watercourse
- Proposed Lewis Road Channel
- Possible Watercourse 7.2 Diversion Channel
- Sand/Gravel Soils

Proposed Landuse

- Residential
- Employment

NOTES:

0 125 250 500 750

Meters

Aquafor Beech Limited

77 James Street North
Hamilton ON
L8R 2K3
Phone: (905) 546-2424

Hamilton

SCUBE East Subwatershed Study
Stormwater Management Strategy

FIGURE No. 7.1

DATE: November 2010

Table 7.2: Summary of Stormwater Management Strategy Components for the SCUBE Lands

Components:	Groundwater Resources	Water Quality	Erosion/Flood Control	Aquatic/Terrestrial Resources
Low Impact Development (LID) Source Controls:				
Targets:	- for areas of sand/gravel: 3 mm over catchment area (residential landuses) - for areas of silt/clay soils: 1.5 mm (residential landuses, and 3 mm (commercial/institutional landuses) over catchment area			
Benefits:	- maintain groundwater recharge rates;	- improved water quality through removal of suspended contaminants	- moderate reductions in stormwater runoff	- protect stream baseflows and improved water quality
Wet Ponds (catchment area > 5ha) and Traditional Source Controls (catchment area <5ha)				
Targets:		- Level 2 (normal) water quality control - residential landuses (50%impervious): 65 m^3/ha permanent pool, 40 m^3/ha active storage - commercial/institutional landuses (80%impervious): 105 m^3/ha permanent pool, 40 m^3/ha active storage	- overcontrol of events up to 2-year storm for erosion control: approximately 200 m^3/ha active storage; - post-to-pre runoff control for flooding: approximately 550 m^3/ha active storage; - lands draining directly to the lined channel of Watercourse 9 are exempt from erosion & flood control requirements.	
Benefits:		- improved water quality through settling and capture of suspended contaminants	- prevent increases in runoff rates which could otherwise worsen existing downstream erosion and flooding	- improved water quality
Stream Restoration				
Targets:				- re-planting streamside vegetation - removal of fish barriers
Benefits:		- potential reduction in erosion and sediment loadings and thus improved water quality with additional streamside vegetation	- potential reduction in erosion and sediment loadings with additional streamside vegetation	- improvements to fish and terrestrial habitat - reduced erosion and improved water quality; - moderates stream temperatures
Potential Capacity Improvements Through Future Channel Construction as Recommended through Other plans and Studies				
Target / Works:			- Lewis Road channel draining to Watercourse 9 (Genivar Ontario, 2007) - diversion of Watercourse 7.2 to the west to the Main Branch of Watercourse 7 upstream of the CNR Line.	
Benefits:			- potential increase in conveyance capacity over the existing channel/ditch systems	

Table 7.3: Summary of Conceptual Stormwater Management Ponds

SWM Facility*	Proposed Landuse	Receiving Watercourse	Type of Facility	Catchment Area (ha)	Permanent Pool Storage (m^3)	Active Storage (m^3)
Pond 12-1	Employment Lands - SCUBE East Parcel "B"	Fifty Creek	Quality, erosion, flood control	11.8	1,235	6,468
Pond 12-2	Employment Lands - SCUBE East Parcel "B"	Fifty Creek	Quality, erosion, flood control	16.0	1,680	8,800
Pond 10-1	Employment Lands - SCUBE East Parcel "B"	Storm Sewer Tributary 10-1	Quality, erosion, flood control	16.4	1,722	9,020
Pond 10-2	Employment Lands - SCUBE East Parcel "B"	Storm Sewer Tributary 10-2	Quality, erosion, flood control	9.6	1,008	5,280
Pond 10-3	Employment Lands - SCUBE East Parcel "B"	Storm Sewer Tributary 10-3	Quality, erosion, flood control	9.3	977	5,115
Pond 9-1	Residential Lands - SCUBE East Parcel "A"	Watercourse 9 Lined East Tributary	Quality only	14.7	956	588**
Pond 9-2	Residential Lands - SCUBE Central	Watercourse 9 West Tributary via Lewis Road channel	Quality, erosion, flood control	54.0	3,508	29,683
Pond 9-3	Residential Lands - SCUBE Central	Watercourse 9 West Tributary via Lewis Road channel	Quality, erosion, flood control	23.1	1,503	12,715
Pond 9-4	Employment Lands	Watercourse 9 West Tributary via Lewis Road channel	Quality, erosion, flood control	16.2	1,700	8,906
Pond 9-5	Employment Lands	Watercourse 9 Lined East Tributary	Quality only	24.8	2,604	992**
Pond 7-2-1	Employment Lands	Watercourse 7.2	Quality, erosion, flood control	10.4	1,087	5,691

* Refer to Figure 7.1 for conceptual SWM Pond locations.

** Active storage for pond 9-1 and 9-5 is $40m^3$/ha for quality control only.

8.0 Natural Heritage System

8.1 Introduction

Section 2.1.2 of the 2005 Provincial Policy Statement (PPS) states that the diversity and connectivity of natural features in an area, and the long-term ecological function and biodiversity of natural heritage systems, should be maintained, restored or, where possible, improved, recognizing linkages between and among natural heritage features and areas, surface water features and ground water features (Ministry of Municipal Affairs and Housing 2005). Accordingly, a key objective of the SCUBE Subwatershed Study is to provide a framework to guide the development of the lands subject to the Fruitland-Winona Secondary Plan so that their ecological processes, functions and significant natural features are protected, maintained and enhanced (City of Hamilton 2009).

The Province of Ontario provides technical guidance to implement the natural heritage policies of the PPS through the Natural Heritage Reference Manual (NHRM). The first edition of the NHRM, issued by the Ministry of Natural Resources (MNR) in 1999, recognizes the development of a natural heritage system as a comprehensive approach to defining and protecting natural heritage features and areas. The most recent edition of the NHRM, issued in 2010, places greater emphasis on planning for natural heritage systems and providing connectivity among natural heritage features and areas (MNR 2010).

The 2005 PPS defines a Natural Heritage System (NHS) as a system made up of natural heritage features and areas, linked by natural corridors which are necessary to maintain biological and geological diversity, natural functions, viable populations of indigenous species and ecosystems. These systems can include lands that have been restored and areas with the potential to be restored to a natural state (Ministry of Municipal Affairs and Housing 2005). The NHS approach is a useful method for the protection of natural heritage features and areas because it reinforces an understanding that the elements of the system have strong ecological ties to each other, as well as to other physical features and areas in the overall landscape. The NHS approach also addresses a number of important land use planning concerns, including biodiversity decline, landscape fragmentation and the maintenance of ecosystem health. The NHRM describes these planning concerns in greater detail and outlines the potential benefits of a NHS (MNR 2010).

8.2 NHS Identification

Aquafor Beech Limited used a systems approach to identify a recommended NHS for the study

area of the SCUBE Subwatershed Study. The systems approach identifies a NHS that includes core areas while ensuring that smaller, less significant natural areas or degraded lands between these areas are maintained or restored to provide a connected system of natural areas (City of Hamilton 2008, 2009). Briefly, the approach used by Aquafor Beech Limited involved the following steps:

(1) Data from existing information sources and supplemental reconnaissance-level fieldwork was used to characterize the existing conditions of the study areas of the SCUBE West Subwatershed Study and the SCUBE East Subwatershed Study (collectively, the SCUBE Subwatershed Study) with a particular emphasis on the four blocks of land added to the Urban Area of the City of Hamilton and under consideration for urban development, i.e. SCUBE West, SCUBE Central, SCUBE East (Parcel A) and SCUBE East (Parcel B).

(2) A preliminary NHS for the study area of the SCUBE Subwatershed Study was identified based on Core Areas and Linkages as mapped by the City of Hamilton (2006, 2009).

(3) The preliminary NHS was refined through further assessment. Aquafor Beech Limited divided the study area of the SCUBE Subwatershed Study into three Zones (Zones A, B and C) and applied a different level of assessment to each based on existing and potential future land uses.

This approach is described in greater detail below.

8.3 Study Area Characterization

Aquafor Beech Limited obtained background information on the study area of the SCUBE Subwatershed Study from the City of Hamilton, Hamilton Conservation Authority and the MNR Niagara Area Office. Sources of background information reviewed by Aquafor Beech Limited include the following:

- City of Hamilton Rural Official Plan (City of Hamilton 2006)
- City of Hamilton Urban Official Plan (City of Hamilton 2009)
- Nature Counts Project: Hamilton Natural Areas Inventory (Dwyer 2003)
- Natural Heritage Information Centre (NHIC) database records of significant species and natural areas

- Records of birds observed in the study area of the SCUBE Subwatershed Study between January 2001 and March 2011 as documented by three databases maintained by Bird Studies Canada, including the Great Backyard Bird Count, Ebird and the Ontario Breeding Bird Atlas (2001-2005)

- Species lists from the City of Hamilton's Natural Heritage Database for three areas defined by Dwyer (2003) as Devil's Punch Bowl Escarpment (STCK-76), Fifty Point Conservation Area (STCK-80) and Fifty Creek Valley (STCK-136)

- The Reptiles and Amphibians of the Hamilton Area. A Historical Summary and Results of the Hamilton Herpetofaunal Atlas (Lamond 1994)

- Natural Heritage Assessment of Lands Bounded by Fruitland Road, Glover Road, Barton Street and Highway 8, City of Hamilton (Dillon Consulting Limited 2010)

- City of Hamilton Watercourse 5 & 6 Class EA Study Draft Report (Dillon Consulting Limited 2007)

- Aquatic Habitat and Fisheries Impact Assessment – Watercourses 5, 6, 7, and 9. Final Report to the City of Stoney Creek Department of Engineering (SNC Lavalin 1991)

- Birds of Hamilton and Surrounding Areas (Curry 2006)

Additional reference materials used in the preparation of this report are listed in Section 7. For convenient reference, Aquafor Beech Limited compiled a consolidated list of species recorded from the study area of the SCUBE Subwatershed Study (Appendix E).

In developing the recommended NHS, Aquafor Beech Limited staff conducted supplemental reconnaissance-level fieldwork on April 6, 2011 to confirm existing conditions. Fieldwork focused on the four blocks of land added to the Urban Area of the City of Hamilton and under consideration for urban development, i.e. SCUBE West, SCUBE Central, SCUBE East (Parcel A) and SCUBE East (Parcel B). Incidental wildlife observations were recorded and representative site photographs were taken. Altogether, Aquafor Beech Limited staff spent a total of approximately 22 person-hours in the field.

8.4 City of Hamilton NHS

During the preparation of its new Official Plan, the City of Hamilton identified the components of a municipal NHS consisting of Core Areas and Linkages. The City of Hamilton (2006, 2009)

defines Core Areas as Key Natural Heritage Features, Key Hydrologic Features, and Local Natural Areas. The City of Hamilton (2006, 2009) defines Key Natural Heritage Features as:

- Significant habitat of endangered, threatened, and special concern species;
- Fish habitat;
- Wetlands;
- Life Science Areas of Natural and Scientific Interest (ANSIs);
- Significant valleylands;
- Significant woodlands;
- Significant wildlife habitat;
- Sand barrens, savannahs, and tallgrass prairies; and
- Alvars.

The City of Hamilton (2006, 2009) defines Key Hydrologic Features as:

- Permanent and intermittent streams;
- Lakes (and their littoral zones);
- Seepage areas and springs; and,
- Wetlands.

The City of Hamilton (2006, 2009) defines Local Natural Areas as:

- Environmentally Significant Areas as identified by the City of Hamilton;
- Unevaluated wetlands; and
- Earth Science Areas of Natural and Scientific Interest.

The City of Hamilton (2006, 2009) defines linkages as landscape areas that connect natural areas. Linkages may include the following:

- Woodland linkages (e.g. small woodlands);
- Other natural vegetation types (e.g. meadows, old field, thickets); and
- Streams and watercourses that connect Core Areas.

The City of Hamilton's definitions of (i) woodland linkages and (ii) other natural vegetation types vary between the Urban and Rural Official Plans (Table 8.1).

Table 8.1: City of Hamilton definitions of woodland linkages and other natural vegetation types.

Term	Definition – Urban Official Plan	Definition – Rural Official Plan
Woodland linkage	Any natural or planted wooded area of any size or composition of 0.5 ha or more in size that either connects or lies within 100 m of a Core Area.	Any natural or planted wooded area of any size or composition that either connects or lies within 100 m of a Core Area.
Other natural vegetation types	Any meadow, thicket, or old field at least 0.5 ha in size that connects Core Areas or is situated within 100 m of a Core Area.	Any meadow, thicket, or old field that connects Core Areas or is situated within 100 m of a Core Area.

Aquafor Beech Limited used the Core Areas and Linkages identified by the City of Hamilton (2006, 2009) as the preliminary NHS for the study area of the SCUBE Subwatershed Study (Figures 8.1 and 8.2). This preliminary NHS was subject to further review and refinement as described below.

8.5 Study Area Zones

In reviewing the preliminary NHS, Aquafor Beech Limited divided the study area of the SCUBE Subwatershed Study into three Zones (Zones A, B and C) and applied a different level of assessment to each based on existing and potential future land uses.

Zone A consists of the lands north of the Fruitland-Winona Secondary Plan Study Area. Much of Zone A is dedicated to urban land uses. Residential housing is the primary land use north of the Queen Elizabeth Way; south of the Queen Elizabeth Way industrial/commercial land uses predominate. The two largest blocks of undeveloped land in Zone A (Block A1 and Block A2) are located between Barton Street and the Canadian National (CN) rail line (Figure 8.3). Block A1, located between McNeilly Road and Lewis Road, consists of a mosaic of deciduous forest, cultural meadow, cultural savannah and agricultural land. Block A2, located between Lewis Road and West Avenue, consists of a mosaic of cultural meadow and agricultural lands although its western portion is currently being developed into an industrial park. Since large portions of Blocks A1 and A2 have received draft plan approval under the Planning Act, their natural features were not considered for incorporation in the refined NHS.

Lake Ontario

NORTH SERVICE RD

QUEEN ELIZABETH WY

FRUITLAND RD

QUEEN ELIZABETH WY

GLOVER RD

NORTH SERVICE RD

SOUTH SERVICE RD

MCNEILLY RD

NORTH SERVICE RD

CN Rail Line

GLOVER RD

BARTON ST

MCNEILLY RD

DEWITT RD

SHERWOOD PARK RD.

FRUITLAND RD

JONES RD

HIGHWAY NO. 8

RIDGE RD

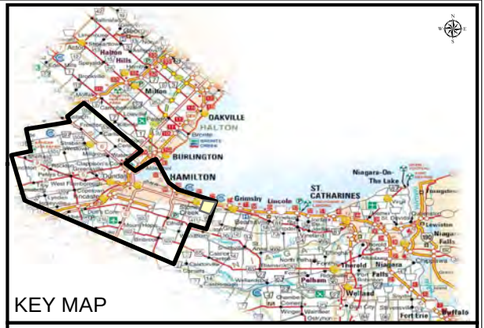
FIFTH RD E

EIGHTH RD E

EIGHTH RD E

RIDGE RD

LEWIS RD



KEY MAP

LEGEND:

- Study Area - SCUBE East Subwatershed Study
- Land Under Consideration for Urban Development
- Core Areas
- Linkages
- Urban – Not Subject to Policies of Greenbelt Plan

NOTES:

0 125 250 500 750 1,000

Meters

Hamilton

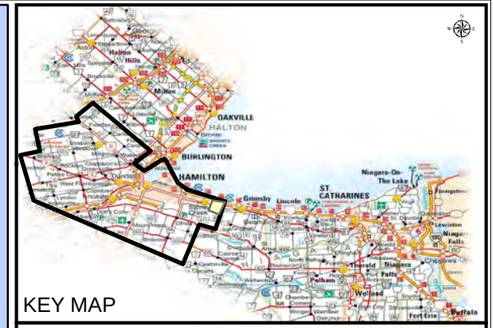
Aquafor Beech Limited

Preliminary Natural Heritage System

SCUBE EAST

FIGURE No. 8.2

DATE: February 23, 2012



LEGEND:

- SCUBE EAST Subwatershed Study Area
- SCUBE WEST Subwatershed Study Area
- Land Under Consideration for Urban Development
- Fruitland-Winona Secondary Plan Area
- Greenbelt Plan - Protected Countryside
- Recommended Area Specific Policy Area for Bobolink
- Urban – Not Subject to Policies of Greenbelt Plan

Niagara Escarpment Plan Designations

- Escarpment Natural Area
- Escarpment Protection Area

0 125 250 500 750 1,000

Meters

Hamilton

Aquafor Beech Limited

NOTES:

Zone A consists of the lands north of the Fruitland-Winona Secondary Plan Area.

Zone B consists of the lands within the Fruitland-Winona Secondary Plan Area.

Zone C consists of the lands between Zone B and the Niagara Escarpment.

SCUBE Subwatershed Study

Natural Heritage System Zones

FIGURE No. 8.3

DATE: February 23, 2012

Zone A contains few remnant natural heritage features and areas; moreover, existing land uses provide limited opportunities for ecological restoration. Accordingly, in considering Zone A during the development of the recommended NHS, Aquafor Beech Limited focused on its watercourses, with a particular emphasis on maintaining, restoring or, where possible, improving the linkages they provide between Lake Ontario and lands upstream.

Zone B consists of the lands within the Fruitland-Winona Secondary Plan Study Area. The majority of the Zone B lands consists of the four blocks of land added to the Urban Area of the City of Hamilton and under consideration for urban development, i.e. SCUBE West, SCUBE Central, SCUBE East (Parcel A) and SCUBE East (Parcel B). These lands largely consist of a mosaic of agricultural lands, cultural meadow and cultural thicket. A portion of Zone B consists of the Town of Winona. The rest of Zone B consists of two blocks of land (Blocks B1 and B2). Block B1 is bound by Barton Street to the north, Highway 8 to the south, Glover Street to the west and McNeilly Road to the east. Block B2 is located between the CN rail line to the north and Highway 8 to the south; it extends from about 250 m west of Fifty Road to the municipal boundary between the City of Hamilton and the Regional Municipality of Niagara (Figure 8.3). Blocks B1 and B2 are largely dedicated to agricultural land uses and both are designated under the Greenbelt Plan as Specialty Crop Area (Niagara Peninsula Tender Fruit and Grape Area). The Greenbelt Plan generally does not permit urban land uses within lands designated Specialty Crop Area. Specifically, Section 3.1.2 of the Greenbelt Plan states the following:

- Within Specialty Crop Areas, normal farm practices and a full range of agricultural, agriculture-related and secondary uses are supported and permitted.

- Lands within Specialty Crop Areas shall not be re-designated in municipal official plans for non-agricultural uses, with the exception of those uses permitted in the general [Greenbelt Plan] policies of Sections 4.2 to 4.6.

- Towns/Villages and Hamlets are not permitted to expand into Specialty Crop Areas.

Zone B includes several remnant natural heritage features and areas; moreover, existing agricultural use and the prevalence of vacant lands (mostly cultural meadow or cultural thicket) provide considerable opportunities for ecological restoration. Accordingly, in refining the preliminary NHS identified by the City of Hamilton to develop the recommended NHS for the study area of the SCUBE Subwatershed Study, Aquafor Beech Limited focused it assessment on the lands of Zone B, with a particular emphasis on the four blocks of land added to the Urban Area of the City of Hamilton and under consideration for urban development, i.e. SCUBE West, SCUBE Central, SCUBE East (Parcel A) and SCUBE East (Parcel B). Blocks B1 and B2 received less consideration as the potential for land use change within these lands is constrained by the policies of Section 3.1.2 of the Greenbelt Plan.

Zone C consists of the lands between those within the Fruitland-Winona Secondary Plan Study Area and the Niagara Escarpment. These lands are designated Escarpment Protection Area (EPA) under the Niagara Escarpment Plan. Policies associated with the EPA designation aim to maintain the remaining natural features and the open, rural landscape character of the Niagara Escarpment and lands in its vicinity. The EPA designation permits existing uses, agricultural operations, single dwellings, transportation and utility facilities as well as forest, wildlife and fisheries management. However, the EPA designation does not permit large scale residential, industrial, commercial or recreational development (Niagara Escarpment Commission 2010).

Zone C lands are largely in agricultural production and few natural heritage features and areas remain. As with Blocks B1 and B2, policy constraints limit the potential for land use change, however, in contrast to Zone A, existing land use does not greatly constrain future opportunities for ecological restoration. Accordingly, in considering Zone C during the development of the recommended NHS, Aquafor Beech Limited focused on its watercourses, with a particular emphasis on maintaining, restoring or, where possible, improving the linkages they provide between Niagara Escarpment and lands downstream. Aquafor Beech Limited also considered potential opportunities to enhance other linkages as defined by the City of Hamilton (i.e. woodland linkages or other natural vegetation types).

The development of the recommended NHS is described in greater detail below.

8.6 Development of Recommended NHS

Aquafor Beech Limited reviewed and refined the preliminary NHS for the study area of the SCUBE Subwatershed Study to incorporate the following:

- Core Areas as defined by the City of Hamilton (2009) including Key Natural Heritage Features, Key Hydrologic Features and Local Natural Areas;
- Linkages as defined by the City of Hamilton (2009);
- Hazardous Lands as defined by the Hamilton Conservation Authority (2009);
- Preliminary vegetation protection zones, consistent with the minimum requirements of the City of Hamilton (City of Hamilton 2009); and
- Opportunities to enhance the attributes of Core Areas and Linkages.

This process is described in greater detail below.

8.6.1 Review and Refinement of Core Areas (Key Natural Heritage Features)

Aquafor Beech Limited reviewed and refined the preliminary NHS for the study area of the SCUBE Subwatershed Study to incorporate Key Natural Heritage Features as described below.

8.6.1.1 Significant Habitat of Endangered, Threatened and Special Concern Species (COSSARO)

Within Zone B, the preliminary NHS was reviewed to address the protection afforded the habitat of species designated endangered, threatened or special concern by the Committee on the Status of Species at Risk in Ontario (COSSARO) including:

- the habitat of COSSARO-designated species protected by the Endangered Species Act (2007).

- the significant habitat of species designated endangered, threatened or special concern by COSSARO. By definition, such habitat constitutes a Key Natural Heritage Feature and a Core Area as established by the City of Hamilton's Urban Official Plan (City of Hamilton 2009).

The MNR Niagara Area Office provided Aquafor Beech Limited with a list of 42 COSSARO-designated species at risk known or suspected to occur in the City of Hamilton (Appendix F). Aquafor Beech Limited identified three other COSSARO-designated species at risk previously recorded in the City of Hamilton, including Cucumber Tree (*Magnolia acuminate*), Canada Warbler (*Wilsonia canadensis*) and Horned Grebe (*Podiceps auritus*). The MNR recommends that specific surveys be completed per MNR-specified protocols to determine whether COSSARO-designated species known or suspected to occur in the City of Hamilton are present at the local (i.e. property-scale) level if potentially suitable habitat for the species is present (MNR 2010).

Accordingly, for each of the 45 COSSARO-designated species at risk known or suspected to occur in the City of Hamilton, Aquafor Beech Limited used background information and the results of previous studies to determine (i) the habitat requirements of the species, (ii) the availability of potentially suitable habitat for the species in Zone B, (iii) whether Zone B has been surveyed for the species per MNR-specified protocols and (iv) whether the species has been recorded in Zone B. Based on this information, Aquafor Beech Limited developed seven categories to characterize the occurrence in Zone B of each of the 45 COSSARO-designated

species (Table 8.2).

Table 8.2: Categories of occurrence assigned to COSSARO-designated species.

Occurrence Category	Definition
1	The species is known to occur in Zone B.
2	The species does not occur in Zone B because all available evidence suggests that Zone B is located well beyond the distribution of the species.
3	The species does not occur in Zone B because suitable habitat is not present.
4	The species does not occur in Zone B – potentially suitable habitat was located but no specimens were observed during surveys completed per MNR-specified protocols.
5	The species does not occur in Zone B - no potentially suitable habitat was located and no specimens were observed during surveys completed per MNR-specified protocols.
6	The presence of the species in Zone B has not been assessed per MNR-specified protocols; specific surveys are not recommended because any potentially suitable habitat for the species is incorporated in the recommended NHS.
7	The presence of the species in Zone B has not been assessed per MNR-specified protocols; future surveys for the species are recommended to guide implementation of the recommended NHS.

Table 8.3 lists the 45 COSSARO-designated species at risk known or suspected to occur in the City of Hamilton and the occurrence category of each as assessed by Aquafor Beech Limited and North-South Environmental Incorporated.

Table 8.3: Occurrence categories of 45 COSSARO-designated species at risk known or suspected to occur in the City of Hamilton as assessed by Aquafor Beech Limited or North-South Environmental Limited.

Taxon	COSSARO Status	Common Name	Scientific Name	Occurrence Category	Comments
Plants	Endangered	American Ginseng	*Panax quinquefolius*	4	COSEWIC (2000) describes American Ginseng habitat as follows: Rich, moist, undisturbed and relatively mature sugar maple-dominated deciduous woods in areas of circumneutral soil such as over limestone or marble bedrock. Colonies are often found near the bottom of gentle slopes facing south-east to south-west; a warmer microhabitat that is usually well-drained and species-rich. The forest canopy is dominated by sugar maple, white ash, bitternut hickory, and basswood. Potential habitat in Zone B is highly disturbed and no individuals were found during surveys completed by Dillon Consulting Limited (2010) and NRSI (2010). All potential American Ginseng habitat in Zone B is incorporated in the NHS.
		Butternut	*Juglans cinerea*	7	The Butternut Recovery Strategy (Environment Canada 2010) states the following: Butternut can tolerate a large range of soil types. It typically grows best on rich, moist, well-drained loams often found along stream banks but can also be found on well-drained gravelly sites, especially of limestone origin. Butternut is intolerant of shade and competition, requiring sunlight from above to survive but it has the ability to maintain itself as a minor component of forests in later successional stages. As a result, the species is typically scattered throughout a stand and occasionally, groups of butternuts can be found along forest roads, forest edges or anywhere sunlight is adequate to support regeneration through seed. Surveys completed by Dillon Consulting Limited (2010) and NRSI (2010) did not cover all potential Butternut habitat in detail; individual Butternut could be present in remnant hedgerows, forest edges, etc. Additional surveys for Butternut at subsequent planning stages are recommended.
		Eastern Flowering Dogwood	*Cornus florida*	4	Eastern Flowering Dogwood occurs in Hamilton according to Riley (1989) and Oldham (2009). No individuals were found during surveys of existing marginal habitat within Zone B completed by Dillon Consulting Limited (2010) and NRSI (2010). Eastern Flowering Dogwood habitat is protected under the Endangered Species Act (2007) based on the Act's general definition of habitat; MNR is currently considering draft habitat regulations for the species.
		American Columbo	*Frasera caroliniensis*	7	American Columbo grows in a wide variety of habitats. COSEWIC (2006) states that that American Columbo is found in primarily open deciduous forest, but also in open forest edges and dense shrub thickets. Threadgill *et al*. (1979) note its occurrence in a variety of habitats across its range, including deciduous, pine and red cedar forests, thickets, open meadows and grasslands. They note that it is most common in dry upland woods, but has also been collected from swampy areas. It has been collected on rocky hillsides throughout its range, but will grow on a wide variety of soils. American Columbo occurs in Hamilton according to Riley (1989) and Oldham (2009). No individuals were found during surveys completed by Dillon Consulting Limited (2010) and NRSI (2010). The disturbed character of potential habitat in Zone B makes occurrence(s) unlikely, however not all potential habitat has been

Taxon	COSSARO Status	Common Name	Scientific Name	Occurrence Category	Comments
					thoroughly surveyed. Additional surveys for American Columbo at subsequent planning stages are recommended.
		Few-flowered Club-rush	*Trichophorum planifolium*	4	Few-flowered Club-rush habitat is protected under the Endangered Species Act (2007). For the purposes of the Act, Section 27 of Ontario Regulation 242/06 defines Few-flowered Club-rush habitat. This habitat is not present in Zone B.

Taxon	COSSARO Status	Common Name	Scientific Name	Occurrence Category	Comments
Plants	Endangered	Red Mulberry	*Morus rubra*	4	The Red Mulberry Recovery Strategy (Parks Canada 2011) describes Red Mulberry habitat as fresh (damp) to moist, well-drained, forested habitats, including floodplains, bottomlands, the slopes and ravines along the southern portion of the Niagara Escarpment and in swales on some western Lake Erie sand spits. Critical habitat for Red Mulberry as defined by Parks Canada (2011) is found only on Pelee Island. All potential habitat in Zone B is incorporated in the NHS.
		Spotted Wintergreen	*Chimaphila maculata*	3	Kirk (1987) describes suitable habitat for Spotted Wintergreen as dry-mesic oak-pine woods. Such habitat is not present in Zone B. No individuals were found during surveys completed by Dillon Consulting Limited (2010) and NRSI (2010).
		American Chestnut	*Castanea dentata*	4	COSEWIC (2004) states the following regarding American Chestnut habitat: Typical habitat is an upland deciduous forest on acid to neutral, sandy soil. Common associates, in order of highest frequency, are red oak, black cherry, sugar maple, American beech, white ash, white oak, red maple and sassafras. White pine, hemlock, shagbark hickory and black oak are occasional associates. Isolated deposits of sandy soils exist in Zone B within the southwest portion of SCUBE Central; no individuals were found during surveys completed by Dillon Consulting Limited (2010) and NRSI (2010). All potential American Chestnut habitat in Zone B is incorporated in the NHS.
		Cucumber Tree	*Magnolia acuminata*	5	COSEWIC (2010) states the following: Cucumber Tree occurs in forests with rich, moist, medium to coarse-textured soils, sometimes near standing water in swampy woodlands but on slopes or rises above the saturated soils; regeneration occurs in forest openings or areas of partly open forest canopies. Typical sites alternate between swamps, especially Silver and Red Maple mineral deciduous swamps: SWD3-1, 3-2 and sometimes swamp thickets: SWT2-6, 2-9, 3-11, and more upland fresh to moist Sugar Maple deciduous or mixed forests: FOD 6-1, 6-3, 6-5, FOM6-1. These latter upland forests are often in headwater areas, especially in Niagara. Dillon Consulting Limited (2010) and NRSI (2010) surveyed all wooded areas in Zone B; no individuals or suitable habitat as described by COSEWIC (2010) were found.
	Threatened	White Wood Aster	*Eurybia divaricata*	4	COSEWIC (2002) describes the habitat of White Wood Aster as follows: Well-drained soils in open, dry deciduous forests dominated by sugar maple and American beech, but contain red, white and black oaks, shagbark hickory, basswood and Carolinian affiliates. It may be suggested that this plant also likes some disturbance, as it seems to grow along trails in the majority of the populations in Ontario. White Wood Aster occurs in Hamilton according to Riley (1989) and Oldham (2009). All potential White Wood Aster habitat in Zone B is incorporated in the NHS.
	Special Concern	Green Dragon	*Arisaema dracontium*	4	Potentially suitable habitat for Green Dragon consists of damp deciduous forests and along streams (http://www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=251). All potential Green Dragon habitat in Zone B is incorporated in the NHS.

Taxon	COSSARO Status	Common Name	Scientific Name	Occurrence Category	Comments
		Broad Beech Fern	*Phegopteris hexagonoptera*	4	The habitat of Broad Beech Fern is described as shady moist areas of maple and beech forests (http://www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=244). The species occurs in Hamilton according to Riley (1989) and Oldham (2009). All potential Broad Beech Fern habitat in Zone B is incorporated in the NHS, although the highly disturbed nature of this potential habitat makes the occurrence of this species unlikely.
Mammals	Endangered	American Badger	*Taxidea taxus jacksoni*	7	The habitat requirements of the American Badger are not well understood but the presence of soils suitable for burrowing appears to be important (http://www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=621). The MNR suggests that sandy or loamy soils provide suitable habitat (MNR 2011). The majority of Zone B lies within the Iroquois Plain, which is characterized by Queenston Shale bedrock overlain by a relatively thin (often less than 1 m deep) layer of silty clay till (Halton Till). A large isolated area of sand and gravel deposits extends from the southwestern portion of SCUBE Central to Zone C; within the study area of the SCUBE Subwatershed Study this area has the greatest potential to function as American Badger habitat. American Badger habitat is protected under the Endangered Species Act (2007). For the purposes of the Act, Section 24 of Ontario Regulation 242/06 defines American Badger habitat as follows: 1. An American badger den that is being used by an American badger or was used by an American badger at any time during the previous 12 months. 2. The area within five metres of the entrance of a den described in paragraph 1. 3. A woodchuck burrow or Franklin's ground squirrel burrow that, (i) is being used by a woodchuck or Franklin's ground squirrel or was used by a woodchuck or Franklin's ground squirrel at any time in the past, and (ii) is within 850 metres of a den described in paragraph 1. Potential dens and Woodchuck burrows within the area of sand and gravel deposits in SCUBE Central should be surveyed for use by American Badger at subsequent planning stages.
	Special Concern	Woodland Vole	*Microtus penetorum*	6	COSSARO assessed Woodland Vole on February 16, 2011 and confirmed its status as Special Concern.
Birds	Endangered	Acadian Flycatcher	*Empidonax virescens*	5	
		Barn Owl	*Tyto alba*	7	Barn Owl habitat is protected under the Endangered Species Act (2007). For the purposes of the Act, Section 24.1 of Ontario Regulation 242/06 defines Barn Owl habitat as follows: 1. A nesting or roosting site that is being used by a barn owl or was used by a barn owl at any time during the previous 12 months. 2. A barn, building or other structure, or a tree or other natural feature, on or in which a nesting or roosting site described in paragraph 1 is located. 3. If a nesting or roosting site described in paragraph 1 is located on a tree or other natural feature, the area within 25 metres of the base of the tree or other natural feature. 4. Those parts of the area within one kilometre of an area described in paragraph 1 or 2 that provide suitable foraging conditions for a barn owl.

Taxon	COSSARO Status	Common Name	Scientific Name	Occurrence Category	Comments
					Additional surveys for Barn Owl at subsequent planning stages are recommended.
		Henslow's Sparrow	*Ammodramus henslowii*	5	
		King Rail	*Rallus elegans*	3	
		Prothonotary Warbler	*Protonotaria citrea*	5	

Taxon	COSSARO Status	Common Name	Scientific Name	Occurrence Category	Comments
Birds	Threatened	Bobolink	*Dolichonyx oryzivorus*	1	Bobolink habitat is protected under the Endangered Species Act (2007) based on the Act's general definition of habitat. MNR is currently developing a Recovery Strategy and a species-specific habitat regulation for the species (MNR 2011). Additional surveys for Bobolink were completed by Stantec Consulting Limited in 2012 (see Appendix I).
		Chimney Swift	*Chaetura pelagica*	1	Chimney Swift habitat is protected under the Endangered Species Act (2007) based on the Act's general definition of habitat. MNR is currently developing a Recovery Strategy and a species-specific habitat regulation for the species (MNR 2009). Additional surveys for Chimney Swift roosting and nesting sites were completed by Stantec Consulting Limited in 2012 (see Appendix I).
		Least Bittern	*Ixobrychus exilis*	3	
		Peregrine Falcon	*Falco peregrinus*	5	Peregrine Falcon habitat is protected under the Endangered Species Act (2007). For the purposes of the Act, Section 29 of Ontario Regulation 242/06 defines Peregrine Falcon habitat as follows: 1. A natural cliff face on which a peregrine falcon is nesting or has nested at any time during the previous 15 years, excluding any part of the cliff face where the top of the cliff face is less than 15 metres above the base of the cliff face. 2. The area within one kilometre of an area described in paragraph 1. 3. An artificially created cliff face, such as a vertical or very steep rock cut in an open pit mine, on which a peregrine falcon is nesting. 4. A nesting site on a building or other structure that is being used by a peregrine falcon or was used by a peregrine falcon at any time during the previous two years, and the area on the outside surface of the building or structure that is within 10 metres of the nesting site. 5. An area that, (i) is on or within 200 metres of a building or structure described in paragraph 4, and (ii) is habitually used by peregrine falcons.
		Cerulean Warbler	*Dendroica cerulea*	5	COSSARO assessed Cerulean Warbler on February 16, 2011 and revised its status from Special Concern to Threatened. The Species at Risk in Ontario List (Ontario Regulation 230/08) will be amended to reflect this change on June 8, 2011. This will result in the automatic protection of Cerulean Warbler habitat under the Endangered Species Act (2007) based on the Act's general definition of habitat.

Taxon	COSSARO Status	Common Name	Scientific Name	Occurrence Category	Comments
Birds	Special Concern	Bald Eagle	*Haliaeetus leucocephalus*	5	
		Black Tern	*Chlidonias niger*	3	
		Common Nighthawk	*Chordeiles minor*	5	
		Hooded Warbler	*Wilsonia citrina*	5	
		Louisiana Waterthrush	*Seiurus motacilla*	5	
		Red-Headed Woodpecker	*Melanerpes erythrocephalus*	5	
		Short-eared Owl	*Asio flammeus*	5	
		Yellow-breasted Chat	*Icteria virens*	5	
		Horned Grebe	*Podiceps auritus*	5	
		Canada Warbler	*Wilsonia canadensis*	5	

Taxon	COSSARO Status	Common Name	Scientific Name	Occurrence Category	Comments
Reptiles and Amphibians	Threatened	Jefferson Salamander	*Ambystoma jeffersonainum*	7	COSSARO assessed Jefferson Salamander on February 16, 2011 and revised its status from Threatened to Endangered. The Species at Risk in Ontario List (Ontario Regulation 230/08) will be amended to reflect this change on June 8, 2011. Jefferson Salamander is associated with deciduous or mixed woodlands. Terrestrial habitat must contain suitable microhabitat (e.g. leaf litter, downed woody debris, tree stumps and rodent burrows) for foraging and overwintering. Breeding occurs in ponds located in or in proximity to woodlands. Breeding ponds generally consist of vernal pools but other types of wetlands may be used. Some individuals migrate up to 1 km, but 90% of adults reside in suitable habitat within 300 m of their breeding pond. Migratory movements to and from breeding ponds may occur through a variety of habitats, including woodlands, plantations, agricultural fields and early successional areas (MNR 2010). Jefferson Salamander habitat is protected under the Endangered Species Act (2007). For the purposes of the Act, Section 28 of Ontario Regulation 242/06 defines Jefferson Salamander habitat as follows: In the City of Hamilton, the counties of Brant, Dufferin, Elgin, Grey, Haldimand, Norfolk and Wellington and the regional municipalities of Halton, Niagara, Peel, Waterloo and York, i. a wetland, pond or vernal or other temporary pool that is being used by a Jefferson salamander or Jefferson dominated polyploid or was used by a Jefferson salamander or Jefferson dominated polyploid at any time during the previous five years, ii. an area that is within 300 metres of a wetland, pond or vernal or other temporary pool described in subparagraph i and that provides suitable foraging, dispersal, migration or hibernation conditions for Jefferson salamanders or Jefferson dominated polyploids, iii. a wetland, pond or vernal or other temporary pool that, A. would provide suitable breeding conditions for Jefferson salamanders or Jefferson dominated polyploids, B. is within one kilometre of an area described in subparagraph i, and C. is connected to the area described in subparagraph i by an area described in subparagraph iv, and iv. an area that provides suitable conditions for Jefferson salamanders or Jefferson dominated polyploids to disperse and is within one kilometre of an area described in subparagraph i. Potentially suitable habitat in Zone B has not been surveyed for Jefferson Salamander. Additional surveys for Jefferson Salamander at subsequent planning stages are recommended.

Taxon	COSSARO Status	Common Name	Scientific Name	Occurrence Category	Comments
		Blanding's Turtle	*Emydoidea blandingii*	6	Blanding's Turtles are aquatic and occur primarily in shallow water; adults are generally found in open or partially vegetated sites, whereas juveniles prefer sites with thick aquatic vegetation. During the active season an individual turtle may travel more than 6.5 km and use several connected lakes, rivers, streams, marshes, and/or ponds. Adult females nest in a variety of loose substrates including sand, organic soil and gravel. Overwintering occurs in slow flowing streams or permanent pools that average about 1 m in depth (COSEWIC 2005). The status of Blanding's Turtle in the City of Hamilton is unclear, but most populations appear to be small and in decline; 18 of 24 populations identified by the Hamilton Herpetofaunal Atlas were documented by single individuals and of these, six consisted of dead specimens (Lamond 1994). The records of Blanding's Turtle nearest to Zone B are from sites located approximately 5 km from the study area of the SCUBE Subwatershed Study. In the opinion of Aquafor Beech Limited, it is highly unlikely that the few small, disjunct wetlands within Zone B function as Blanding's Turtle habitat. However, the potential use by Blanding's Turtles of watercourses as movement corridors and/or overwintering sites cannot be wholly discounted.

Taxon	COSSARO Status	Common Name	Scientific Name	Occurrence Category	Comments
Reptiles and Amphibians	Threatened	Eastern Hognose Snake	*Heterodon platirhinos*	2	Lamond (1994) considers the Eastern Hognose Snake "a species of doubtful occurrence" and notes that there is no conclusive evidence that the species has ever occurred in the Hamilton area.
		Spiny Softshell	*Apalone spinifera*	3	
	Special Concern	Snapping Turtle	*Chelydra serpentina serpentina*	1	The Snapping Turtle is widespread in the City of Hamilton and several records occur from within the study area of the SCUBE Subwatershed Study, including two records located south of the Queen Elizabeth Way (Lamond 1994).
		Northern Map Turtle	*Graptemys geographica*	3	
		Eastern Milk Snake	*Lampropeltis triangulum*	1	The Eastern Milk Snake is widespread in the City of Hamilton and several records occur from within the study area of the SCUBE Subwatershed Study, including two records located south of the Queen Elizabeth Way (Lamond 1994). The species is difficult to locate because of their secretive behaviour (COSEWIC 2002). Consequently, although no individuals were encountered incidentally during surveys completed by Dillon Consulting Limited (2010) and NRSI (2010) it is premature to conclude that the species is not extant in Zone B. Accordingly, additional surveys for Eastern Milk Snake at subsequent planning stages are recommended.
		Eastern Ribbon Snake	*Thamnophis sauritus*	3	Eastern Ribbon Snake is semi-aquatic and is most often found along the edges of shallow ponds, streams, marshes and other wetlands bordered by dense vegetation (Smith 2002). In Hamilton the species is characteristic of wetlands that are associated with large wooded areas; the Eastern Ribbon Snake record nearest to Zone B is from a site located above the Niagara Escarpment approximately 3 km from the study area of the SCUBE Subwatershed Study (Lamond 1994). In the opinion of Aquafor Beech Limited, it is highly unlikely that the few small, disjunct wetlands remaining in Zone B function as Eastern Ribbon Snake habitat.
Fish	Endangered	American Eel	*Anguilla rostrata*	3	
		Redside Dace	*Clinostomus elongatus*	3	
	Special Concern	Grass Pickerel	*Esox americanus vermiculatus*	3	
Insects	Special Concern	Monarch	*Danaus plexippus*	1	

In refining the preliminary NHS, Aquafor Beech Limited considered only the habitat requirements of COSSARO-designated species known to occur in Zone B (i.e. Category 1 species). No further consideration was given to the habitat requirements of those species that do not occur in Zone B (i.e. Category 2, 3, 4 and 5 species) or those whose habitat (e.g. wetlands) the City of Hamilton has already identified as a component of the municipal NHS (i.e. Category 6 species). Additional surveys at subsequent planning stages are recommended for COSSARO-designated species whose presence in Zone B has not been assessed per MNR-specified protocols (i.e. Category 7 species); survey results may require future refinement to the recommended NHS. Recommendations for additional surveys are described further below.

8.6.1.1.1 Category 1 Species

Aquafor Beech Limited identified five COSSARO-designated species that have previously been recorded in Zone B (i.e. Category 1 species). Of these, two species (Bobolink and Chimney Swift) are designated Threatened; the habitat of both species is protected under the provisions of the Endangered Species Act (2007) based on the Act's general definition of habitat:

> An area on which a species depends, directly or indirectly, to carry on its life processes, including life processes such as reproduction, rearing, hibernation, migration or feeding and includes places that are used by members of the species such as dens, nests, hibernacula or other residences.

The other three species (Eastern Milk Snake, Snapping Turtle and Monarch) are designated Special Concern. The habitat of species designated Special Concern is not protected under the Endangered Species Act (2007). However, the significant habitat of species designated Special Concern is considered a Key Natural Heritage Feature and a Core Area as established by the City of Hamilton's Urban Official Plan (City of Hamilton 2009). The City of Hamilton (2009) defines the significant habitat of Threatened, Endangered and Special Concern species as follows:

> The habitat, as approved by the Ministry of Natural Resources, that is necessary for the maintenance, survival and/or recovery of naturally occurring or reintroduced populations of species at risk and where those areas of occurrence are occupied or habitually occupied by the species during all or any part(s) of its life cycle.

Proposed measures to address the habitat of each of the five Category 1 species identified by Aquafor Beech Limited are discussed in greater detail below.

8.6.1.1.1.1 Bobolink

Bobolink was observed in the SCUBE West lands east of Jones Road during breeding bird surveys completed on May 26, May 27, June 22 and June 23, 2009 (Dillon Consulting Limited 2010). Two or three individuals were observed, but specific locality data and evidence of breeding were not recorded because, at the time, Bobolink was not designated a species at risk by either COSEWIC or COSSARO.

Bobolink was observed in the SCUBE Central lands east of Lewis Road and lands south of Highway 8 during breeding bird surveys completed by North-South Environmental Incorporated on May 26, June 7 and June 12, 2010. Specific locality data and evidence of breeding were recorded because at the time of the surveys Bobolink had recently been designated Threatened by COSEWIC. The species was subsequently designated Threatened by COSSARO in June, 2010.

The identification of Bobolink habitat for the purposes of the Endangered Species Act (2007) is not a simple matter. The potential for a given site to function as Bobolink habitat is determined by a variety of factors, including the site's size, management regime and the structure and composition of its vegetation (COSEWIC 2010). The regional setting in which the site is located also appears to play a role (e.g. Haire et al. 2000, Forman et al. 2002).

MNR is currently developing a Recovery Strategy and a species-specific habitat regulation for Bobolink (MNR 2011). In the absence of specific MNR guidelines, Aquafor Beech Limited retained North-South Environmental Incorporated to assist with the identification of Bobolink habitat for the purposes of the Endangered Species Act (2007). Appendix G provides the results of the North-South Environmental Incorporated review of Bobolink habitat. The review (i) describes Bobolink habitat requirements, (ii) assesses SCUBE Central, SCUBE East (Parcel A) and SCUBE East (Parcel B) as potential Bobolink habitat and (iii) provides management recommendations to protect Bobolink habitat within the study area of the SCUBE East Subwatershed Study.

Based on a review of background literature and consultation with MNR staff, North-South Environmental Incorporated recommends the following:

- Designate the entire portion of the SCUBE Central lands east of Lewis Road as an Area Specific Policy Area (ASPA) pending MNR development of a species-specific regulation for protection of Bobolink habitat (Figure 8.3).

- Promote agricultural practices that support Bobolink habitat in Zone C

Based on the results of the North-South Environmental Incorporated review, Aquafor Beech Limited assessed the potential for the portion of the SCUBE West lands where Dillon Consulting Limited (2010) recorded Bobolink (i.e. the lands located between Jones Road and Glover Road) to function as Bobolink habitat. In the opinion of Aquafor Beech Limited, this area has limited potential to function as Bobolink habitat. This assessment is based on the following considerations:

- The area consists of a mosaic of vegetation communities, the majority of which generally do not function as Bobolink habitat (e.g. orchard, vineyard, deciduous thicket and deciduous forest).

- The area includes several vegetation units that provide potentially suitable grassland habitat for Bobolink (e.g. meadow, meadow marsh); these vegetation units occur as three disjunct blocks and occupy a total of approximately 7 ha, which is below the typical minimum habitat requirements of Bobolink.

- All three vegetation blocks that provide potentially suitable grassland habitat for Bobolink are at least partly bordered by deciduous forest or hedgerows, the edges of which Bobolink typically avoid.

- The area is surrounded by residential, industrial, commercial and institutional land uses; Bobolink is not generally found in habitat surrounded by urban development.

In the opinion of Aquafor Beech Limited and North-South Environmental Incorporated, the designation of the entire portion of the SCUBE Central lands east of Lewis Road as an ASPA is sufficient to satisfy Endangered Species Act (2007) requirements to protect Bobolink habitat in the context of the Fruitland-Winona Secondary Plan Study Area. No other portions of the Fruitland-Winona Secondary Plan Study Area warrant protection as Bobolink habitat. However, in the absence of specific guidelines from MNR, the identification of the ASPA (i.e. the portion of the SCUBE Central lands east of Lewis Road) as Bobolink habitat for the purposes of the Endangered Species Act (2007) must be considered preliminary and subject to revision. It is also unclear whether the ASPA lands constitute significant Bobolink habitat as defined by the City of Hamilton (2009). Accordingly, Aquafor Beech Limited did not revise the preliminary NHS to incorporate the ASPA. Breeding bird studies conducted in 2012 by Stantec Consulting Limited concluded that habitat within SCUBE East was not extant, and no individuals were observed. The final breeding bird report completed by Stantec Consulting Limited is contained within Appendix I.

8.6.1.1.1.2 Chimney Swift

Chimney Swift habitat is difficult to characterize as adults spend much of the day foraging for insects in flight; the presence of the species in a given area largely depends on the availability of suitable nesting sites and the abundance of insects. Historically, Chimney Swift used large hollow trees as nesting and roosting sites. However, with European settlement of North America, the species adopted a variety of artificial structures (e.g. chimneys, barns, silos, abandoned buildings and wells) as nesting and roosting habitat. Of these, chimneys are the most abundant and most frequently used. The use of hollow trees now appears rare. As a result, the species is highly dependent on humans for habitat (COSEWIC 2007).

The presence of Chimney Swift in Zone B has been assessed per MNR-specified protocols by Stantec Consulting Limited in 2012 (see Appendix I).

8.6.1.1.1.3 Eastern Milk Snake

The Eastern Milk Snake occurs throughout southern Ontario. The species uses a wide range of habitats, including suburban parks and gardens, hayfields, pastures, old fields, meadows, and deciduous, coniferous and mixed forests. In rural areas, the species is found in and around sheds, barns, abandoned buildings and anthropogenic debris (Cook 1984, Harding 1997, COSEWIC 2002). Little is known about the movement patterns of Eastern Milk Snakes in Canada, but their activity range is estimated to encompass approximately 20 ha and it is assumed that individuals migrate to and from hibernation sites (COSEWIC 2002).

The presence of Eastern Milk Snake in Zone B has not been assessed per MNR-specified protocols.

8.6.1.1.1.4 Snapping Turtle

Snapping Turtles are aquatic and generally occur in habitats that provide slow-moving water, a soft mud bottom and dense aquatic vegetation such as ponds, sloughs, shallow bays and slow streams. Some individuals persist in heavily urbanized water bodies such as golf course ponds and irrigation canals. Females generally nest on sand and gravel banks along waterways, but may also use muskrat houses, abandoned beaver lodges and anthropogenic features such as road shoulders, railway embankments and gardens. Snapping turtles hibernate under water in lakes, marshes or small, continuously flowing streams (COSEWIC 2008).

The presence of Snapping Turtle in Zone B has not been assessed per MNR-specified protocols.

However, Aquafor Beech Limited does not recommend additional surveys for this species because, if extant, Snapping Turtles are likely to be largely restricted to watercourses and immediately adjacent riparian areas and these features will be incorporated in the recommended NHS as Core Areas (e.g. permanent and intermittent streams), Linkages or Vegetation Protection Zones (see below).

8.6.1.1.1.5 Monarch

Monarch habitat consists of open areas that support its larval host plant Milkweed (*Asclepias* spp.) and other wildflowers (http://www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=294). Such habitat is common in Southern Ontario and includes cultural meadows, roadsides and other disturbed lands. Accordingly, the designation of Monarch as Special Concern mainly reflects its vulnerability to the loss of overwintering areas in Mexico rather than habitat-related concerns in Ontario (COSEWIC 2010).

In the opinion of Aquafor Beech Limited, Monarch habitat in Zone B does not constitute significant habitat as defined by the City of Hamilton (2009). Accordingly, Aquafor Beech Limited did not revise the preliminary NHS to incorporate Monarch habitat.

8.6.1.1.2 Category 7 Species

Five species designated Endangered by COSSARO have not previously been recorded in the study area of the SCUBE Subwatershed Study but their potential presence in Zone B has not been per assessed per MNR-specified protocols. These species include American Columbo, Butternut, American Badger, Barn Owl and Jefferson Salamander.

The habitat of American Badger, Barn Owl and Jefferson Salamander and individual specimens of American Columbo and Butternut are protected by regulation under the Endangered Species Act (2007).

8.6.1.2 Significant Habitat of Endangered, Threatened and Special Concern Species (COSEWIC)

Within Zone B, the preliminary NHS was reviewed to address the protection afforded the significant habitat of species designated Endangered, Threatened or Special Concern by the

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). By definition, such habitat constitutes a Key Natural Heritage Feature and a Core Area as established by the City of Hamilton's Urban Official Plan (City of Hamilton 2009).

All COSEWIC-designated species at risk previously recorded or potentially present in the study area of the SCUBE Subwatershed Study are also designated species at risk by COSSARO. As Aquafor Beech Limited recommendations address the significant habitat of COSSARO-designated species at risk, no further recommendations are required to address the protection afforded the significant habitat of COSEWIC-designated species at risk.

8.6.1.3 Fish Habitat

Within the study area of the SCUBE Subwatershed Study, the preliminary NHS was reviewed to confirm the inclusion of fish habitat as defined by the City of Hamilton (2009). Table 8.4 summarizes fish habitat identified in the study area of the SCUBE Subwatershed Study. Figures 8.5 and 8.6 illustrate fish habitat within the study area of the SCUBE Subwatershed Study.

8.6.1.4 Wetlands

Within Zone B, the preliminary NHS was reviewed to confirm the inclusion of wetlands as defined by the City of Hamilton (2009):

> Land such as swamp, marsh, bog, or fen (not including land that is being used for agricultural purposes and no longer exhibits wetland characteristics) that:
>
> (a) is seasonally or permanently covered with shallow water or has the water table close to or at the surface;
>
> (b) has hydric soils and vegetation dominated by water-tolerant plants; and
>
> (c) has been further identified according to evaluation procedures established by the Ministry of Natural Resources, as amended from time to time.
>
> (d) This includes provincially and locally significant wetlands (Greenbelt Plan, 2005)

The Ontario Wetland Evaluation System – Southern Manual (3rd Edition) requires that wetlands be 0.5 ha or larger to be evaluated (MNR 2003). As the City of Hamilton (2009) considers unevaluated wetlands to be Local Natural Areas (and therefore, by definition, Core Areas) Aquafor Beech Limited revised the preliminary NHS to incorporate any wetland 0.5 ha or larger

not previously mapped as a Core Area.

Table 8.4: Fish habitat identified in the study area of the SCUBE Subwatershed Study

Watercourse	Zone A	Zone B	Zone C
5.0	Indirect Fish Habitat	Indirect Fish Habitat	Not Assessed
5.2	Indirect Fish Habitat	Indirect Fish Habitat	Not Applicable
6.0	Indirect Fish Habitat	Indirect Fish Habitat	Not Assessed
6.1	Indirect Fish Habitat	Not Applicable	Not Applicable
6.2	Indirect Fish Habitat	Not Applicable	Not Applicable
6.3	Not Fish Habitat	Not Applicable	Not Applicable
7.0	Upstream of Barton Street - Indirect Fish Habitat Downstream of Barton Street - Direct Fish Habitat	Indirect Fish Habitat	Indirect Fish Habitat
7.2	Indirect Fish Habitat	Not Applicable	Not Applicable
9.0	Upstream of QEW – Indirect Fish Habitat Downstream of QEW – Direct Fish Habitat	Not Applicable	Not Applicable
10.0	Direct Fish Habitat	Not Applicable	Not Applicable
10.1	Not Fish Habitat	Not Fish Habitat	Not Applicable
10.2	Not Fish Habitat	Not Fish Habitat	Not Applicable
11	Not Fish Habitat	Not Applicable	Not Applicable
12 (Fifty Creek)	Direct Fish Habitat	Direct Fish Habitat	Indirect Fish Habitat

Within the study area of the SCUBE West Subwatershed Study, Dillon Consulting Limited (2010) identifies nine vegetation units characterized by the Ecological Land Classification System for Southern Ontario as wetlands (Figure 8.4). Of these, five units form three discrete wetland blocks larger than 0.5 ha:

- Wetland 1 consists of two units (meadow marsh and deciduous swamp) and is located immediately east of Watercourse 5.
- Wetland 2 consists of a deciduous swamp unit located along Watercourse 6.
- Wetland 3 consists of two deciduous swamp units and is located along Watercourse 7.

The remaining four units are smaller than 0.5 ha:

- a deciduous swamp located along Watercourse 5 (Wetland 4).
- a meadow marsh located approximately 300 m east of Watercourse 5 (Wetland 5).
- a meadow marsh located approximately 150 m east of Watercourse 6 (Wetland 6).
- a deciduous swamp located along Watercourse 7.0 immediately downstream of Highway 8 (Wetland 7).

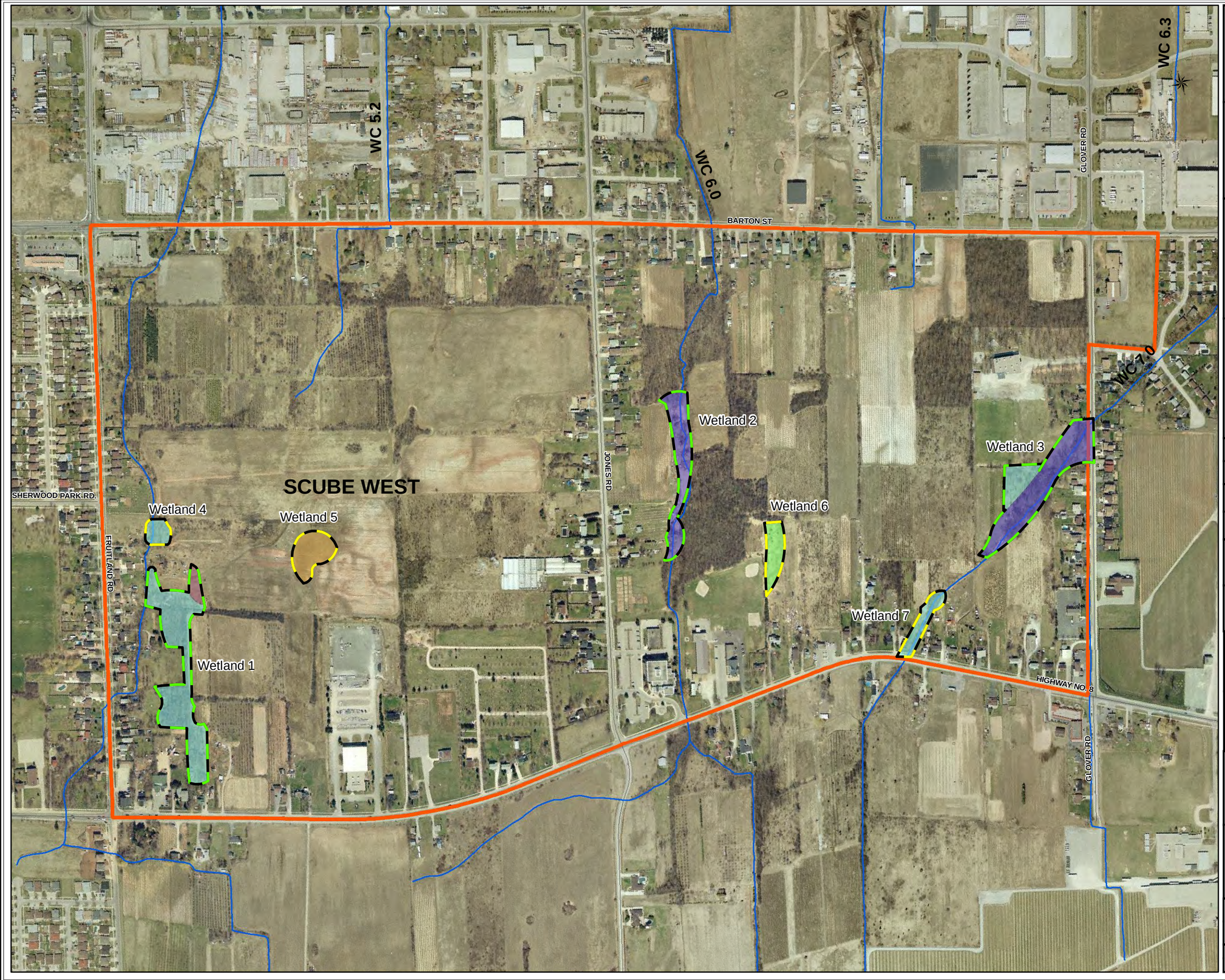
Accordingly, Aquafor Beech Limited revised the preliminary NHS to incorporate Wetlands 1, 2 and 3 as Core Areas. Natural Resources Solutions Incorporated does not identify any wetlands 0.5 ha or larger within the study area of the SCUBE East Subwatershed Study.

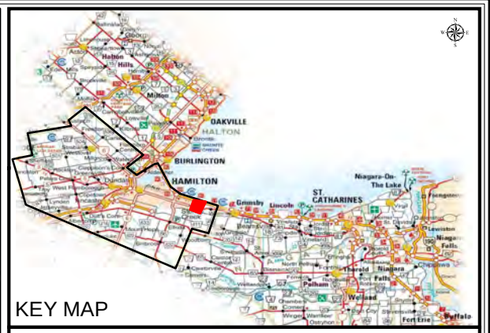
8.6.1.5 Life Science Areas of Natural and Scientific Interest (ANSI)

The preliminary NHS was reviewed to confirm the inclusion of Life Science Areas of Natural and Scientific Interest (ANSI) as defined by the City of Hamilton (2009). No Life Science ANSI is present in the study area of the SCUBE Subwatershed Study.

8.6.1.6 Significant Valleylands

The preliminary NHS was reviewed to confirm the inclusion of Significant Valleylands as defined by the City of Hamilton (2009). No Significant Valleylands have been identified in the study area of the SCUBE Subwatershed Study by the City of Hamilton, Ministry of Natural Resources or Hamilton Conservation Authority.





LEGEND:

- Land Under Consideration for Urban Development
- Wetlands Assessed as Core Areas
- Wetlands Assessed as Not Core Areas

ELC Vegetation Community

- MAMM1-15 (Bulrush Graminoid Mineral Meadow Marsh)
- MAMM1-3 (Reed Canary Grass Graminoid Mineral Meadow Marsh)
- MAMM2-5 (Purple Loosestrife Forb Meadow Marsh)
- SWDM2-2 (Green Ash Mineral Deciduous Swamp)
- SWDM4-1 (Willow Mineral Deciduous Swamp)

NOTES:

0 100 200 400
Meters

Hamilton

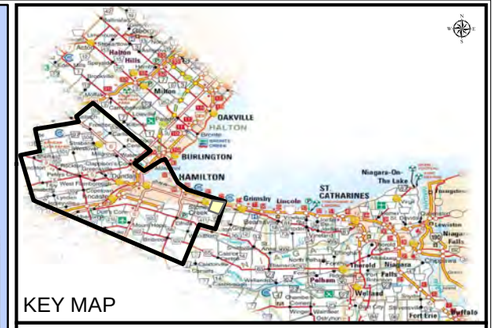
Aquafor Beech Limited

Development of Natural Heritage System
Wetlands

SCUBE WEST

FIGURE No. 8.4

DATE: February 23, 2012



LEGEND:

- Study Area - SCUBE East Subwatershed Study
- Land Under Consideration for Urban Development
- Urban – Not Subject to Policies of Greenbelt Plan
- Wetlands
- Pond

NOTES:

0 125 250 500 750 1,000
Meters

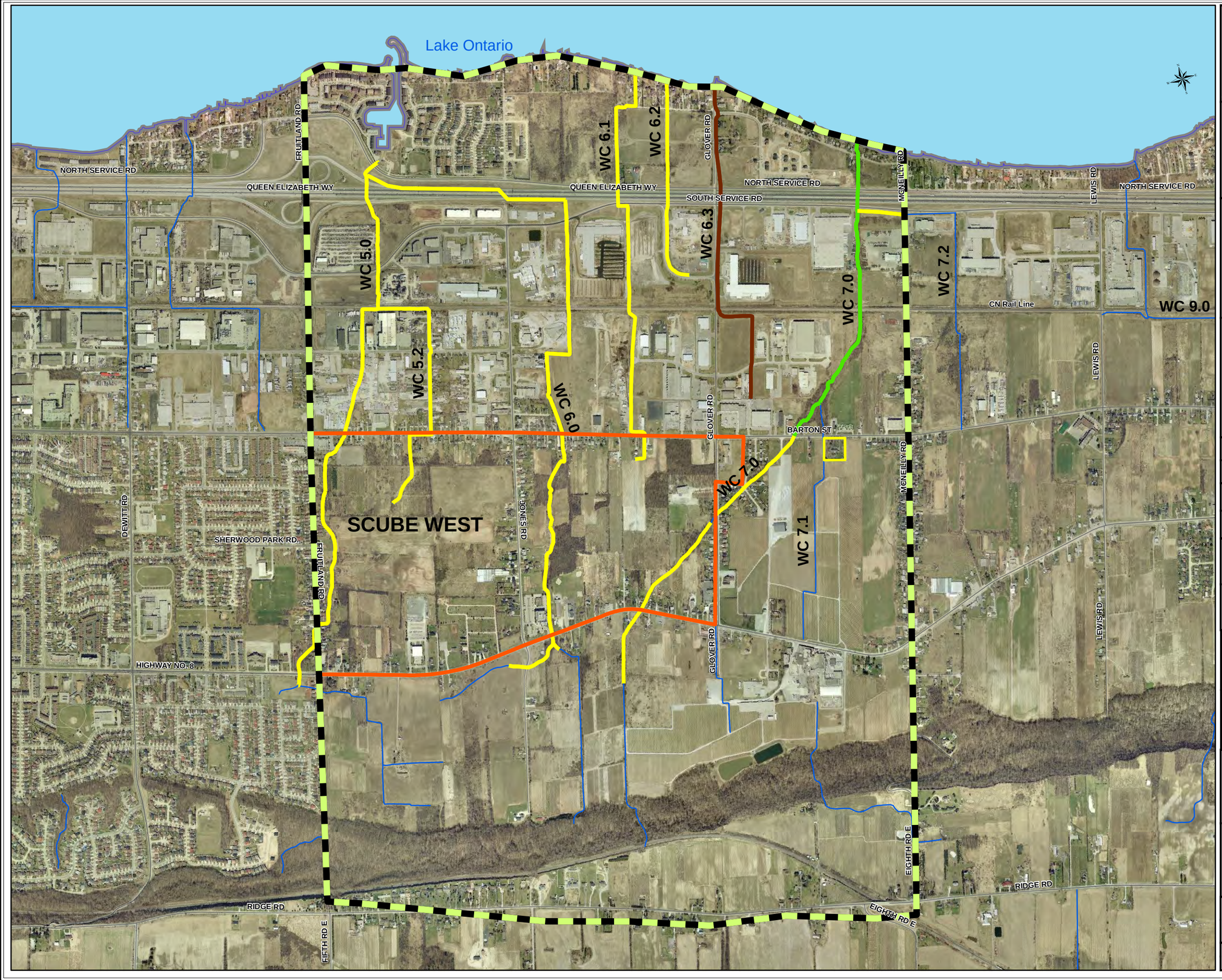
Hamilton

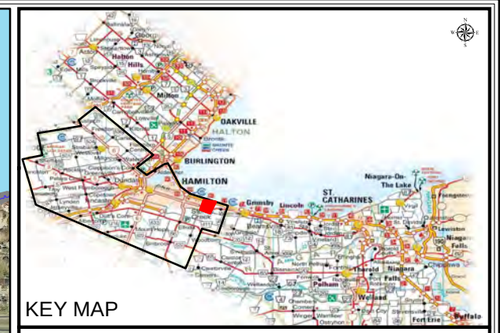
Aquafor Beech Limited

Development of Natural Heritage System
Wetlands
SCUBE East

FIGURE No. 8.5

DATE: February 23, 2012





LEGEND:

- Study Area Boundary - SCUBE West Subwatershed Study
- Land Under Consideration for Urban Development
- Urban – Not Subject to Policies of Greenbelt Plan
- Direct Fish Habitat
- Indirect Fish Habitat
- Not Fish Habitat
- Not Assessed

NOTES:

0 100 200 400 600 800 1,000
Meters

Hamilton

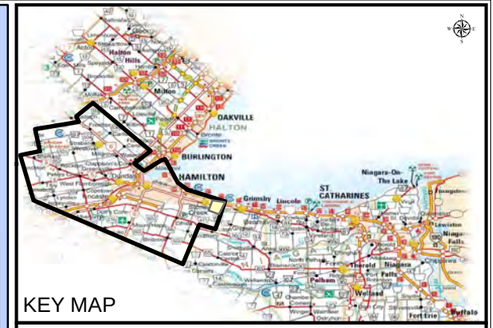
Aquafor Beech Limited

SCUBE SUBWATERSHED STUDY

Development of Natural Heritage System
Fish Habitat

FIGURE No. 8.6

DATE: February 23, 2012



KEY MAP

LEGEND:

- Study Area - SCUBE East Subwatershed Study
- Land Under Consideration for Urban Development
- Urban – Not Subject to Policies of Greenbelt Plan
- Potential Fish Barriers
- 125 HCA Fish Collection Record
- Direct Fish Habitat
- Indirect Fish Habitat
- Not Fish Habitat
- Not Assessed

NOTES:

0 125 250 500 750 1,000
Meters

Hamilton

Aquafor Beech Limited

SCUBE Subwatershed Study
Development of Natural Heritage System
Fish Habitat

FIGURE No. 8.7

DATE: February 23, 2012

8.6.1.7 Significant Woodlands

Within Zone B, the preliminary NHS was reviewed to confirm the inclusion of significant woodlands as defined by the City of Hamilton (2009). The City of Hamilton (2009) defines woodlands as follows:

Treed areas that provide environmental and economic benefits to both the private landowners and the general public, such as erosion prevention, hydrological and nutrient cycling, provision of clean air and the long-term storage of carbon, provision of wildlife habitat, outdoor recreational opportunities, and the sustainable harvest of a wide range of woodland products. Woodlands include treed areas, woodlots or forested areas.

The City of Hamilton (2009) defines significant woodlands as follows:

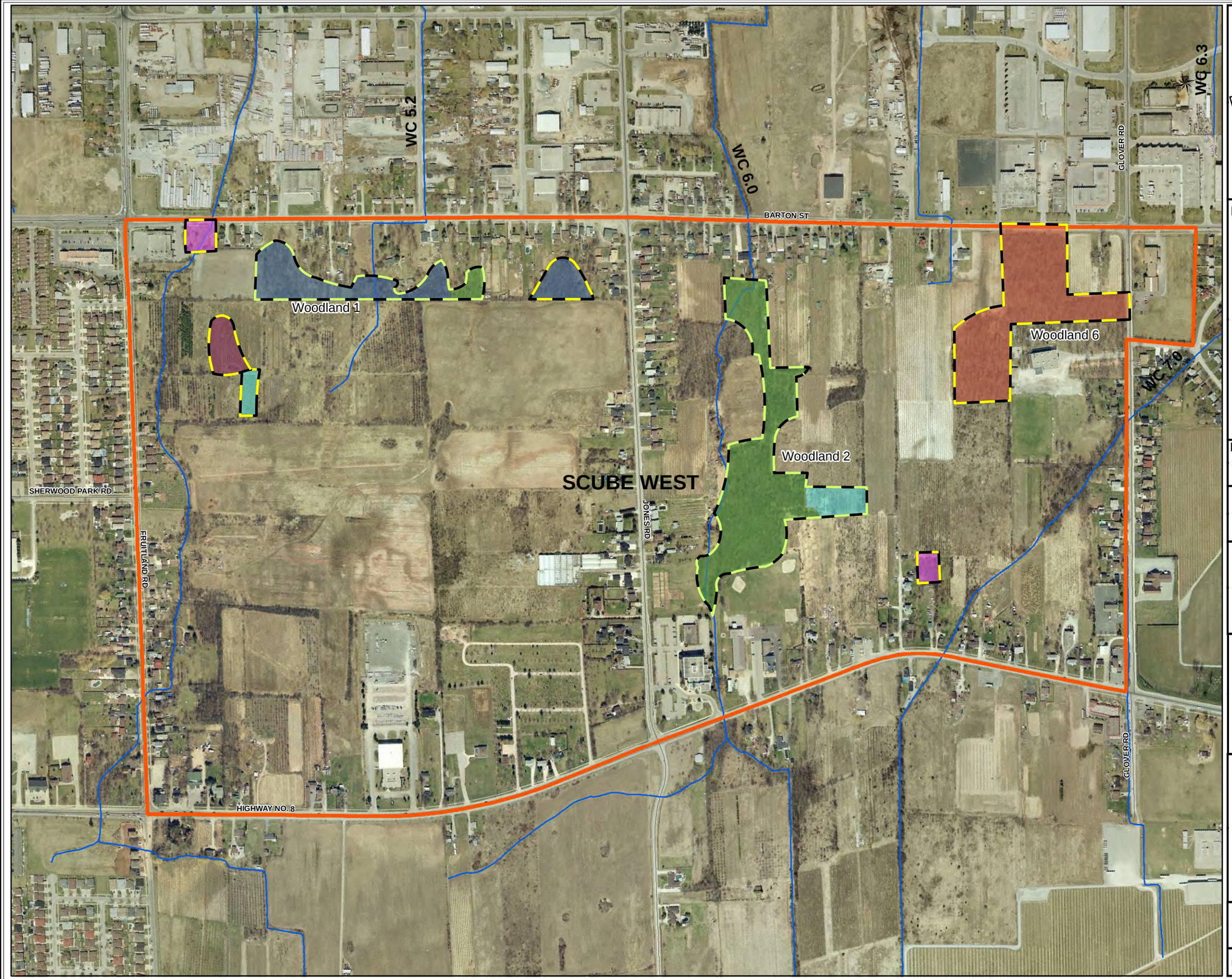
> An area which is ecologically important in terms of:
>
> (a) Features such as species composition, age of trees, stand history;
>
> (b) Functionally important due to its contribution to the broader landscape because of its location, size, or due to the amount of forest cover in the planning area; and
>
> (c) Economically important due to site quality, species composition or past management history.

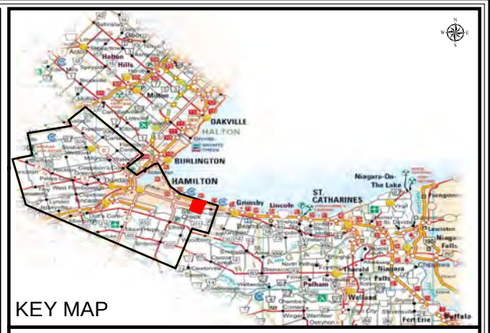
Significant woodlands must meet two or more of the following criteria:

<table>
<tr><th>Criterion</th><th>Description</th></tr>
<tr><td>Size</td><td>All woodlands that meet the minimum size criteria (below) are significant.
<table>
<tr><th>Forest Cover (By Planning Unit)</th><th>Minimum Patch Size for Significance</th></tr>
<tr><td>< 5%</td><td>1</td></tr>
<tr><td>5-10%</td><td>2</td></tr>
<tr><td>11-15%</td><td>4</td></tr>
<tr><td>16-20%</td><td>10</td></tr>
<tr><td>21-30%</td><td>15</td></tr>
</table></td></tr>
<tr><td>Interior Forest</td><td>Any woodland with interior forest habitat (100 metres from edge) is considered significant.</td></tr>
<tr><td>Proximity/ Connectivity</td><td>Woodlands that are located within 50 metres of a significant natural area, (defined as wetlands 0.5 hectares or greater in size, ESAs, PSWs, and Life Science ANSIs) are significant.</td></tr>
<tr><td>Proximity to Water</td><td>Woodlands are considered significant if any portion is within 30 metres of any hydrological feature, including all streams, headwater areas, wetlands, and lakes.</td></tr>
<tr><td>Age</td><td>Woodlands with trees of 100 years or more in age are significant. Age will be determined initially using FRI mapping and can be verified during the EIS.</td></tr>
<tr><td>Rare Species</td><td>Any woodland containing threatened, endangered, special concern, provincially or locally rare plant or wildlife species is significant.</td></tr>
</table>

Within the study area of the SCUBE West Subwatershed Study, Dillon Consulting Limited (2010) identified 10 vegetation units characterized by the Ecological Land Classification System for Southern Ontario as woodlot, plantation or forest (Figure 8.7). Of these, four units form two discrete woodland blocks (Woodland 1 and Woodland 2); each block is considered significant because it satisfies two or more City of Hamilton criteria for significance (Table 8.5).

Within the study area of the SCUBE East Subwatershed Study, Natural Resources Solutions Incorporated identified five vegetation units characterized by the Ecological Land Classification System for Southern Ontario as deciduous forest or cultural woodland (Figure 8.8). One of these units has since been removed; three of the remaining four units (Woodlands 3, 4 and 5) are considered significant because they satisfy two or more City of Hamilton criteria for significance (Table 8.5).





KEY MAP

LEGEND:

- Land Under Consideration for Urban Development
- Woodlands Assessed as Core Areas
- Woodlands Assessed as Not Core Areas

ELC Vegetation Community

- DECW (Deciduous Woodlot)
- FODM7-2 (Green Ash Hardwood Lowland Deciduous Forest)
- FODM9-4 (Fresh Moist Shagbark Hickory Deciduous Forest)
- FODM9-6 (Fresh Moist Oak-Hardwood Deciduous Forest)
- TAGM1 (Coniferous Plantation)
- TAGM3 (Deciduous Plantation)

NOTES:

0 100 200 400

Meters

Hamilton

Aquafor Beech Limited

Development of Natural Heritage System
Woodlands

SCUBE WEST

FIGURE No. 8.8

DATE: February 23, 2012

The incorporation of Woodlands 1-5 in the refined NHS was further reviewed based on City of Hamilton methodology. This review determined that the refined NHS should incorporate only Woodlands 2 and 5 as Core Areas.

Woodland 1 was not incorporated in the refined NHS as a Core Area because it consists of a linear feature with extensive edge habitat and is heavily disturbed. As such, it is unlikely to contribute significantly to the function of the refined NHS. Moreover, Woodland 1 provides little hydrologic function because it is oriented east-west and only a small portion abuts Watercourse 5.2.

Woodlands 3 and 4 were not incorporated in the refined NHS as Core Areas because they are located within lands that have already received draft plan approval under the Planning Act.

The preliminary NHS mapped by the City of Hamilton (2006, 2009) incorporates Woodland 5 as a Core Area but does not accurately reflect the boundaries of Woodland 2. Accordingly, Aquafor Beech Limited revised the preliminary NHS to incorporate Woodland 2 as shown by Figure 8.7 as a Core Area. Refinements to the preliminary NHS include the following:

- Reclassification of a vegetation unit characterized by Dillon Consulting Limited (2010) as thicket from Core Area to Linkage (see Section 6.4);
- Reclassification of a vegetation unit characterized by Dillon Consulting Limited (2010) as deciduous forest from Linkage to Core Area; and
- Incorporation of a vegetation unit characterized by Dillon Consulting Limited (2010) as deciduous plantation within Woodland 2.

Furthermore, Woodland 6 has been classified as a potential core area in the refined NHS. During the course of this study access to Woodland 6 was restricted and, accordingly, the ecological function of the woodland was not evalutated. It is recommended that the ecological function of Woodland 6 be evaluated as a subsequent planning stage, pending full access to the property. Accordingly, the area of natural vegetation which links the south of Woodland 6 to the natural heritage features associated with Watercourse 7.0, has been marked as a candidate linkage area. Should it be determined that Woodland 6 is a core area, the natural area immediately south will qualify as a linkage.

Table 8.5: Significant woodlands as defined by the City of Hamilton (2009) within Zone B.

Designation	Composition (ELC Units)	Significance Criteria Satisfied
Woodland 1	(1) Fresh-Moist Oak-Hardwood Deciduous Forest (FODM9-6) (2) Green Ash Hardwood Lowland Deciduous Forest (FODM7-2)	(1) Size – larger than 2 ha (2) Proximity to Water – bisected by Watercourse 5.2
Woodland 2	(1) Green Ash Hardwood Lowland Deciduous Forest (FODM7-2) (2) Deciduous Plantation (TAGM3)	(1) Size – larger than 2 ha (2) Proximity/Connectivity – located adjacent to Wetland 2 (3) Proximity to Water – Adjacent to Watercourse 6.0
Woodland 3	Deciduous Forest Ecosite (FOD)	(1) Size – larger than 2 ha (2) Proximity to Water – bisected by Watercourse 7.2
Woodland 4	Mineral Cultural Woodland (CUW1)	(1) Size – larger than 2 ha (2) Proximity to Water – adjacent to Watercourse 10.1
Woodland 5	Fresh-Moist Lowland Deciduous Forest (FOD7)	(1) Proximity/Connectivity – forms part of Fifty Creek Valley ESA (2) Proximity to Water – located along Fifty Creek (Watercourse 12)

8.6.1.8 Significant Wildlife Habitat

Within Zone B, the preliminary NHS was reviewed to confirm the inclusion of Significant Wildlife Habitat as defined by the City of Hamilton (2009):

> Areas where plants, animals and other organisms live and find adequate amounts of food, water, shelter and space needed to sustain their populations. Wildlife habitat is significant where it is ecologically important in terms of features, functions, representation, or amount and contributes to the quality and diversity of a Natural Heritage System. Significant wildlife habitat areas are defined as consisting of one or more of the following:
>
> (a) Critical habitat areas that provide for seasonal concentrations of animals;
>
> (b) Wildlife movement corridors;
>
> (c) Rare vegetation communities or specialized habitats for wildlife; and/or
>
> (d) Habitats for species of conservation concern including provincially and federally threatened, endangered, special concern species, and locally rare species.
>
> (e) MNR identifies criteria, as amended from time to time for the foregoing.

Zone B has limited potential to function as Significant Wildlife Habitat as it is dominated by agricultural land use and common culturally influenced habitats. The NHIC has no records of Significant Wildlife Habitat from within the larger study area of the SCUBE Subwatershed Study and none was identified by Dillon Consulting Limited (2010) or Natural Resources Solutions Incorporated during surveys of SCUBE West, SCUBE Central, SCUBE East (Parcel A) and SCUBE East (Parcel B).

If present in Zone B, Significant Wildlife Habitat is most likely located within the Core Areas of the preliminary NHS as revised above. However, to ensure the inclusion of Significant Wildlife Habitat in the refined NHS, Aquafor Beech Limited further assessed the potential presence in Zone B of Significant Wildlife Habitat as defined by MNR (2000). In the opinion of Aquafor Beech Limited, the following seven types of Significant Wildlife Habitat are potentially present in Zone B:

- Landbird migratory stopover areas
- Raptor winter feeding and roosting areas
- Migratory butterfly stopover areas

- Habitat for area sensitive species
- Forests providing a high diversity of habitats
- Amphibian woodland breeding ponds
- Habitats for species of conservation concern

Each of these seven types of Significant Wildlife Habitat is discussed in greater detail below.

8.6.1.8.1 Landbird migratory stopover areas

The MNR (2000) describes landbird migratory stopover areas as follows:

> Stopover areas must provide a variety of different habitat types ranging from open fields to large woodlands, to provide abundant food and cover for the diversity of different species during migration. In addition, raptors will use updrafts along cliff faces to assist in migration during spring and fall. Many of the best sites are found within 2 km of Lake Ontario and Lake Erie.

Zone B consists of a variety of habitat types, including cultural meadows, wetlands, cultural thickets and remnant deciduous woodlands. As it is located between the Lake Ontario shoreline and the cliffs of the Niagara Escarpment, Zone B has the potential to function as a landbird migratory stopover area. While SCUBE West, SCUBE Central, SCUBE East (Parcel A) and SCUBE East (Parcel B) have been surveyed for breeding birds, these areas have not been surveyed in the spring or fall to assess their potential function as a landbird migratory stopover area.

8.6.1.8.2 Raptor winter feeding and roosting areas

The MNR (2000) describes raptor winter feeding and roosting areas as follows:

> Open fields, including hayfields, pastures, and meadows that support large and productive small mammal populations (mice, voles) are important to the winter survival of many birds of prey. Such fields usually have a diversity of herbaceous vegetation that provides food for mammals. Scattered trees and fence posts provide perches for hunting birds. Windswept fields in more open areas that are not covered by deep snow are preferred by raptors because hunting prey is easier. The best roosting sites will likely be

found in relatively mature mixed or coniferous woodlands that abut these windswept fields. Some species, such as northern harriers and short-eared owls, roost in large grassy fields. Some feeding and roosting sites support many birds, especially in years when northern species are numerous. In areas with few remaining forested areas, woodlots with dense conifer cover may support numerous roosting birds, especially long-eared owls. Highway corridors appear to attract many hunting raptors throughout the year, because these areas are open and the vegetation is relatively low, making hunting easier. As with waterfowl nesting habitat, protection of large areas of potentially suitable habitat will increase the probability of including significant raptor winter feeding and roosting areas within a Natural Heritage System.

The MNR (2000) further notes the following:

- Raptors frequently hunt over large areas and, as winter progresses, prey populations decline. Therefore, it is important to protect sites that are large enough to support wintering raptors for the entire winter. The best sites should be at least 25-30 ha in size.
- The land use of a site should be noted. Sites that are most likely to remain unchanged for several years are preferred. Cattle pastures often remain unchanged for many years; whereas hay fields can be cultivated and different crops planted that make the site unsuitable. Sites that are least disturbed are preferred and sites that are part of a rural landscape are preferred to those surrounded by urban development.

Portions of Zone B have the potential to function as raptor winter feeding areas, including the cultural meadows of SCUBE West and SCUBE East (Parcel B) and much of SCUBE Central. However, these areas are generally less than 25 ha in size and are surrounded by urban development. Larger areas of similar habitat are located in Zone C; these lands are designated Escarpment Protection Area under the Niagara Escarpment Plan, and, as such, are intended to maintain their rural landscape character. Accordingly, in the opinion of Aquafor Beech Limited, the hayfields, pastures, and cultural meadows of Zone C lands are more likely than those of Zone B to constitute Significant Wildlife Habitat as raptor winter feeding and roosting areas.

8.6.1.8.3 Migratory butterfly stopover areas

The MNR (2000) describes migratory butterfly stopover areas as follows:

> In the fall, during the southward migration, some species of butterflies (Monarchs) stop to feed, rest, or wait for inclement weather conditions to pass before they attempt to cross Lake Ontario, Lake Erie, and Lake Huron. Preferred stopover areas provide an abundance of preferred nectar plants, as well as places for shelter and sunning. Potential stopover areas include fields and other open areas within 5 km of Lake Ontario, Lake Erie, or Lake Huron shorelines.

Zone B is located within 5 km of the Lake Ontario shoreline and includes a number of open areas that provide butterfly nectar plants, such as cultural meadows and meadow marsh. Accordingly, portions of Zone B may function as a migratory butterfly stopover area.

8.6.1.8.4 Habitat for area sensitive species

The MNR (2000) describes habitat for area sensitive species as follows:

> Some wildlife species require large areas of suitable habitat for their long-term survival. This seems to be particularly true for larger mammalian carnivores such as gray wolf, lynx, and fisher. On a smaller scale, many birds require substantial areas of suitable habitat for successful breeding and their populations decline when habitat becomes fragmented and reduced in size. Over time, competitive species, predators, and nest parasites (primarily the brown-headed cowbird) reduce productivity of these birds...
>
> The larger and least fragmented forest stands within a planning area will support the most significant populations of forest-area sensitive birds. Forests should cover about 30% of the regional landscape to provide minimal conditions for these species and there should be several large woodlands (30 to 100+ ha) present to provide enough suitable forest-interior bird nesting habitat. Forests comprised of a mainly closed canopy of large trees and a variety of vegetation layers tend to support a greater diversity of species because of the broader range of habitats they provide...
>
> For area-sensitive grassland bird species, large grassland areas are required as they are more likely to be buffered from disturbance, more likely to increase the distance of nesting habitat to woody edges (thereby reducing nest predation and parasitism), and provide more opportunities for nesting. An endangered species in Ontario, the Henslow's sparrow, appears to prefer tall-grass fields of at least 30 ha. Sufficient habitat is required for several breeding pairs before the habitat will be used, although one pair of birds may only use an area of 1 to 2 ha in size. Even more common grassland species such as bobolinks, savannah sparrows, and grasshopper sparrows are more abundant as breeding birds in grasslands of at least 10 ha. Grasslands with a variety of vegetation structure,

> density, and composition tend to support a greater diversity of grassland nesting birds because different species require different nesting habitat.
>
> Protecting significant woodlands as suggested in the Natural Heritage Section of the Provincial Policy Statement, will also maintain some critical habitat for area-sensitive forest species. The significant woodland component is closely linked to this important significant wildlife habitat. The largest, least-disturbed grasslands might also be identified for their value to area-sensitive grassland species and provision of further landscape diversity. Each planning area should protect representative examples of these habitats.

Nine species recorded from Zone B are considered by MNR (2000) to be area sensitive. Bobolink is discussed in detail in Section 6.1.1.1. As specific locality data is unavailable for most records of the other eight species, Aquafor Beech Limited used background information and the results of previous studies to determine (i) the habitat requirements of these species and (ii) the availability of potentially suitable habitat for these species in Zone B. Table 8.6 summarizes the results of this assessment.

The refined NHS incorporates all but one of the woodlands in Zone B that have the potential to function as habitat for area sensitive forest species. However, the refined NHS does not identify Woodland 6, the largest remaining woodland in SCUBE West, as a core area because it does not satisfy City of Hamilton criteria as a Significant Woodland. Rather, Woodland 6 has been identified as a candidate core area. As property access to the woodland was not granted during the course of this Study it is recommended that the woodland be investigated during subsequent planning stages, such as the secondary plan stage, to determine the ecological function and planning status of the woodland. Accordingly, the area of natural vegetation which links the south of Woodland 6 to the natural heritage features associated with Watercourse 7, has been marked as a candidate linkage area. Should it be determined that Woodland 6 is a core area, the natural area immediately south will qualify as a linkage.

In the opinion of Aquafor Beech Limited, the area in Zone B with the greatest potential to function as habitat for area sensitive grassland species is the portion of SCUBE Central east of Lewis Road. This area provides the largest block of grassland habitat (approximately 10 ha) in Zone B; surveys completed by North-South Environmental Incorporated in 2010 document its use by 10 individuals of three different area sensitive grassland species, including five Savannah Sparrows, three Bobolink and two Eastern Meadowlarks. However, the potential of this area to function long term as habitat for area sensitive grassland species is uncertain because:

- it is near the minimum size threshold required by several species;
- its suitability for some species may be degraded by the urbanization of adjacent lands; and
- it would require regular management (e.g. removal of trees and shrubs) to maintain suitable grassland habitat.

In the opinion of Aquafor Beech Limited, the cultural meadows of Zone C have greater potential to function long term as habitat for area sensitive grassland species because these areas:

- are as large or larger than similar grassland habitats in Zone B;
- abut fewer urban land uses and so are subject to less disturbance (e.g. predation by cats);
- are more likely to be regularly subject to activities (e.g. haying) that will maintain suitable grassland habitat; and
- are designated Escarpment Protection Area (EPA) under the Niagara Escarpment Plan, and, as such, are more likely to be maintained because the EPA designation does not permit large scale residential, industrial, commercial or recreational development.

As previously discussed in Section 8.6.1.1.1.1, North-South Environmental Incorporated recommends that the entire portion of the SCUBE Central lands east of Lewis Road be designated an Area Specific Policy Area (ASPA) pending MNR development of a species-specific regulation for protection of Bobolink habitat. Should the MNR confirm the ASPA as Bobolink habitat, Aquafor Beech Limited recommends that the NHS be revised to incorporate these lands as a Core Area. The potential incorporation in the refined NHS of other areas of cultural meadow within Zone B is considered further in Section 8.6.4 (Review and Refinement of Linkages) and Section 8.6.6 (Enhancement of Core Areas and Linkages).

It is noted that breeding bird studies completed in 2012 by Stantec Consulting Limited concluded that there is no breeding evidence for avian species at risk, including Bobolink, previously identified within the Subwatershed Study Area (see Appendix I).

Table 8.6: Area sensitive species recorded from Zone B.

Species	Habitat Requirements	Availability of Potentially Suitable Habitat in Zone B
American Redstart *Setophaga ruticilla*	Primarily a species of deciduous understory and woodland edges. Preferred habitat includes open and semi-open deciduous and mixed forests; tends to avoid fully mature forests (OBBA 2007).	The revised NHS incorporates the largest areas of potentially suitable forest habitat in Zone B, including Woodland 1 (primarily mid-aged Green Ash Forest as well as deciduous plantation) and Woodland 5 (lowland deciduous forest dominated by Crack Willow and Black Walnut). The revised NHS includes Woodland 6, which consists of less suitable mature Shagbark Hickory forest, as a potential core area. The status of Woodland 6 is to be determined at a subsequent planning stage.
Blue-gray Gnatcatcher *Polioptila caerulea*	In Ontario, this species favours open-canopied, deciduous swamp and floodplain forests. It nests in a variety of deciduous woodlands, often in close proximity to water and at the edges of openings (OBBA 2007).	The revised NHS incorporates all deciduous swamps identified in Zone B (Wetlands 1, 2, 3, 4 and 7) as well as the largest areas of deciduous woodland in close proximity to water, including Woodland 1 (mid-aged Green Ash Forest and deciduous plantation adjacent to Watercourse 6.0) and Woodland 5 (lowland deciduous forest dominated by Crack Willow and Black Walnut adjacent to Fifty Creek).
Hairy Woodpecker *Picoides villosus*	Large blocks of mature deciduous forest are preferred; small isolated woodlots do not provide desirable habitat and the species becomes uncommon in landscapes dominated by farm, suburban or urban habitats (OBBA 2007).	The revised NHS incorporates two of the largest areas of potentially suitable forest habitat in Zone B, including Woodland 1 (primarily mid-aged Green Ash Forest as well as deciduous plantation) and Woodland 5 (lowland deciduous forest dominated by Crack Willow and Black Walnut The revised NHS includes Woodland 6 (mature Shagbark Hickory forest) as a potential core area. The status of Woodland 6 is to be determined at a subsequent planning stage. Woodland 6 may provide potentially suitable habitat for Hairy Woodpecker; however, the species was not recorded in Woodland 6 by Dillon Consulting Limited (2010).
Ovenbird *Seiurus aurocapillus*	Breeds in the interior of larger tracts of mature deciduous and mixed forest (OBBA 2007).	The revised NHS incorporates two of the largest areas of potentially suitable forest habitat in Zone B, including Woodland 1 (primarily mid-aged Green Ash Forest as well as deciduous plantation) and Woodland 5 (lowland deciduous forest dominated by Crack Willow and Black Walnut). The revised NHS includes Woodland 6 (mature Shagbark Hickory forest) as a potential core area. The status of Woodland 6 is to be determined at a subsequent planning stage. Woodland 6 may provide potentially suitable habitat for Ovenbird; however, the species was not recorded in Woodland 6 by Dillon Consulting Limited (2010).
Scarlet Tanager *Piranga olivacea*	Prefers mature deciduous forests, especially those dominated by larger trees. May also occur in mixed forests and younger deciduous habitats (OBBA 2007).	The revised NHS incorporates two of the largest areas of potentially suitable forest habitat in Zone B, including Woodland 1 (primarily mid-aged Green Ash Forest as well as deciduous plantation) and Woodland 5 (lowland deciduous forest dominated by Crack Willow and Black Walnut). The revised NHS includes Woodland 6 (mature Shagbark Hickory forest) as a potential core area. The status of Woodland 6 is to be determined at a subsequent planning stage. Woodland 6 may provide potentially suitable habitat for Scarlet Tanager; however, the species was not recorded in Woodland 6 by Dillon Consulting Limited (2010).

Species	Habitat Requirements	Availability of Potentially Suitable Habitat in Zone B
Savannah Sparrow *Passerculus sandwichensis*	In southern Ontario this species breeds primarily in grassy meadows, pastures, cultivated fields (especially alfalfa) and along roadsides. Habitat often includes scattered small trees or shrubs (OBBA 2007). More abundant as breeding birds in grasslands of at least 10 ha (MNR 2000). NatureServe Explorer (2011) and references therein note the following: • Savannah Sparrow may occupy small (less than 5 ha) areas of suitable habitat (Potter 1972); • Jones and Vickery (1997) suggest that minimum grassland size is 8-16 ha; • In Illinois, Herkert (1991) found no Savannah Sparrows on grasslands less than 10 ha in size; • Incidence of Savannah Sparrow increased with area and reached 50% at about 10 ha in Maine (Vickery et al. 1994) and 40 ha in Illinois (Herkert 1994). • Wiens (1969) noted that most breeding territories are located in the center of grassland habitats, away from cultivated fields and fence lines; • Sample (1989) found a negative correlation between abundance and percent shrub cover.	Large areas of cultural meadow exist throughout Zone B but most are bisected by roads, hedgerows or other habitat types into blocks less than 10 ha in size.
Eastern Meadowlark *Sturnella magna*	Prefers native grasslands but will nest in pastures and cultivated fields, particularly those in alfalfa and hay. Also uses old fields and meadows, often overgrown with shrubs. Prefers dry habitat to wet and tall grass to short. Occasionally will use other areas such as golf courses or sand dunes (OBBA 2007). More abundant as breeding birds in grasslands of at least 10 ha (MNR 2000). NatureServe Explorer (2011) and references therein suggest that minimum grassland size is 6-8 ha (Jones and Vickery 1997).	Large areas of cultural meadow exist throughout Zone B but most are bisected by roads, hedgerows or other habitat types into blocks less than 10 ha in size. Breeding bird studies completed in 2012 by Stantec Consulting Limited concluded that suitable breeding habitat for Eastern Meadowlark is not present within the SCUBE East parcels; no Eastern Meadowlark were observed in SCUBE East.
Grasshopper Sparrow *Ammodramus savannarum*	Prefers drier, sparsely vegetated grasslands, particularly rough or unimproved pastures, at least 30 ha in size and supporting varying amounts of forb and shrub growth. Will occasionally use cultivated hay fields and cereal crops (OBBA 2007). More abundant as breeding birds in grasslands of at least 10 ha (MNR 2000). NatureServe Explorer (2011) and references therein note the following: • In Colorado, Grasshopper Sparrows were about three times more abundant in interior grasslands than in areas less than 200 m from suburban development (Bock et al. in press). • In Minnesota tallgrass prairie, nest depredation and Brown-headed Cowbird brood parasitism decreased farther from woody edges, and nest depredation rates were lower on large (130-486 ha) than on small (16-32 ha) grasslands (Johnson and Temple 1990).	Large areas of cultural meadow exist throughout Zone B but most are bisected by roads, hedgerows or other habitat types into blocks less than 10 ha in size.

8.6.1.8.5 Forests providing a high diversity of habitats

The MNR (2000) describes forests providing a high diversity of habitats as follows:

> Forests with a variety of vegetation communities and dominant tree cover are most likely to have the highest diversity of plant and wildlife species. Complexes of upland and wetland habitats also may have high diversity.
>
> Many species of wildlife such as squirrels, and cavity-nesting birds like pileated woodpeckers, barred owls, and wood ducks use large trees with hollow cavities to bear and raise young. These trees can also provide resting or loafing habitat for mammals like raccoon and porcupine. Older forest stands usually have more cavity trees and support a higher diversity of species than young stands. Best sites contain a mix of large and small tree cavities. Cavities in living trees are generally better than those in dead trees because they last longer. Some tree species make better cavity trees than others do. For example, species such as red pine or white birch break down very quickly and are of limited use for cavities.
>
> Very tall trees, such as white pine, that grow above the main canopy (supercanopy trees), provide important habitat for birds of prey, that may use these trees for nests, roosts, and hunting perches.
>
> Forests with numerous vertical layers of vegetation also contribute greatly to site diversity because of the many microhabitats they provide for wildlife. In addition, an abundance of ground structure such as large fallen logs and leaf litter further enhances a site's ability to support wildlife. Fallen logs are essential habitat for some salamanders, members of the weasel family, certain woodpeckers, and many invertebrate species.

The NHS as revised above incorporates as Core Areas most forested areas within Zone B because they constitute Significant Woodlands or Wetlands as defined by the City of Hamilton (2009). However, the NHS does not include as a Core Area the Shagbark Hickory deciduous forest located in the vicinity of the intersection of Barton Street and Glover Road (Woodland 6) because, due to property access restrictions during this Study, it could not be determined if the woodland met the City of Hamilton criteria as a Significant Woodland. Accordingly, it is recommended that the woodland be subject to appropriate study during subsequent planning stages so that the ecological function of the woodland is known, and planning status determined. Until further studies are completed, Woodland 6 is included in the NHS as a potential core area.

8.6.1.8.6 Amphibian woodland breeding ponds

The MNR (2000) describes amphibian woodland breeding ponds as follows:

> These ponds are used for breeding by several species of frogs and salamanders. Such water bodies may be small and ephemeral but nevertheless, important to local amphibian populations, especially if they provide the only suitable habitat in the area.
>
> The best breeding ponds are unpolluted, and contain a variety of vegetation structure, both in and around the edge of the pond, for egg-laying and calling by frogs. The best adjacent habitats are closed-canopy woodlands with rather dense undergrowth that maintains a damp environment. Moist fallen logs are another important habitat component required by salamanders. Sites with several ponds and/or ponds close to creeks are especially valuable.

As noted above, the refined NHS incorporates as Core Areas most forested areas within Zone B except for the Shagbark Hickory deciduous forest located in the vicinity of the intersection of Barton Street and Glover Road (Woodland 6). As mentioned above in Section 8.6.1.8.5, Woodland 6 is included in the NHS as a potential core area. The status of Woodland 6 is to be determined at a subsequent planning stage after the ecological function of the woodland has been evaluated.

8.6.1.8.7 Habitats for species of conservation concern

A number of locally rare species previously recorded from Zone B are also designated Endangered, Threatened or Special Concern by COSEWIC and/or COSSARO. These species are not considered further as their habitat is addressed by Aquafor Beech Limited recommendations for COSEWIC- and/or COSSARO-designated species at risk.

Twenty-seven locally rare species not designated species at risk by COSEWIC and/or COSSARO have previously been recorded from Zone B. As specific locality data is unavailable for most records of these species, Aquafor Beech Limited used background information and the results of previous studies to determine (i) the habitat requirements of these species and (ii) the availability of potentially suitable habitat for these species in Zone B. Table 8.7 summarizes the results of this assessment.

Zone B does not provide potentially suitable habitat for three of the 27 locally rare species, including Tickle Grass (*Agrostis hyemalis*), Black-crowned Night Heron (*Nycticorax nycticorax*) and Yellow-rumped Warbler (*Dendroica coronata*). The specimen of Tickle Grass previously recorded from Zone B was likely misidentified, while the records of the latter two species likely

represent incidental observations. Zone B does provide potentially suitable habitat for the other 24 locally rare species. However, the extent to which the revised NHS incorporates this habitat, and the availability of other areas of potentially suitable habitat beyond Zone B, vary from species to species. Accordingly, the 24 locally rare species can be divided into the following three categories:

Category 1 – the revised NHS incorporates most of the vegetation communities in Zone B that provide potentially suitable habitat for these species.

Category 2 – the revised NHS incorporates few of the vegetation communities in Zone B that provide potentially suitable habitat for these species; however, the same vegetation communities occur in Zone C and immediately adjacent lands and have similar or greater potential to function as habitat for these species.

Category 3 - the revised NHS incorporates some of the vegetation communities in Zone B that provide potentially suitable habitat for these species; however, the same vegetation communities occur in Zone C and immediately adjacent lands and have similar or greater potential to function as habitat for these species. These species may also use anthropogenic habitat, such as suburban yards, orchards, agricultural lands and/or industrial parks. Such habitat is located in throughout the study area of the SCUBE Subwatershed Study.

Table 8.8 classifies the 24 locally rare species based on the above three categories.

Table 8.7: Locally rare species not designated species at risk by COSEWIC and/or COSSARO recorded in Zone B.

Taxon	Species	Habitat Requirements	Availability of Potentially Suitable Habitat in Zone B
Plants	Blue Beech *Carpinus caroliniana*	Typically an understory tree located in moist woods and swamps. NHIC (2011) indicates the species is common and widespread nationally (N5) and provincially (S5); local rarity is most likely due to the relative rarity of this species' habitat in the greater landscape.	The revised NHS incorporates all deciduous swamps identified in Zone B (Wetlands 1, 2, 3, 4 and 7) as well as the largest areas of deciduous woodland in close proximity to water, including Woodland 1 (mid-aged Green Ash Forest and deciduous plantation adjacent to Watercourse 6.0) and Woodland 5 (lowland deciduous forest adjacent to Fifty Creek).
	Eastern Few-fruited Sedge *Carex oligocarpa*	Occurs in mesic or dry-mesic deciduous forests, usually in calcium-rich loams on rocky slopes above streams. Sensitive to disturbance. (http://labs1.eol.org/pages/1123782?category_id=17)	The revised NHS incorporates the largest, least disturbed deciduous woodlands near streams in Zone B, including Woodland 1 (Green Ash Forest/deciduous plantation adjacent to Watercourse 6.0) and Woodland 5 (lowland deciduous forest adjacent to Fifty Creek). However, the revised NHS does not incorporate the largest woodland in SCUBE West, Woodland 6 (mature Shagbark Hickory forest). Woodland 6 is included in the NHS as a potential core area. The status of Woodland 6 is to be determined at a subsequent planning stage after the ecological function of the woodland has been evaluated.
	Hardstem Bulrush *Schoenoplectus acutus var. acutus* (previously *Scirpus acutus*)	This species is most often found in calcareous to brackish marshes, slow streams, fens, and lakes; it is often emergent in water up to 1.5 m deep (Flora North America Vol. 23 Pages 48-49). NHIC (2011) indicates that the species is common and widespread nationally (N5) and provincially (S5); local rarity is most likely due to the relative rarity of this species' habitat in the greater landscape.	The revised NHS incorporates most areas of habitat in Zone B that are potentially suitable for this species except Watercourse 5.2 and two small areas of meadow marsh in SCUBE West – Wetland 5 and Wetland 6.
	Perfoliate Bellwort *Uvularia perfoliata*	This species occurs in deciduous forests and thickets with acid-neutral soils (Flora North America Vol. 26 Pages 148, 150).	Dillon Consulting Limited (2010) completed spring surveys of suitable habitat in SCUBE West and found no occurrences of this species. However, potentially suitable habitat for this species is present in SCUBE Central, SCUBE East (Parcel A) and SCUBE East (Parcel B). The revised NHS incorporates Woodland 5, the largest area of deciduous forest in SCUBE East (Parcel B). Areas of cultural savannah, cultural thicket and cultural woodland which may provide suitable habitat for this species are located in SCUBE Central, SCUBE East (Parcel A) and SCUBE East (Parcel B). The revised NHS generally does not incorporate these habitats (see Sections 6.1.9 and 6.4).
	Prickly Rose *Rosa acicularis*	Typically found in open woodlands, meadows, open rocky areas, and thickets. May also occur in hedgerows (Voss 1985).	The revised NHS incorporates two of the largest areas of potentially suitable woodland habitat in Zone B, including Woodland 1 (primarily mid-aged Green Ash Forest as well as deciduous plantation) and Woodland 5 (lowland deciduous forest dominated by Crack Willow and Black Walnut). However, the revised NHS does not incorporate Woodland 6 (mature Shagbark Hickory forest). Woodland 6 is included in the NHS as a potential core area. The status of Woodland 6 is to be determined at a subsequent planning stage after the ecological function of the woodland has been evaluated. Meadows, thickets and hedgerows which may provide suitable habitat for this species are located in SCUBE West, SCUBE Central, SCUBE East (Parcel A) and SCUBE East (Parcel A). The revised NHS incorporates only a few of these features (see Section 6.11).

Taxon	Species	Habitat Requirements	Availability of Potentially Suitable Habitat in Zone B
	Spearscale *Atriplex patula*	Spearscale can occur in a variety of habitats including waste places. It is sometimes considered weedy, but is mostly intolerant of salinity and shade.	Potentially suitable habitat for the species exists throughout Zone B.
	Tickle Grass *Agrostis hyemalis*		Specimen reported by Dillon Consulting Limited (2010) is most likely a misidentification/mislabelling of *A. scabra* or *A. hyemalis* var. *tenuis*. The only occurrence of *A. hyemalis* in Ontario is on Pelee Island.

Taxon	Species	Habitat Requirements	Availability of Potentially Suitable Habitat in Zone B
Birds	American Kestrel *Falco sparverius*	Typical habitat includes open country, including grasslands, forest edges and clearings. In recent decades, the species has increasingly taken to nesting in cities, favouring not only green spaces but also industrial parks (OBBA 2007).	Potentially suitable habitat for the species exists throughout Zone B.
	American Redstart *Setophaga ruticilla*	Primarily a species of deciduous understory and woodland edges. Preferred habitat includes open and semi-open deciduous and mixed forests; it tends to avoid fully mature forests (OBBA 2007).	The revised NHS incorporates the largest areas of potentially suitable forest habitat in Zone B, including Woodland 1 (primarily mid-aged Green Ash Forest as well as deciduous plantation) and Woodland 5 (lowland deciduous forest dominated by Crack Willow and Black Walnut). The revised NHS does not incorporate Woodland 6, which consists of less suitable mature Shagbark Hickory forest. Woodland 6 is included in the NHS as a potential core area. The status of Woodland 6 is to be determined at a subsequent planning stage after the ecological function of the woodland has been evaluated.
	Belted Kingfisher *Ceryle alcyon*	Areas in the vicinity of streams, rivers, and lakes (OBBA 2007).	There are no lakes in Zone B. With the exception of Watercourse 5.2, the revised NHS incorporates all watercourses in Zone B and the vegetation communities immediately adjacent to these watercourses, including Wetlands 1, 2, 3, 4 and 7 and Woodlands 2 and 5.
	Black-crowned Night-heron *Nycticorax nycticorax*	Within the City of Hamilton the Black-crowned Night-heron is a fairly common summer resident and very uncommon winter resident. Breeding is uncommon and occurs in restricted locations. In Hamilton, Black-crowned Night Heron is found in various locations mostly around Hamilton Harbour (Curry 2006).	Potentially suitable habitat for the species does not exist in Zone B.
	Blue-gray Gnatcatcher *Polioptila caerulea*	In Ontario, this species favours open-canopied, deciduous swamp and floodplain forests. It nests in a variety of deciduous woodlands, often in close proximity to water and at the edges of openings (OBBA 2007).	The revised NHS incorporates all deciduous swamps identified in Zone B (Wetlands 1, 2, 3, 4 and 7) as well as the largest areas of deciduous woodland in close proximity to water, including Woodland 1 (mid-aged Green Ash Forest and deciduous plantation adjacent to Watercourse 6.0) and Woodland 5 (lowland deciduous forest dominated by Crack Willow and Black Walnut adjacent to Fifty Creek).
	Clay-coloured Sparrow *Spizella pallida*	Open shrubland, second-growth abandoned fields and young evergreen plantations (Hughes 2001).	Potentially suitable habitat for the species exists throughout Zone B. A small (approximately 0.5 ha) immature coniferous plantation is located in SCUBE West; the revised NHS does not incorporate this vegetation unit.
	Eastern Bluebird *Sialia sialis*	Found in a variety of habitats including agricultural lands, forest clearings, old fields, golf courses and large lawns (Hughes 2001). Will nest in almost any area with short vegetation as long as suitable nest cavities are available (OBBA 2007).	Potentially suitable habitat for the species exists throughout Zone B.
	Grasshopper Sparrow *Ammodramus savannarum*	Prefers drier, sparsely vegetated grasslands, particularly rough or unimproved pastures, at least 30 ha in size and supporting varying amounts of forb and shrub growth. Will occasionally use cultivated hay fields and cereal crops (OBBA 2007).	Large areas of cultural meadow exist throughout Zone B but most are bisected by roads, hedgerows or other habitat types into blocks less than 10 ha in size.

Taxon	Species	Habitat Requirements	Availability of Potentially Suitable Habitat in Zone B
	Hairy Woodpecker *Picoides villosus*	Large blocks of mature deciduous forest are preferred; small isolated woodlots do not provide desirable habitat and the species becomes uncommon in landscapes dominated by farm, suburban or urban habitats (OBBA 2007).	The revised NHS incorporates two of the largest areas of potentially suitable forest habitat in Zone B, including Woodland 1 (primarily mid-aged Green Ash Forest as well as deciduous plantation) and Woodland 5 (lowland deciduous forest dominated by Crack Willow and Black Walnut). However, the revised NHS does not incorporate Woodland 6 (mature Shagbark Hickory forest). Woodland 6 is included in the NHS as a potential core area. The status of Woodland 6 is to be determined at a subsequent planning stage after the ecological function of the woodland has been evaluated.Woodland 6 may provide potentially suitable habitat for Hairy Woodpecker; however, the species was not recorded in Woodland 6 by Dillon Consulting Limited (2010).
	Herring Gull *Larus argentatus*	Beaches, lakes, farmland and garbage dumps (Hughes 2001).	There are no beaches or lakes in Zone B. Farmland exists throughout Zone B.
	Mourning Warbler *Oporornis philadelphia*	Prefers fairly open, early successional habitats with a dense understory. Breeds in recently disturbed and regenerating coniferous and mixed forests, including hydro rights-of-way and roadsides (OBBA 2007).	No conifer or mixed forest is present in Zone B. However, a variety of open, early successional habitat (i.e. cultural thicket, cultural savannah and cultural woodland) exists throughout Zone B.
	Northern Mockingbird *Mimus polyglottos*	Habitat includes suburban gardens, orchard and woodland edges, hedges and thickets (Hughes 2001).	Potentially suitable habitat for the species exists throughout Zone B.
	Orchard Oriole *Icterus spurius*	Orchards, hedgerows, open woods, cemeteries, golf courses, oak savannahs, and open riparian forests are all used as breeding habitat, especially if water is nearby (OBBA 2007).	Potentially suitable habitat for the species exists throughout Zone B. With the exception of Watercourse 5.2, the revised NHS incorporates all watercourses in Zone B and the vegetation communities immediately adjacent to these watercourses, including Woodlands 2 and 5.
	Purple Martin *Progne subis*	Breeds near human settlements where nest houses are provided, especially near water and large open areas. In eastern North America it has nested almost exclusively in nest boxes for more than 100 years (Brown 1997).	Potentially suitable habitat for the species exists throughout Zone B. With the exception of Watercourse 5.2, the revised NHS incorporates all watercourses in Zone B and the vegetation communities immediately adjacent to these watercourses.
	Red-bellied Woodpecker *Melanerpes carolinus*	Mature deciduous forest with high basal areas, many large-diameter trees and snags (OBBA 2007).	The revised NHS incorporates two of the largest areas of potentially suitable forest habitat in Zone B, including Woodland 1 (primarily mid-aged Green Ash Forest as well as deciduous plantation) and Woodland 5 (lowland deciduous forest dominated by Crack Willow and Black Walnut). However, the revised NHS does not incorporate Woodland 6 (mature Shagbark Hickory forest). Woodland 6 is included in the NHS as a potential core area. The status of Woodland 6 is to be determined at a subsequent planning stage after the ecological function of the woodland has been evaluated. Woodland 6 may provide potentially suitable habitat for Red-bellied Woodpecker; however, the species was not recorded in Woodland 6 by Dillon Consulting Limited (2010).

Taxon	Species	Habitat Requirements	Availability of Potentially Suitable Habitat in Zone B
	Scarlet Tanager *Piranga olivacea*	Prefers mature deciduous forests, especially those dominated by large trees, but may also occupy mixed forests and younger deciduous habitats (OBBA 2007).	The revised NHS incorporates two of the largest areas of potentially suitable forest habitat in Zone B, including Woodland 1 (primarily mid-aged Green Ash Forest as well as deciduous plantation) and Woodland 5 (lowland deciduous forest dominated by Crack Willow and Black Walnut). However, the revised NHS does not incorporate Woodland 6 (mature Shagbark Hickory forest). Woodland 6 is included in the NHS as a potential core area. The status of Woodland 6 is to be determined at a subsequent planning stage after the ecological function of the woodland has been evaluated. Woodland 6 may provide potentially suitable habitat for Scarlet Tanager; however, the species was not recorded in Woodland 6 by Dillon Consulting Limited (2010).
	Turkey Vulture *Cathartes aura*	Forages over mixed farmland, open woodland and swamps. Nests in caves, cliffs and hardwood forests (Hughes 2001). Frequently observed along the Niagara Escarpment, which attracts the species with its thermals and ready accessibility of numerous nest sites (OBBA 2007).	Potentially suitable foraging habitat for the species exists throughout Zone B. Nesting is more likely to occur along the Niagara Escarpment than within Zone B.
	White-throated Sparrow *Zonotrichia albicollis*	Openings and edges in coniferous and mixed forests (OBBA 2007).	No coniferous or mixed forest is present in Zone B. However, a variety of open, early successional habitat (i.e. cultural thicket, cultural savannah and cultural woodland) exists throughout Zone B.
	Yellow-rumped Warbler *Dendroica coronata*	Prefers mature coniferous and mixed coniferous-deciduous forests, including conifer plantations. It is a generalist and will use whatever conifer species is present (OBBA 2007).	No coniferous or mixed forest is present in Zone B. A small (approximately 0.5 ha) immature coniferous plantation is located in SCUBE West; the revised NHS does not incorporate this vegetation unit.
Amphibians	Red-spotted Newt *Notophthalmus viridescens viridescens*	Adults and larvae occur in permanent and semi-permanent water bodies, including ponds, small lakes, marshes, ditches and quiet portions of streams; the terrestrial eft stage occurs in moist forests and other upland habitats (Conant and Collins 1998).	The revised NHS incorporates all potential habitat for this species within Zone B except for two small areas of meadow marsh in SCUBE West – Wetland 5 and Wetland 6.

Table 8.8: Categories of 24 locally rare species. See text above for clarification.

Category 1	Category 2	Category 3
Blue Beech	Perfoliate Bellwort	Spearscale
Eastern Few-fruited Sedge	Prickly Rose	American Kestrel
Hardstem Bulrush	Clay-coloured Sparrow	Eastern Bluebird
American Redstart	Grasshopper Sparrow	Herring Gull
Belted Kingfisher	Mourning Warbler	Northern Mockingbird
Blue-gray Gnatcatcher	White-throated Sparrow	Orchard Oriole
Hairy Woodpecker		Purple Martin
Red-bellied Woodpecker		Turkey Vulture
Scarlet Tanager		
Red-spotted Newt		

The refined NHS incorporates most of the vegetation communities in Zone B that provide potentially suitable habitat for Category 1 species. However, the refined NHS does not incorporate Woodland 6, the largest remaining woodland in SCUBE West, as a core area. Rather, as a conservative measure Woodland 6 is included in the NHS as a potential core area. The status of Woodland 6 is to be determined at a subsequent planning stage after the ecological function of the woodland has been evaluated.Woodland 6 has the potential to function as habitat for a number of locally rare species previously recorded from Zone B, such as Eastern Few-fruited Sedge, American Redstart and Red-bellied Woodpecker.

The refined NHS incorporates few of the vegetation communities in Zone B that provide potentially suitable habitat for Category 2 species (i.e. cultural meadow, cultural thicket and cultural woodland). However, Zone C and the immediately adjacent lands to the east between Highway 8 and the Niagara Escarpment consist of a similar mosaic of cultural vegetation communities and agricultural land as is found in SCUBE West, SCUBE Central, SCUBE East (Parcel A) and SCUBE East (Parcel B). In the opinion of Aquafor Beech Limited, the cultural vegetation communities of Zone C and the immediately adjacent lands to the east have similar or greater potential to function long term as habitat for Category 2 species because they:

- are as large or larger than those of Zone B;
- abut fewer urban land uses and so are subject to less disturbance (e.g. predation by cats);

- are more likely to be regularly subject to activities (e.g. haying) that will maintain suitable early successional habitat; and
- are designated Escarpment Protection Area (EPA) under the Niagara Escarpment Plan, and, as such, are more likely to be maintained because the EPA designation does not permit large scale residential, industrial, commercial or recreational development.

The refined NHS incorporates some of the vegetation communities in Zone B that provide potentially suitable habitat for Category 3 species (e.g. riparian forest) but not others (e.g. cultural thicket). However, Zone C and the immediately adjacent lands to the east between Highway 8 and the Niagara Escarpment consist of a similar mosaic of cultural vegetation communities and agricultural land as is found in SCUBE West, SCUBE Central, SCUBE East (Parcel A) and SCUBE East (Parcel B). In the opinion of Aquafor Beech Limited, the cultural vegetation communities of Zone C and the immediately adjacent lands to the east have similar or greater potential to function long term as habitat for Category 3 species because they:

- are as large or larger than those of Zone B;
- abut fewer urban land uses and so are subject to less disturbance (e.g. predation by cats);
- are more likely to be regularly subject to activities (e.g. haying) that will maintain suitable early successional habitat; and
- are designated Escarpment Protection Area (EPA) under the Niagara Escarpment Plan, and, as such, are more likely to be maintained because the EPA designation does not permit large scale residential, industrial, commercial or recreational development.

In the opinion of Aquafor Beech Limited, no further measures to protect the habitat of Category 3 species are warranted, as these species use a range of anthropogenic habitat, including suburban yards, orchards, agricultural lands and industrial parks and such areas are located throughout the study area of the SCUBE Subwatershed Study.

8.6.1.9 Sand barrens, savannahs and tallgrass prairies

The preliminary NHS was reviewed to confirm the inclusion of sand barrens, savannahs and tallgrass prairies as defined by the City of Hamilton (2009). Sand barrens and tallgrass prairies are not present in the study area of the SCUBE Subwatershed Study (City of Hamilton 2009). However, Natural Resources Solutions Incorporated identified two vegetation units characterized by the Ecological Land Classification System for Southern Ontario as Cultural Savannah

(CUS1). One unit is located in Block A1, the other in SCUBE Central (Figure 8.9).

The City of Hamilton (2009) defines savannah as follows:

> Land (not including land that is being used for agricultural purposes or no longer exhibits savannah characteristics) that:
>
> (a) has vegetation with a significant component of non-woody plants, including tallgrass prairie species that are maintained by seasonal drought, periodic disturbances including fire, or both;
>
> (b) has from 25 per cent to 60 per cent tree cover;
>
> (c) has mineral soils; and,
>
> (d) has been further identified, by the Ministry of Natural Resources or by any other person according to evaluation procedures established by the Ministry of Natural Resources, as amended from time to time.

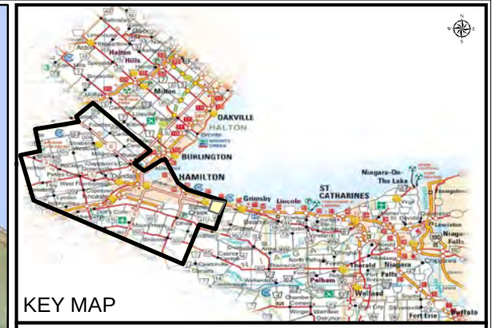
In the opinion of Aquafor Beech Limited, the two vegetation units identified by Natural Resources Solutions Incorporated consist of mid-successional regenerating agricultural lands and do not constitute savannah as defined by the City of Hamilton (2009). Accordingly, Aquafor Beech Limited did not revise the preliminary NHS to incorporate these units as Core Areas.

8.6.1.10 Alvars

Within Zone B, the preliminary NHS was reviewed to confirm the inclusion of alvars as defined by the City of Hamilton (2009). Alvars are not present in the study area of the SCUBE Subwatershed Study (City of Hamilton 2009).

8.6.2 Review and Refinement of Core Areas (Key Hydrologic Features)

Aquafor Beech Limited reviewed and revised the preliminary NHS for the study area of the SCUBE Subwatershed Study to incorporate all Key Hydrologic Features as defined by the City of Hamilton (2009), including (i) permanent and intermittent streams, (ii) lakes (and their littoral zones) and (iii) wetlands. No seepage areas and/or springs have been identified in the study area of the SCUBE Subwatershed Study.



LEGEND:

- Study Area - SCUBE East Subwatershed Study
- Land Under Consideration for Urban Development
- Urban – Not Subject to Policies of Greenbelt Plan
- Woodlands Assessed as Core Areas
- Woodlands Assessed as Not Core Areas

ELC Vegetation Community

- CUW1 (Mineral Cultural Woodland)
- FOD4 (Dry-Fresh Deciduous Forest)
- FOD7 (Moist Lowland Deciduous Forest)

NOTES:

0 125 250 500 750 1,000
Meters

Hamilton

Aquafor Beech Limited

Development of Natural Heritage System Woodlands

SCUBE EAST

FIGURE No. 8.9

DATE: February 23, 2012

8.6.3 Review and Refinement of Core Areas (Local Natural Areas)

Aquafor Beech Limited reviewed the preliminary NHS for the study area of the SCUBE Subwatershed Study to confirm the inclusion of all Local Natural Areas as defined by the City of Hamilton (2009) including (i) Environmentally Significant Areas as identified by the City of Hamilton, (ii) unevaluated wetlands and (iii) Earth Science Areas of Natural and Scientific Interest.

Two City of Hamilton-designated Environmentally Significant Areas are located within the study area of the SCUBE Subwatershed Study, including Devil's Punch Bowl Escarpment ESA (ESA 54) and Fifty Creek Valley ESA (ESA 80). The preliminary NHS incorporates both. No Earth Science Areas of Natural and Scientific Interest are located within the study are of the SCUBE Subwatershed Study.

8.6.4 Review and Refinement of Linkages

Within Zone B, the preliminary NHS, as revised above, was reviewed to confirm the inclusion of Linkages as defined by the City of Hamilton (2009).

Aquafor Beech Limited reviewed vegetation units characterized by Dillon Consulting Limited (2010) or Natural Resources Solutions Incorporated (2009) using the Ecological Land Classification System for Southern Ontario and identified one Woodland Linkage (Woodland Linkage 1) and 17 Linkages of other natural vegetation types (Table 8.9) not previously mapped by the City of Hamilton (2009). Figures 8.10 and 8.11 illustrate these Linkages.

The incorporation of Woodland Linkage 1 and the 17 Linkages of other natural vegetation types in the refined NHS was reviewed based on City of Hamilton methodology. Woodland Linkage 1 was not incorporated in the refined NHS because it is located more than 30 m from Watercourse 5.0 and does not provide a significant riparian linkage function. Table 8.10 describes the extent to which the 17 Linkages of other natural vegetation types were incorporated in the refined NHS. This review also resulted in the incorporation in the refined NHS of two wetland units as Linkages of other natural vegetation types, including the following:

- Wetland 4, a deciduous swamp located along Watercourse 5.0 immediately downstream of Wetland 1 (Figure 8.4).
- Wetland 7, a deciduous swamp located along Watercourse 6.0 immediately downstream of Highway 8 (Figure 8.4).

The incorporation in the refined NHS of Wetlands 4 and 7 as Linkages of other vegetation types reflects the limited amount of riparian wetland remaining in SCUBE West.

Aquafor Beech Limited also identified two areas in SCUBE West that do not satisfy the City of Hamilton (2009) definition of Linkage but are shown as such in the preliminary NHS (Figure 8.1). These areas include the following:

- a mature Shagbark Hickory deciduous forest unit located in the vicinity of the intersection of Barton Street and Glover Road. This vegetation unit (Woodland 6) is the largest remaining woodland in SCUBE West but does not constitute a Woodland Linkage because it does not connect or lie within 100 m of a Core Area (Figure 8.10). Woodland 6 is included in the NHS as a potential core area. The status of Woodland 6 is to be determined at a subsequent planning stage after the ecological function of the woodland has been evaluated.

- an irregularly-shaped area located immediately north of Highway 8 and west of Watercourse 7.0 that incorporates portions of vegetation units characterized by Dillon Consulting Limited (2010) as deciduous woodlot and rural property. The deciduous woodlot does not constitute a Woodland Linkage because it is less than 0.5 ha in size; the remaining portion does not constitute a Linkage of other vegetation type because it does not consist of natural vegetation.

Accordingly, Aquafor Beech Limited has not included the latter area in the preliminary NHS.

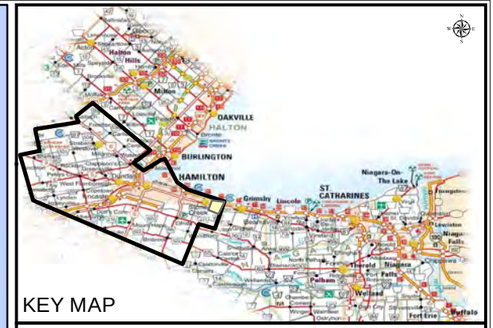
Table 8.9: Linkages of other natural vegetation types as defined by the City of Hamilton (2009) within Zone B.

Designation	Composition (ELC)	Location
Linkage 1	Fresh-Moist Mixed Meadow (MEMM4)	SCUBE West
Linkage 2	Fresh-Moist Mixed Meadow (MEMM4)	SCUBE West
Linkage 3	Fresh-Moist Mixed Meadow (MEMM4)	SCUBE West
Linkage 4	Native Deciduous Regeneration Thicket (THDM4-1)	SCUBE West
Linkage 5	Fresh-Moist Mixed Meadow (MEMM4)	SCUBE West
Linkage 6	Forb Meadow (MEF)	SCUBE West
Linkage 7	Hawthorn (dogwood/buckthorn) Deciduous Scrub Thicket	SCUBE West
Linkage 8	Hawthorn (dogwood/buckthorn) Deciduous Scrub Thicket	SCUBE West
Linkage 9	Hawthorn (dogwood/buckthorn) Deciduous Scrub Thicket	SCUBE West
Linkage 10	Mineral Cultural Meadow (CUM1-1)	Block A
Linkage 11	Mineral Cultural Meadow (CUM1-1)	SCUBE East (Parcel A)
Linkage 12	Grey Dogwood Cultural Thicket (CUT1-4)	SCUBE East (Parcel A) and Block B2
Linkage 13	Mineral Cultural Meadow (CUM1-1)	SCUBE East (Parcel B)
Linkage 14	Mineral Cultural Meadow (CUM1-1)	SCUBE East (Parcel B)
Linkage 15	Mineral Cultural Meadow (CUM1-1)	SCUBE East (Parcel B)
Linkage 16	Mineral Cultural Meadow (CUM1-1)	SCUBE East (Parcel B)
Linkage 17	Mineral Cultural Meadow (CUM1-1)	SCUBE East (Parcel B)

Table 8.10: Linkages of other natural vegetation types as defined by the City of Hamilton (2009) within Zone B.

Designation	Incorporated in Refined NHS?	Rationale
Linkage 1	No	Does not provide a significant riparian linkage function as it is located more than 30 m from Watercourse 5.0.
Linkage 2	Only portions within 30 m of Watercourse 5.0	Portions of Linkage 2 located within 30 m of Watercourse 5.0 contribute to its hydrologic function. Remaining portions were not incorporated in the refined NHS because they do not contribute significantly to the hydrologic function of Watercourse 5.0.
Linkage 3	No	Does not provide a significant riparian linkage function as it is located more than 30 m from Watercourse 5.0.
Linkage 4	Yes	
Linkage 5	Yes	
Linkage 6	No	Does not provide a significant riparian linkage function as it is located more than 30 m from Watercourse 6.0; does not provide significant habitat.
Linkage 7	No	Vegetation provides low-quality habitat that does not promote plant or wildlife movement along Watercourse 6.0.
Linkage 8	No	Does not provide a significant riparian linkage function as it is located more than 30 m from Watercourse 6.0 and Watercourse 7.0; habitat is disturbed and is not considered significant.
Linkage 9	No	Vegetation is disturbed and does not promote plant or wildlife movement along Watercourse 6.0 or Watercourse 7.
Linkage 10	No	Located within lands that have already received draft plan approval under the Planning Act.
Linkage 11	No	Located within lands that have already received draft plan approval under the Planning Act.

Designation	Incorporated in Refined NHS?	Rationale
Linkage 12	No	Located within lands that have already received draft plan approval under the Planning Act.
Linkage 13	No	Located within lands that have already received draft plan approval under the Planning Act.
Linkage 14	No	Located within lands that have already received draft plan approval under the Planning Act.
Linkage 15	No	Located within lands that have already received draft plan approval under the Planning Act.
Linkage 16	No	Located within lands that have already received draft plan approval under the Planning Act.
Linkage 17	No	Located within lands that have already received draft plan approval under the Planning Act.



LEGEND:

- Study Area - SCUBE East Subwatershed Study
- Land Under Consideration for Urban Development
- Cultural Savannah
- Urban – Not Subject to Policies of Greenbelt Plan

NOTES:

0 125 250 500 750 1,000
Meters

Hamilton

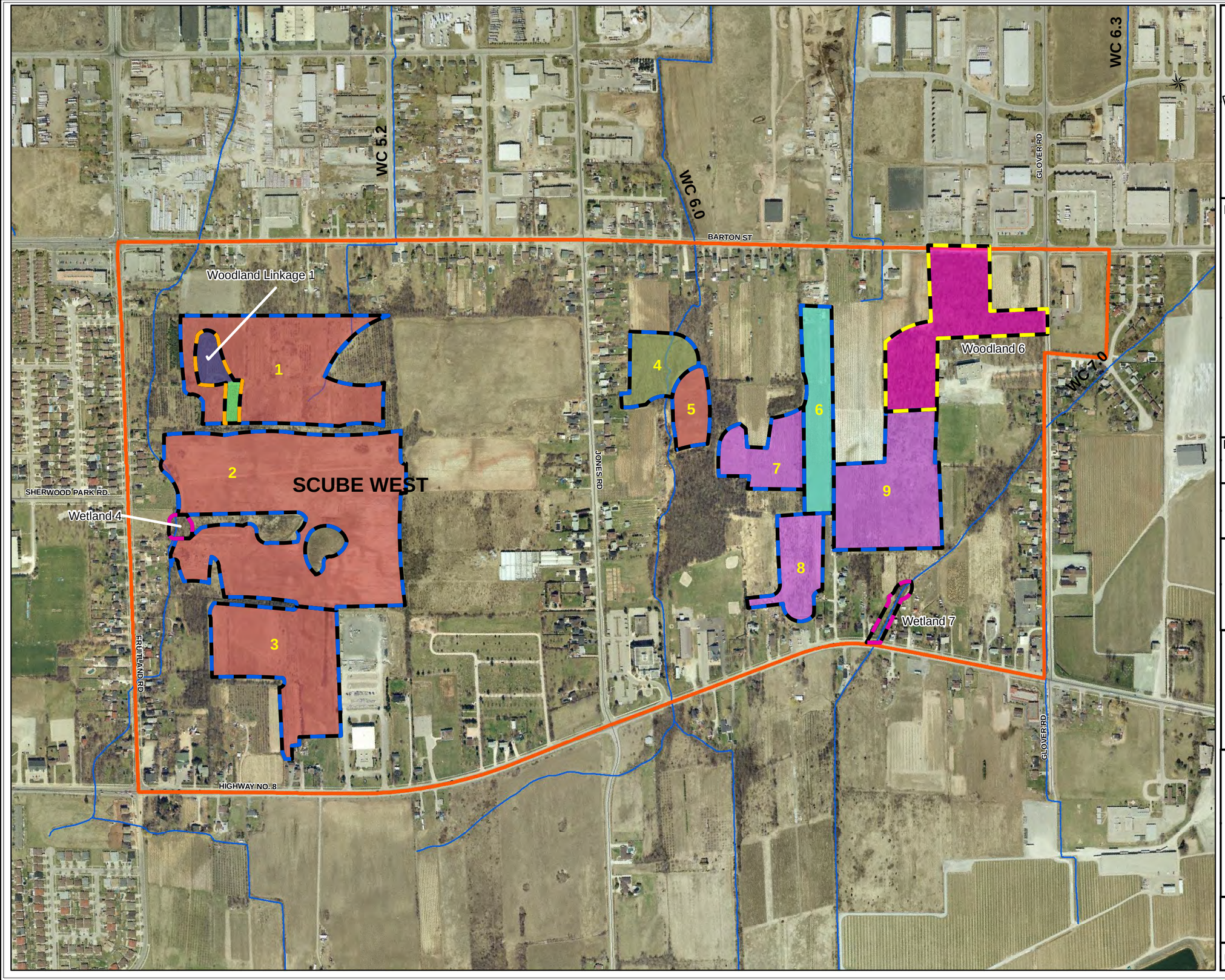
Aquafor Beech Limited

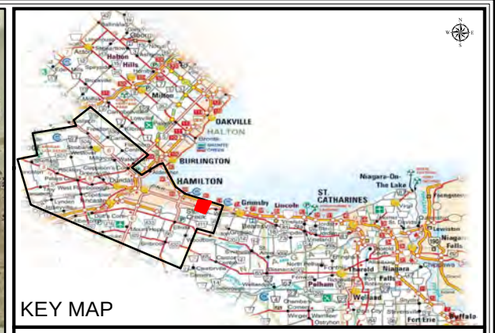
Development of Natural Heritage System Sand Barrens, Savannahs and Tallgrass Prairies

SCUBE EAST

FIGURE No. 8.10

DATE: February 23, 2012





KEY MAP

LEGEND:

- Land Under Consideration for Urban Development
- Assessed as Woodland Linkage
- Woodland Assessed as Not Core Areas
- Linkage of Other Natural Vegetation Type
- Assessed as Linkage of Other Natural Vegetation Type

ELC Vegetation Community

- FODM9-4 (Fresh Moist Shagbark Hickory Deciduous Forest)
- MEF (Forb Meadow)
- MEMM4 (Fresh-Moist Mixed Meadow)
- TAGM1 (Coniferous Plantation)
- TAGM3 (Deciduous Plantation)
- THDM2-11 (Hawthorn (dogwood/buckthorn)
- THDM4-1 (Native Deciduous Regeneration Thicket)

NOTES:

0 100 200 400
Meters

Hamilton

Aquafor Beech Limited

Development of Natural Heritage System Linkages

SCUBE WEST

FIGURE No. 8.11

DATE: February 23, 2012

8.6.5 Hazardous Lands

Within Zone B and the immediately downstream lands where Watercourse 7.0 extends through a remnant area of deciduous forest, the preliminary NHS, as revised above, was further refined to incorporate hazardous lands as defined by Hamilton Conservation Authority (2009). This includes (i) lands within the flood plain of the Regulatory Flood as previously determined by Aquafor Beech Limited and (ii) lands within the erosion hazard limit as approximated by a preliminary meander belt assessment (Appendix H). Final erosion hazard limits are to be determined through future studies.

8.6.6 Vegetation Protection Zones

Within Zone B, the preliminary NHS, as revised above, was further refined to incorporate preliminary vegetation protection zones consistent with the minimum requirements of the City of Hamilton Official Plan (Table 8.11). The widths of these preliminary VPZ are to be reviewed at a subsequent planning stage and may be increased based on the recommendations of an approved Environmental Impact Statement. Figures 8.12 and 8.13 illustrate the NHS as recommended by Aquafor Beech Limited and the associated vegetation protection zones.

8.6.7 Enhancement of Core Areas and Linkages

The recommended NHS was reviewed to identify opportunities to enhance the attributes of constituent Core Areas and Linkages by restoring/creating natural cover (e.g. tree planting). Attributes of Core Areas considered for enhancement include size, completeness, shape and potential for connectivity. Attributes of Linkages considered for enhancement include ecological function, scale, and crossing opportunities. A full list of the attributes of Core Areas and Linkages considered for enhancement is provided by Tables 3-2 and 3-3 of the NHRM, respectively (MNR 2010).

Aquafor Beech Limited identified a number of opportunities to enhance the watercourses within the study area of the SCUBE Subwatershed Study. Table 8.12 outlines these opportunities. Opportunities to enhance the terrestrial elements of the NHS within Zone B are described below.

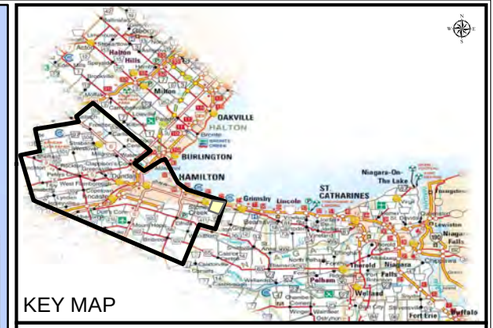
Table 8.11: City of Hamilton minimum vegetation protection zone requirements; adapted from City of Hamilton (2009).

Core Area	Vegetation Protection Zone (VPZ) Requirements
Coldwater Watercourse	30 m VPZ on each side of the watercourse, measured from the bankfull channel.
Critical Fish Habitat	30 m VPZ on each side of the watercourse, measured from the bankfull channel.
Warmwater Watercourse	15 m VPZ on each side of the watercourse, measured from the bankfull channel.
Important/Marginal Fish Habitat	15 m VPZ on each side of the watercourse, measured from the bankfull channel.
Provincially Significant Wetlands	30 m VPZ, measured from the boundary of the wetland, as approved by the Conservation Authority or MNR.
Locally Significant Wetlands	30 m VPZ, measured from the boundary of the wetland, as approved by the Conservation Authority or MNR.
Unevaluated wetlands > 2 ha in size	30 m VPZ, measured from the boundary of the wetland, as approved by the Conservation Authority or MNR.
Unevaluated wetlands ≤ 2 ha in size	30 m VPZ, unless an Environmental Impact Statement recommends a more appropriate VPZ.
Woodlands	10 m VPZ, measured from the edge (drip line) of the woodland.
Significant woodlands	15 m VPZ, measured from the edge (drip line) of the significant woodland.
ANSI	Life and Earth Science ANSIs require a 15 m VPZ.
Valleylands	As required by the relevant Conservation Authority.

Table 8.12: Opportunities to enhance the watercourses within the study area of the SCUBE Subwatershed Study.

Watercourse	Zone A	Zone B	Zone C
5.0	• To the extent possible, extend riparian areas and increase their degree of naturalness through the removal of invasive, exotic species and the planting of native species. • Assess the feasibility of mitigating the barrier to fish movement at the QEW culvert. Consider culvert replacements at the CNR and South Service Road crossings to improve water quality and the possibility of fish migration • Secure banks and improve aquatic habitat through riparian plantings at erosion points. • Consider opportunities to reconnect flood plain access upstream of the QEW per Section 3.2.4.4.2 of the SCUBE West Subwatershed Study: Phase 1 and Phase 2 Final Report. • Incorporate riparian habitat enhancements with recommended stream restoration works between Arvin Avenue and the QEW. •	• The existing culvert at the proposed east-west road crossing south of Barton Street should be replaced; the use of an open-bottom culvert should be considered to facilitate fish passage. • Secure banks and improve aquatic habitat through riparian plantings at erosion points. • Assess the feasibility of replacing the deteriorated culvert at Barton Street and Fruitland Road. • Incorporate riparian habitat enhancements with planned relocation of Watercourse 5.0 within Zone B.	• Riparian habitat corridor and linkage enhancements to improve downstream aquatic habitat, bank stability, stream shading and wildlife linkages. Potential enhancement opportunities to be investigated include: o A minimum 15 m natural vegetation protection zone should be applied to each bank of the sinuous channel; o Revegetate riparian areas with the objective to restore 50-75% of the corridors with self-sustaining woody vegetation.
6.0	• To the extent possible, extend riparian areas and increase their degree of naturalness through the removal of invasive, exotic species and the planting of native species. • Heavily eroded banks between the QEW and the CN rail line would benefit from riparian plantings.Assess the feasibility of culvert replacements at the CNR crossing to improve water quality and the possibility of fish migration. • Consider opportunities to reconnect flood plain access upstream of the QEW (SCUBE West Subwatershed Study: Phase 1 and Phase 2 Final Report, Section 3.2.4.4.2). • Incorporate riparian habitat enhancements with recommended stream restoration works between the QEW and Barton Street. •	• Assess opportunities to improve the ecological function of Watercourse 6.0 through plantings along its east bank immediately downstream of Highway 8. • Secure banks and improve aquatic habitat through riparian plantings at erosion points. • Assess the feasibility of replacing the deteriorated culvert at Barton Street	• Riparian habitat corridor and linkage enhancements to improve downstream aquatic habitat, bank stability, stream shading and wildlife linkages. Potential enhancement opportunities to be investigated include: o Widen watercourse corridor to allow channel to retain sinuous form; o A minimum 15 m natural vegetation protection zone should be applied to each bank of the sinuous channel; o Revegetate riparian areas with the objective to restore 50-75% of the corridors with self-sustaining woody vegetation. o

Watercourse	Zone A	Zone B	Zone C
7.0	• Riparian plantings along erosion points on the west bank between the QEW and Barton Street would improve aquatic habitat and increase bank stability. • Assess the feasibility of eliminating the grade control structure at the CN rail line to increase the possibility of fish migration upstream. • Incorporate riparian habitat enhancements with planned channel capacity improvements between the QEW and Barton Street.	• The existing culvert at the proposed east-west road crossing upstream of Glover Road should be replaced; the use of an open-bottom culvert should be considered to facilitate fish passage. • The City of Hamilton should explore opportunities to encourage stewardship of watercourses. Potential measures include providing support for the purchase of riparian plantings and facilitating the development/distribution of educational/interpretive materials.	• Riparian habitat corridor and linkage enhancements to improve downstream aquatic habitat, bank stability, stream shading and wildlife linkages. Potential enhancement opportunities to be investigated include: o Widen watercourse corridor to allow channel to retain sinuous form; o A minimum 15 m natural vegetation protection zone should be applied to each bank of the sinuous channel; o Revegetate riparian areas with the objective to restore 50-75% of the corridors with self-sustaining woody vegetation. o
9.0	• Incorporate a minimum 15 m wide vegetation protection zone along each side of the proposed channel improvements along the West Tributary of Watercourse 9. • Assess the feasibility of eliminating the barrier to fish movement at the QEW.	NOT APPLICABLE	NOT APPLICABLE
Fifty Creek	• Assess the feasibility of eliminating the barrier to fish movement at the QEW.	• To the extent possible, enhance 30 m VPZ with riparian plantings throughout Zone B.	• Riparian habitat corridor and linkage enhancements to improve downstream aquatic habitat, bank stability, stream shading and wildlife linkages. Potential enhancement opportunities to be investigated include: o Widen watercourse corridor to allow channel to retain sinuous form; o A minimum 15 m natural vegetation protection zone should be applied to each bank of the sinuous channel; o Revegetate riparian areas with the objective to restore 50-75% of the corridors with self-sustaining woody vegetation. o • Assess the feasibility of eliminating the barrier to fish movement at the Highway 8 east tributary crossing.



KEY MAP

LEGEND:

- Study Area - SCUBE East Subwatershed Study
- Land Under Consideration for Urban Development
- Assessed as Linkages of Other Natural Vegetation Type
- Urban – Not Subject to Policies of Greenbelt Plan

ELC Vegetation Community

- CUM1-1 (Mineral Cultural Meadow)
- (Grey Dogwood Cultural Thicket)

NOTES:

0 125 250 500 750 1,000
Meters

Hamilton

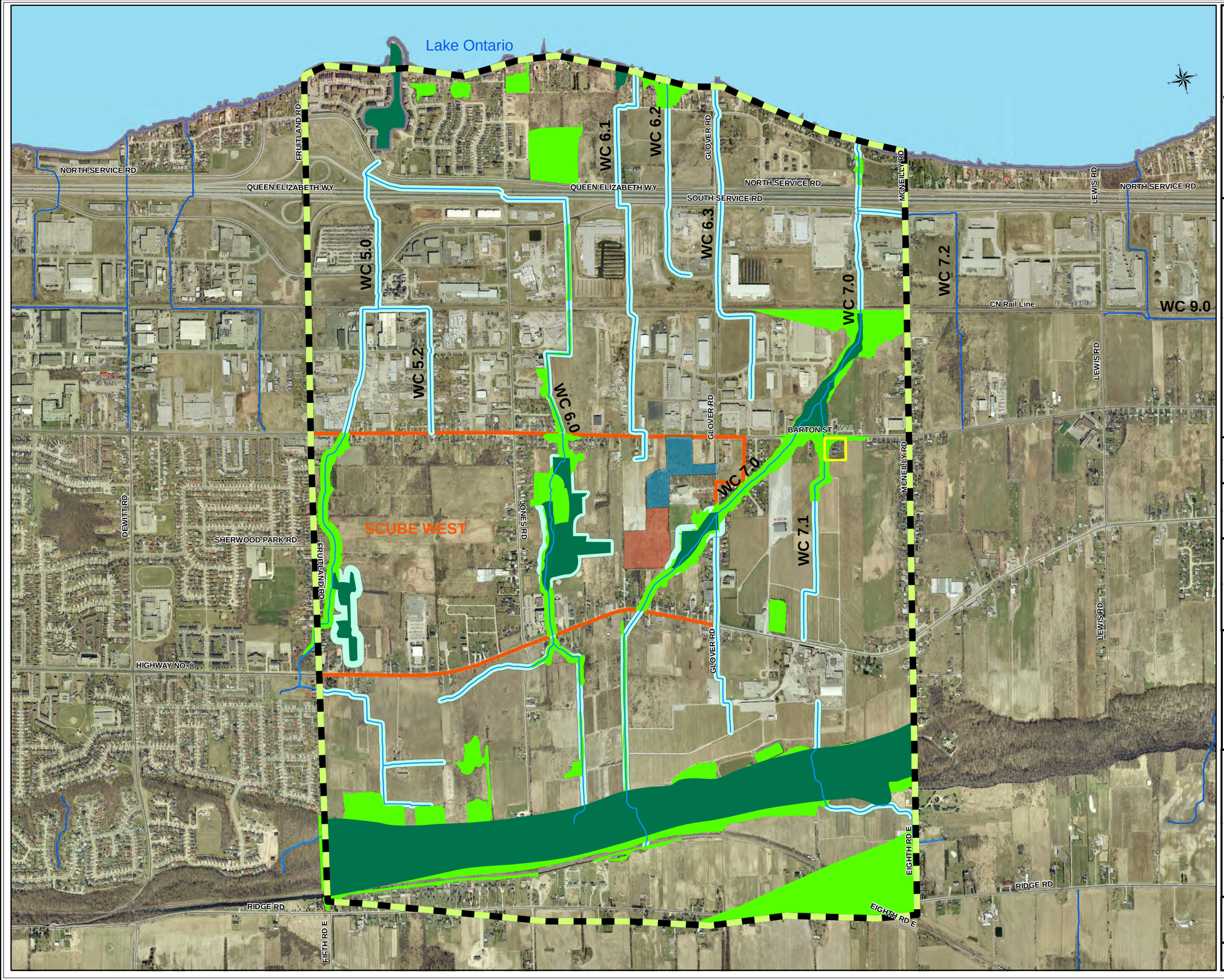
Aquafor Beech Limited

Development of Natural Heritage System Linkages

SCUBE EAST

FIGURE No. 8.12

DATE: February 23, 2012



KEY MAP

LEGEND:

- Study Area Boundary - SCUBE West Subwatershed Study
- Land Under Consideration for Urban Development
- Urban – Not Subject to Policies of Greenbelt Plan
- Core Areas
- Linkage
- Vegetation Protection Zone (15 Meter Buffer)
- Watercourse
- Candidate Core Area
- Candidate Linkage

NOTES:

0 100 200 400 600 800 1,000

Meters

Hamilton

Aquafor Beech Limited

Recommended Natural Heritage System

SCUBE WEST

FIGURE No. 8.13

DATE: February 23, 2012

8.6.7.1 Wetlands Associated with Watercourse 5

Two wetlands (Wetlands 1 and 4) are associated with Watercourse 5.0. Wetland 1 is a Core Area and consists primarily of deciduous swamp with a small lobe of meadow marsh extending from its northeast corner. Wetland 4 is a Linkage of Other Natural Vegetation Type and consists of a small block of deciduous swamp located approximately 50 m downstream of Wetland 1. Wetlands are not widely represented in SCUBE West, and as such those that form part of the recommended NHS should be protected from potential negative effects of future development. To this end, Aquafor Beech Limited recommends three enhancement measures as described below.

(1) The northern and southern portions of Wetland 1 are connected by a narrow corridor approximately 30 m wide. Aquafor Beech Limited recommends that enhancement plantings be used to widen this corridor and consolidate Wetland 1 as a single wetland block.

(2) To increase the diversity of adjacent habitats, Aquafor Beech Limited recommends that active restoration be used to convert the cultural meadow located between the two northern lobes of Wetland 1 to thicket or woodland.

(3) Fruitland Road is proposed to be realigned to the east of Wetland 1 in the future. Consequently this Core Area will be bound to the east and west by roads and possibly other urban development. The swamp and marsh communities that comprise Wetland 1 likely support Western Chorus Frog (*Pseudacris triseriata*, Carolinian population) and the light and noise from future land uses have the potential to disrupt the breeding patterns of this species. To enhance the edge habitat of Wetland 1 and attenuate light and noise from existing (i.e. residential housing) and future land uses, Aquafor Beech Limited recommends that wet-tolerant native evergreen trees such as Eastern White Cedar (*Thuja occidentalis*) be planted in parallel offset rows approximately three-four trees deep as a component of a vegetated buffer to Wetland 1.

8.6.7.2 Core Areas Associated with Watercourse 6

Woodland 2 is a Core Area located adjacent to a number of different habitat types including thicket (Linkage 4), meadow (Linkage 5), deciduous swamp (Wetland 2) and Watercourse 6.0. The proximity of Woodland 2 to these other habitat types increases its significance to wildlife; the NHRM (MNR 2000) and the Significant Wildlife Habitat Technical Guide (MNR 2000) both note that areas containing a diversity of habitats and/or having a diversity of habitat types in close proximity are more valuable than those that are uniform or removed from dissimilar

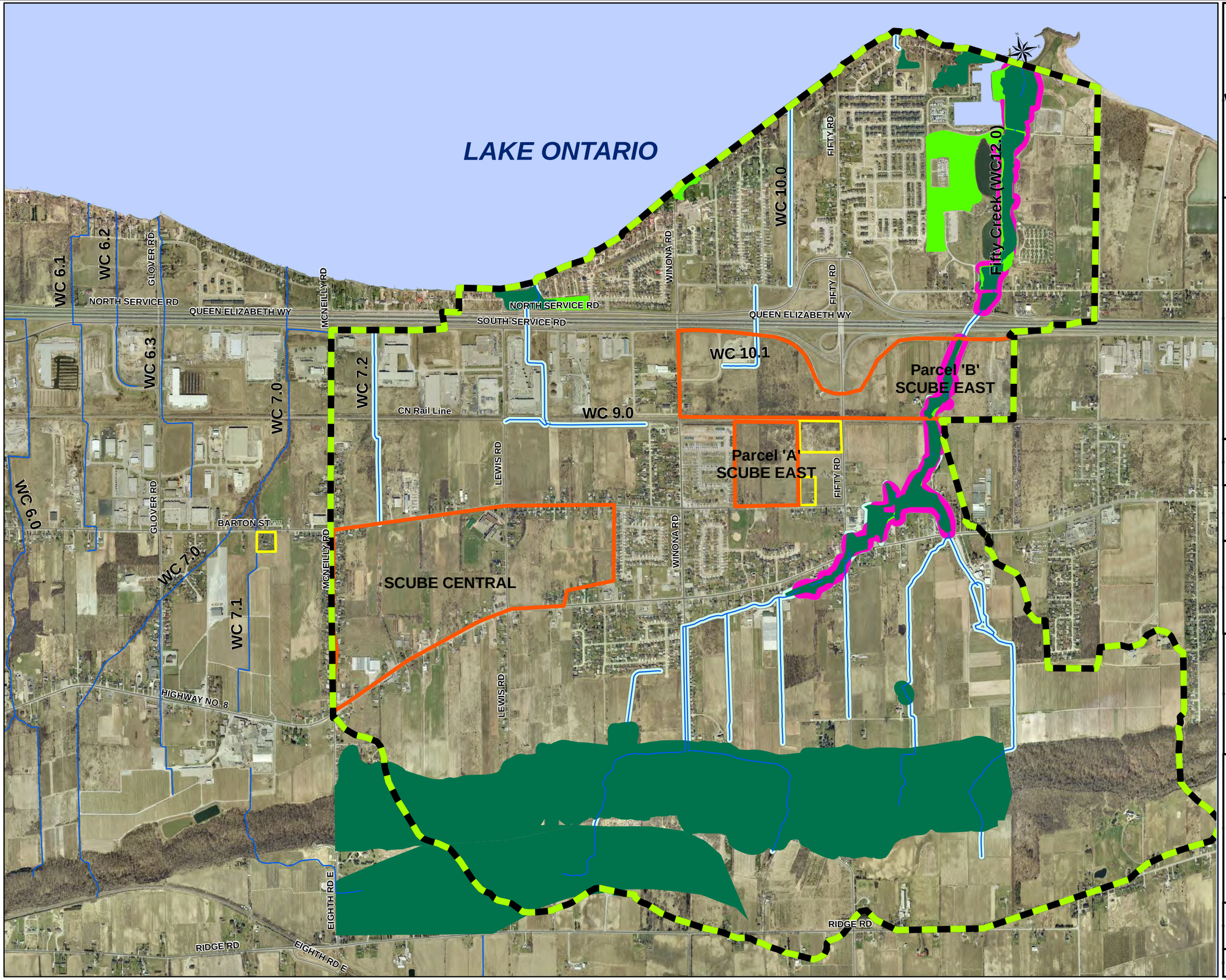
habitats. Accordingly, Woodland 2 is the focus of several proposed enhancements.

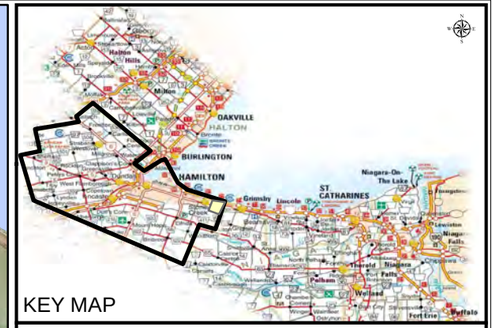
Two pinch points link the three forest lobes that together comprise Woodland 2. Pinch Points A and B (Figure 8.14) are located adjacent to the northeast and southeast corners of Linkage 5, respectively. As described below, the planting of native trees and shrubs in these areas would reduce the edge-interior ratio of Woodland 2 and also improve opportunities for wildlife movement. Plantings could include but are not necessarily limited to forest nucleation pods and banded buffer plantings.

Pinch Point A consists of a narrow strip of trees that connects the northern and middle lobes of Woodland 2. To facilitate wildlife movement, a portion of the meadow west of Pinch Point A (Linkage 5) should be reforested so that the forested connection between the two lobes is a minimum of 30 m wide. The majority of the meadow community would remain intact and continue to provide habitat for wildlife. Similarly, a portion of the thicket east and west of Pinch Point B (Linkage 7) should be reforested to connect the outer edges of the middle and southern lobes of Woodland 2. Additional forest-thicket interface exists further north at Linkage 4, and it is not anticipated that the habitat value of the NHS in the vicinity of Watercourse 6.0 would be adversely affected by the replacement of a small area of thicket with a forest community. In addition to decreasing its edge-interior ratio, recommended enhancement plantings at Pinch Points A and B would increase the forested area of Woodland 2 and make the immediate areas more attractive for north-south wildlife movement. Common edge effects such as adverse microclimate conditions due to wind and sunlight, and infiltration of exotic species would also be locally minimized.

A second Core Area, Wetland 2, is located along Watercourse 6.0. A vineyard and orchard currently abut the western edge of Wetland 2. These anthropogenic habitats provide some buffer function to Wetland 2. However, if the lands east of Jones Road are subject to further urban development, Aquafor Beech Limited recommends that enhanced buffers be established along the entire western edge of Wetland 2.

Lastly, woody riparian plantings should be installed along Watercourse 6 from Highway 8 downstream to Woodland 2 to establish a buffer (vegetation protection zone). Ideally the vegetation protection zone would be 15 m wide on either side of the watercourse, however, given the existing development in the vicinity of this portion of Watercourse 6, the 15 m width may not be attainable. Species selection should account for the potential impacts of salt spray from Highway 8.





LEGEND:

- Study Area - SCUBE East Subwatershed Study
- Land Under Consideration for Urban Development
- Urban – Not Subject to Policies of Greenbelt Plan
- Core Areas
- Linkage
- Vegetation Protection Zone (30 Meter Buffer)
- Vegetation Protection Zone (15 Meter Buffer)
- Watercourse

NOTES:

0 125 250 500 750 1,000
Meters

Hamilton

Aquafor Beech Limited

Recommended Natural Heritage System

SCUBE EAST

FIGURE No. 8.14

DATE: February 23, 2012

8.6.7.3 Wetlands Associated with Watercourse 7

One Core Area (Wetland 3) and one Linkage of Other Natural Vegetation Type (Wetland 7) are associated with Watercourse 7.0. Wetland 3 consists primarily of Willow deciduous swamp; a small lobe of Green Ash deciduous swamp extends from its western edge. Immediately downstream of SCUBE West, Watercourse 7.0 extends through a residential area; further downstream, between Barton Street and the CN rail line, Watercourse 7.0 flows through a deciduous forest community.

Aquafor Beech Limited recommends enhancement of the floodplain surrounding Wetland 3 and the riparian areas of Watercourse 7 between Highway 8 and Glover Road through the use of site-specific plantings. Enhancement plantings should consist of native trees and shrubs. Enhancement plantings between Highway 8 and Wetland 3 should encompass Wetland 7 and be wide enough to function ecologically as a riparian corridor, as connected habitat patches are more valuable than disjunct habitat patches (MNR 2010). Aquafor Beech Limited also recommends that the lands within the floodplain adjacent to Wetland 3 be subject to restoration consisting of nucleation pods planted in a gradient of concentration from the edge of Wetland 3 (higher concentration) outwards to the limits of the floodplain (lower concentration). Such a planting density gradient would mimic patterns of natural succession, providing habitat diversity within the ecotone and enhancing its potential use by wildlife (MNR 2000). Recommended riparian plantings would have the added benefit of improving water quality and enhancing aquatic habitat.

8.6.7.4 SCUBE Central

Given the current uncertainty surrounding the identification of Bobolink habitat for the purposes of the Endangered Species Act (2007), specific enhancement/restoration measures are not recommended for SCUBE Central at this time.

8.6.7.5 Woodland 5

A single Core Area (Woodland 5) is located within SCUBE East. Woodland 5 consists of deciduous forest that extends along Fifty Creek from Lake Ontario to immediately south of Highway 8. The edge-interior ratio of Woodland 5 is relatively high. Core areas with a low edge-interior ratio are more valuable ecologically than those with a high ratio (MNR 2010).

Accordingly, Aquafor Beech Limited recommends restoration of portions of Woodland 5 to improve (i.e. reduce) its edge-interior ratio.

Reforestation efforts within Woodland 5 appear to have already taken place between South Service Road and the CN rail line. Further reforestation efforts are not recommended in the adjacent cultural meadow to the east (Linkage 17) due to the presence in this area of Eastern Meadowlark, a nationally and provincially Threatened grassland species. Instead, reforestation efforts should be concentrated in canopy gaps and along forest edges south of the railroad tracks and west of Bridgman Lane. It is worth noting that buffer plantings along forest edges would likely fill a substantial portion of the exterior forest edges recommended above for reforestation. To save costs and minimize disruption of sensitive habitat, reforestation efforts within Woodland 5 could also be coordinated with riparian habitat enhancement within the 30 m VPZ associated with Watercourse 7.

Aquafor Beech Limited also recommends investigation of opportunities to enhance connectivity between the southern limit of Woodland 5 and the Niagara Escarpment. Linkages should built on wildlife movement pathways associated with existing hedgerows and watercourses, and should be enhanced through continuous tree and shrub plantings to a minimum total width of 30 m. To the extent possible, these linkages should incorporate other areas of retained natural vegetation.

8.6.7.6 Watercourses 5 and 6

Watercourses 6 and 7 originate in the escarpment and drain north, ultimately draining to Lake Ontario. Upstream of Barton Street, both Watercourses exhibit a more natural form than downstream reaches where historical channel adjustments such as straightening, hardening and entrenchment have resulted in unstable channel conditions and highly degraded aquatic habitat. To help stabilize downstream reaches and improve aquatic habitat, Aquafor Beech Limited recommends stream restoration and riparian plantings on Watercourses 5 and 6 downstream of Barton Street. These works are intended to contribute to the enhancement of these watercourses so that they can function as direct fish habitat.

The proposed stream restoration works should include reconnecting flood plain access upstream of the QEW in areas of channel incision and mitigating any barriers to fish movement, both natural and anthropogenic. Also, native riparian plantings in extended riparian areas consisting of native woody vegetation will help increase the degree of naturalness while stabilizing eroded banks and improving water quality, stream shading and aquatic habitat.

8.6.7.7 Barriers to Fish Movement

Proposed watercourse restoration works and riparian plantings are intended to contribute to watercourse enhancement through the creation of direct fish habitat. However, if there are barriers to fish migration to upstream reaches, the enhancement works will not create direct habitat, but simply contribute to direct downstream habitat. Removal of barriers to fish migration is essential to converting indirect fish habitat to direct fish habitat.

Aquafor Beech Limited identified three culverts within the study area of the SCUBE East Subwatershed Study that represent a barrier to fish passage (Figure 8.6):

- Watercourse 9 – QEW culvert
- Fifty Creek – QEW culvert
- Fifty Creek (East Tributary) – Highway 8 culvert

Fifty Creek is classified direct fish habitat from Highway 8 downstream to Lake Ontario even though the QEW culvert acts as a barrier to fish migration, restricting the movement of fish from Lake Ontario to upstream reaches and segregating existing upstream populations. Removal or mitigation of this barrier would help facilitate the migration of fish to upstream reaches, improving aquatic habitat and population diversity while stabilizing population dynamics throughout Fifty Creek. Upstream of Highway 8, the East Tributary of Fifty Creek is classified indirect fish habitat. Removal or mitigation of the Highway 8 culvert may help facilitate fish migration upstream of Highway 8, converting indirect fish habitat to direct fish habitat. Watercourse 9 is also classified indirect fish habitat upstream of the QEW, functioning to support direct fish habitat downstream. As with Fifty Creek, removal or mitigation of the barrier to fish migration at the QEW may help improve aquatic habitat by facilitating fish migration and populating upstream reaches.

8.6.7.8 Zone C Riparian Habitat Enhancements

The Subwatershed Strategy recommends the enhancement of riparian habitat along Watercourses 5.0, 6.0, 7.0 and Fifty Creek between the Niagara Escarpment and Highway 8.

The objective of the recommended riparian habitat enhancements is to improve the ability of headwater reaches of Watercourses 5.0, 6.0, 7.0 and Fifty Creek to function as linkages between the Niagara Escarpment and Core Areas of the recommended NHS within Zone B, particularly

the Fifty Creek Valley Environmentally Significant Area. Recommended enhancements will improve opportunities for wildlife movement and enhance downstream aquatic habitat through increased bank stability and stream shading.

Site-specific restoration/planting plans should be prepared by a qualified professional (e.g. botanist, ecologist or landscape architect) to guide recommended riparian habitat enhancements. These may include restoration/enhancement plantings and/or the control of invasive species. The development of restoration/planting plans should be informed by the findings of the SCUBE Subwatershed Study. However, restoration/planting plans should also reflect new information derived from future studies and changes in COSEWIC/COSSARO status designations. Site-specific restoration/planting plans should account for the habitat requirements of species at risk and/or species of conservation concern, if present. Restoration/planting plans should also include recommendations to monitor the establishment/survival of enhancement plantings. Where possible, efforts should be made to incorporate adjacent natural areas into enhanced watercourse corridors.

8.7 Natural Heritage System Management

8.7.1 Trails

The Fruitland-Winona Secondary Plan draft preferred land use option identifies a conceptual trail network that includes the following:

- The Barton Street Pedestrian Promenade (BSPP) - a City of Hamilton-owned multi-use pathway located along the south side of Barton Street that is to connect public spaces such as schools and City Parks. Where possible, the BSPP is to encourage connections with adjacent natural areas, streets and trails.

- A multi-purpose pedestrian trail link that is to extend east of Jones Road to connect proposed Collector Road B and proposed Collector Road C (hereafter, Trail A).

It is anticipated that the City of Hamilton will complete an Environmental Impact Statement (i) to assess any proposed connection between the BSPP and elements of the SCUBE NHS and (ii) to determine the exact location, design and construction material requirements for Trail A. To guide the trail identification process, Aquafor Beech Limited recommends the following:

- Trails should avoid Core Areas of the SCUBE NHS.

- Per Section 2.5.14 of the City of Hamilton Urban Official Plan, trails should avoid the Vegetation Protection Zones associated with the Core Areas of the SCUBE NHS.
- The City of Hamilton should survey existing informal trails in and adjacent to the SCUBE NHS. Existing informal trails should generally be closed. Those in the vicinity of formal trails should be actively restored; others should be allowed to naturalize through passive regeneration.
- If desirable, existing informal trails should be formalized, provided that they are located in ecologically suitable locations.
- Trails should avoid confirmed and potential habitat for species at risk and locally rare species; consideration should be given to the incorporation of enhanced buffers where trails extend within 120 m of such habitat.
- The trail footprint should be kept to a minimum. Standard construction best management practices should be employed to minimize potential impacts to adjacent natural features; the timing of trail construction should also consider wildlife activities (e.g. nesting) that may be sensitive to human disturbance.

Aquafor Beech Limited does not support trails that would negatively impact the natural features or ecological functions of the SCUBE NHS. The Core Areas and Linkages located along Watercourse 6.0 comprise the single largest block of retained natural habitat within SCUBE West. To avoid fragmenting this block, Aquafor Beech Limited recommends that Trail A avoid its deciduous forest and wetland communities altogether. Ideally, Trail A would cross Watercourse 6.0 immediately upstream or downstream of Woodland 2. Alternatively, Aquafor Beech Limited recommends that Trail A cross Watercourse 6.0 immediately north of Wetland 2 and extend east through Woodland 2 along the interface of Linkages 4 and 5.

To minimize the potential impacts of future trail use on the SCUBE NHS, Aquafor Beech Limited further recommends the following:

- Trails should be well marked.
- Waste disposal bins should be provided in the vicinity of the trail.
- Interpretive signage (i.e. stay on marked trail, no dumping of yard waste) should be used to encourage the public to protect the SCUBE NHS.

8.7.2 Road Crossings

The Fruitland-Winona Secondary Plan draft preferred land use option identifies two new road crossings of watercourses within SCUBE West. Collector Road B is proposed to cross Watercourse 5.0 approximately 30 m north of Wetland 4. Collector Road C is proposed to cross

Watercourse 6.0 midway through Wetland 3. These proposed crossing locations are considered in greater detail below.

For the location of the proposed road crossing of Watercourse 5.0, Aquafor Beech Limited notes the following:

- No significant and/or sensitive aquatic habitat is present at the proposed crossing location.
- The riparian habitat at the proposed crossing location consists of a disturbance-tolerant cultural meadow community; woody vegetation is generally lacking.
- Watercourse 5.0 has previously been disturbed in the vicinity of the proposed road crossing location and is currently conveyed beneath an existing farm land through a steel pipe approximately 1.5 m in diameter.
- Watercourse 5.0 is relatively straight at the proposed road crossing location; this configuration should permit location of the crossing structure perpendicular to the direction of flow.

Although significant and/or sensitive aquatic habitat is not present at the location of the proposed road crossing of Watercourse 7.0, Aquafor Beech Limited notes the following:

- The proposed crossing bisects a relatively significant/sensitive deciduous swamp (Wetland 3).
- The proposed crossing is located upstream of a previously disturbed reach of Watercourse 7.0 where it is currently conveyed beneath an existing pedestrian crossing through a corrugated steel pipe culvert approximately 60 cm in diameter.
- Watercourse 7.0 is relatively straight at the proposed road crossing location; however, the existing channel would need to be realigned to set the crossing structure perpendicular to the direction of flow.

Wetlands are not widely represented in SCUBE West and as such those that form part of the SCUBE NHS should be protected from the potential negative effects of future development to the extent possible. Accordingly, Aquafor Beech Limited recommends the following:

- To the extent possible, the proposed road crossing of Watercourse 5.0 should be located as far north of Wetland 4 as possible to avoid potential indirect impacts. Such impacts could include the loss of wetland vegetation from changes in hydrology or contamination of the wetland by salt spray.

- The location of the proposed road crossing of Watercourse 7.0 should be reconsidered. Aquafor Beech Limited recommends that Collector Road C intersect Glover Road north of Wetland 3. This option would require Collector Road C to extend across the cultural thicket at the southern limit of Woodland 6 but would avoid fragmentation of Wetland 3. A second, less preferable option would be for Collector Road C to cross Watercourse 7.0 immediately upstream of Wetland 3. This option would also avoid fragmentation of Wetland 3, but would largely nullify efforts to improve connectivity between Wetland 3 and Wetland 7 through the recommended enhancement of the floodplain between Highway 8 and Glover Road.
- Should the location of the currently proposed road crossing of Watercourse 7.0 be confirmed, the feasibility of installing wildlife crossing structures for amphibians and other terrestrial mesofauna should be explored to mitigate impacts (i.e. wildlife road mortality and habitat fragmentation).

The structures required for the proposed road crossings will be determined at the detailed design stage. The type of crossing structure to be used will be based on site-specific conditions. From a hydraulics perspective, watercourse crossings should have adequate openings to convey design flows with the required freeboard and clearances without increasing floodwaters in the existing channel upstream of the structure and without increasing the erosion and scour potential downstream.

8.7.3 Stewardship

Aquafor Beech Limited recommends that the City of Hamilton develop educational materials to encourage local stewardship of the SCUBE NHS. In particular, Aquafor Beech Limited recommends that City of Hamilton prepare an education brochure to distribute to residents within the planning area of the Fruitland-Winona Secondary Plan. Such brochures should:

- Emphasize the importance of conserving retained natural areas in urbanizing landscapes.
- Provide an overview of the significant natural heritage features and functions of the SCUBE NHS.
- Provide specific recommendations to residents to promote environmental stewardship. Topics to be addressed could include (i) the proper means to dispose of organic and hazardous waste; (ii) recommended measures to avoid recreational impacts (e.g. stay on designated trails), (iii) examples of encroachment and their potential impact on retained natural areas, (iv) the importance of keeping cats indoors and dogs on a leash; (v) the use native species rather than invasive exotics in landscaping; and (vi) the proper use of pesticides.

- Outline the environmental responsibilities of the City of Hamilton, developers and local residents.
- Promote opportunities for resident participation in the management and restoration of retained natural areas.
- Provide contact information for sources of additional information and support for stewardship efforts, such as the Hamilton-Halton Watershed Stewardship Program and the Hamilton Landowner Stewardship Council.

Opportunities to restore and enhance natural areas exist throughout the SCUBE Subwatershed. In the interest of long-term environmental recovery and sustainability, Aquafor Beech Limited encourages the City of Hamilton, Hamilton Conservation Authority and other relevant agencies to engage communities, organizations and other interest groups in support of Stewardship projects throughout the Subwatershed. Opportunities to engage community partners such as the Hamilton-Wentworth Stewardship Council, ReLeaf Hamilton, the Hamilton Naturalists Club, and the Field and Stream Rescue Team should be investigated.
Aquafor Beech Limited has identified three stewardship initiatives that would be beneficial to the recovery, enhancement and long-term sustainability of the SCUBE Subwatershed:

1) Encourage landowners to avoid cutting grass to the edge of a watercourse and to help maintain naturally vegetated riparian areas. Healthy riparian areas will help maintain aquatic habitat health and water quality while providing habitat for terrestrial animals and birds.
2) Enhance aquatic habitat by eliminating anthropogenic debris, particularly old tires, water barrels, picnic tables and garbage bags from Watercourse 6 between Barton Street and Highway 8.
3) Remove anthropogenic debris from the Fifty Creek Wetland Complex. Removing debris from within this wetland will eliminate barriers to fish movement and prevent the leeching of chemicals into the natural environment.

9.0 PUBLIC CONSULTATION

In accordance with the City's Master Planning practice, public consultation has been undertaken. A Pubic Information Centre (PIC) was held in November 2008 at Stoney Creek Municipal Office Council Chambers (777 Highway No.8, Stoney Creek, Hamilton) to present the draft findings from the Phase 1 characterization study and to get feedback from the local community and landowners. A second PIC was held in June 2010 at the same location to review the development impacts, alternative control techniques and to present a preliminary Stormwater Management Strategy and Natural Heritage Strategy. The PIC's were advertised in the Hamilton Spectator and Stoney Creek Community newspaper. Presentation material from the PIC's is provided in Appendix D.

The PIC's were generally well attended and included informal discussions with members of the public. The majority of the discussions focussed on explaining the overall study process and the draft findings as illustrated on the mapping included in the presentation material. Additional public comment was provided to the City expressing concerns about the impact of future urban development and expressing a desire for flood control measures to prevent increases to existing flow rates.

In addition to the above, the members of the Study Team met with staff from the City of Hamilton, the Hamilton Conservation Authority, and Ministry of Transportation to review interim findings of the Subwatershed Study, including the results of the field studies, modelling, and proposed strategies.

10.0 CONCLUSIONS AND RECOMMENDATIONS

The City of Hamilton is in the process of preparing a Secondary Plan in support of future urban development within the Stoney Creek Urban Boundary Expansion (SCUBE) area. This study, termed the SCUBE Subwatershed Study, or alternatively the SCUBE *East* Subwatershed Study, is one of two subwatershed studies being undertaken in support of the Secondary Plan. The study focuses on the lands to the East of McNeilly Road, between Lake Ontario and the Niagara Escarpment, and eastward to the City boundary. The study area consists of the drainage areas from Watercourses 7.2, 9, 10, and Fifty Creek.

The Subwatershed Study is being conducted as a Master Plan under the Municipal Class Environmental Assessment (Class EA) process, and is intended to satisfy Phases 1 and 2 of the Class EA process.

The Subwatershed Study is being undertaken in three phases:

4. Establish existing environmental conditions;
5. Evaluate future impacts and select, from a set of alternatives, a recommended management plan; and
6. Develop an implementation plan

This Report covers Phase1 and Phase 2 of the Subwatershed Study process.

<u>Phase 1 – Establish Existing Environmental Conditions</u>

The existing environmental resources within the study area were defined in order to identify key features and functions, to establish baseline conditions for the assessment of potential impacts from future urban development, and to identify development constraints and potential future opportunities. A summary of the findings is provided below.

- Hydrologic and hydraulic modeling were undertaken to establish the existing flood

characteristics of Watercourse 9 and Fifty Creek. The Regulatory (100-year) floodplain limits of these watersheds were identified as constraints to future development.

- MTO and private landowners have asked for assurance that future development will not increase the frequency of flooding at the QEW crossings or private lands downstream. Therefore, flood (quantity) control facilities need to be considered to prevent increases in downstream flows and flood frequency.
- Proposed improvements to Lewis Road include an opportunity to construct a new open channel along the west side of Lewis Road from Barton Street to just south of the CN Railway. Proposed works to Watercourse 7.2 include a possible diversion channel along the CN Railway line to the Main Branch of Watercourse 7, west of McNeilly Road.
- Little background information is available to characterize the water quality for the study area streams. However, based on typical conditions found in other areas with similar land uses, the study area stream are expected to have elevated levels of nutrients and bacteria, and locally high levels of metals and chlorides near the QEW corridor.
- The geology of the area is variable, consisting mainly of silt till, with an isolated band of sand near the base of the Escarpment. A water budget assessment was undertaken, and groundwater recharge rates were estimated at approximately 140 mm per year and 230 mm per year for the silt/clay, and sandy soils, respectively. In order to maintain the existing groundwater recharge rates and potential contributions to stream baseflows, it was recommended that stormwater management planning for future development include infiltration measures.
- The existing stream morphology of the watercourses was reviewed and characterized. No significant erosion hazards were identified for mitigation, however, stormwater management planning should include erosion control facilities for development lands draining to the unlined channels of Fifty Creek, Watercourse 7.2, and the west tributary of Watercourse 9.
- Future monitoring of specific stream reaches along Fifty Creek was recommended as development occurs. Further recommendations included general debris removal and slope stability considerations for future development adjacent to valley walls.
- A tolerant warmwater fish community exists in Fifty Creek downstream of Highway 8 and should be protected through a 15m Vegetation Protection Zone applied to both sides

of the stream. Portions of other streams were found to contribute to downstream habitat.

- Field investigations and further background reviews were also completed to inventory the vegetation communities, mammals, birds, amphibians, and invertebrates of the area. Terrestrial features identified for protection include the Fifty Creek ESA and Fifty Creek Locally Significant Wetland Complex (which should be protected with a 30 m Vegetation Protection Zone), the Fifty Creek riparian vegetation and adjacent woodlots, in addition to the Niagara Escarpment Protection Area. Other woodlot and hedgerow features represent enhancement opportunities if they can be accommodated into future block planning for the area.

- In terms of wildlife, one of the bird species observed within the eastern half of the Central SCUBE land parcel, Bobolink, has just recently (September 2010) been added to the regulated list of Species at Risk, as threatened.
- Future development limits along stream corridors identified for protection should incorporate several of the constraints listed above, including flood hazards, slope/erosion hazards, fishery buffers, and riparian woodlots. In addition, future field surveys would be required to identify the top-of-bank location along any defined valley features. An environmental buffer/setback, typically in the order of 5 to 10 metres, would also normally be applied to the outermost feature or hazard to establish the limits of future development along the stream corridor.

Phase 2 - Evaluate Future Impacts, Review and Select A Recommended Management Plan

Subwatershed goals and objectives were defined for the various environmental resources within the study area. The potential impacts of proposed future urban development on these resources were then evaluated. Potential impacts include the following:

- Decreased groundwater recharge rates and corresponding increase in runoff volumes;
- Increased pollutant loadings and reduced water quality;
- Potential increased rates of erosion and flooding along downstream creek reaches;
- Weakened or destruction of aquatic habitats through degraded water quality, increased

erosion, and reduced baseflows;

- Loss or weakening of terrestrial resources through fragmentation of wildlife corridors.

Alternative measures, referred to as Best Management Practices (BMP=s), were reviewed to mitigate these potential impacts and meet the selected objectives. Consistent with the Environmental Assessment approach for the study, a wide range of alternatives were reviewed, screened and evaluated against various physical, social, technical and financial criteria.

Through the evaluation process, a preferred stormwater management strategy for the SCUBE study area was selected, comprising a combination of the following:

- LID source controls for water balance as well as associated water quality and erosion benefits. The identified targets include:
  - § Silt/clay soils - capture and infiltrate the first 1.5 mm over the catchment area for residential landuses, and 3mm for commercial/institutional landuses;
  - § Sandy soils - capture and infiltrate the first 3 mm over the catchment area (residential landuses).
- end-of-pipe wet ponds for Level 2 or "normal" water quality control, as well as post-to-pre runoff control for flooding and erosion, where required:
  - § For lands draining to the lined portion of Watercourse 9 (water quality control only), targets include 65 to 105 m^3/ha of permanent pool storage, depending on landuses, and 40 m^3/ha of active storage.
  - § For all other lands, water quality ***and*** flood/erosion control is required. Targets include 65 to 105 m^3/ha of permanent pool storage, depending on landuses, and approximately 550 m^3/ha of active storage for erosion and flood control.
- stream restoration to benefit aquatic and terrestrial resources.

In addition to the above, additional proposed future channel construction works have been recommended as part of previous studies upstream of the CNR line on Watercourse 7.2 and along Lewis Road to the Western Tributary of Watercourse 9. Although these proposed future channels are conceptual in nature and their ultimate characteristics and capacities are not known

at this time, these works do represent potential capacity improvements over the existing systems which could ultimately relax the flood control storage requirements for future stormwater ponds.

It was also recognized that the feasibility of end-of-pipe stormwater ponds is constrained somewhat by the size of the area it services. Therefore, for small catchment areas, less than 5 hectares in size, an alternative strategy was recommended in which traditional source controls would be applied in place of wet ponds.

The Study also provided recommendations with respect to the Natural Heritage System. Aquafor Beech Limited used a systems approach to identify a recommended NHS for the study area of the SCUBE Subwatershed Study. The systems approach identifies a NHS that includes core areas while ensuring that smaller, less significant natural areas or degraded lands between these areas are maintained or restored to provide a connected system of natural areas. Protected areas include:

- the Niagara Escarpment Protection Area;
- identified terrestrial core areas, including the Fifty Point ESA, Fifty Creek Locally Significant Wetland Complex, Fifty Creek riparian lands, and woodlot at the base of Watercourse 9;
- a 30m Vegetation Protection Zone (15 each side) along the warmwater fish habitat stream corridor of Fifty Creek, Watercourse 7.2, Watercourse 9 and Watercourse 10;
- a 60 m Vegetation Protection Zone (30 m each side) along the Fifty Creek ESA and Fifty Creek Locally Significant Wetland Complex.
- regulatory floodplains; and
- the eastern portion of the SCUBE Central land parcel, where a bird species, Bobolink, was observed. This species has recently been designated Threatened and its habitat is protected under the provisions of the Endangered Species Act (2007).

With respect to the last point above, it was recommended that the entire portion of the SCUBE Central Lands east of Lewis Road be designated Area Specific Policy Area (ASPA) pending MNR development of a species-specific regulation for the protection of Bobolink habitat.

Aquafor Beech Limited reviewed vegetation units characterized by Dillon Consulting Limited (2010) or Natural Resources Solutions Incorporated (2007) using the Ecological Land Classification System for Southern Ontario and identified one Woodland Linkage (Woodland Linkage 1) and 17 Linkages of other natural vegetation types not previously mapped by the City of Hamilton (2009).

Enhancement opportunities were also discussed and include the protected areas and linkage areas noted above, as well as proposed 30m wildlife linkage corridors and stream corridors.

Consistent with the Environmental Assessment approach for the study, the environmental constraints and opportunities for the SCUBE study area were presented to the public at an Open House event. The preliminary recommended Stormwater Management and Natural Heritage Strategies that comprise the results for the SCUBE Subwatershed Study were presented to the public at a second subsequent Open House event. Here, City staff and Study Team consultants provided responses to questions and clarifications raised by the public.

Phase 3 – Develop an Implementation Plan

Although this current Subwatershed Study covers only Phase 1 and Phase 2 of the Subwatershed Study process, a future Phase 3 Report will be prepared dealing with implementation of the Subwatershed Study results. In general, this third phase is anticipated to cover the following:

- review and selection of appropriate types of LID measures to be applied;
- design guidance for the proposed LID measures;
- design guidance for the proposed stormwater management ponds;
- review of the future report requirements for subsequent design phases of development;
- policy recommendations; and
- recommendations with respect to funding responsibility.

11.0 GLOSSARY

Several key words or phases are used throughout the report. Definitions are provided below:

Subwatershed: A subwatershed encompasses all lands (surficial & subsurface) as well as the ditches, tributaries & main branches which drain to a common point. In this study, the subject lands drain via Stoney Creek Watercourses 7.2, 9, 10, 11 and Fifty Creek (Watercourse 12) (refer to Figure 1.1).

Environmental feature: The term environmental feature is used to describe various environmental or water related attributes which presently (or potentially) exist within the subwatersheds. These include:

- aquatic resources;
- terrestrial resources;
- water resources; including water quality and groundwater;
- floodplain characteristics including flooding; and
- erosion/stream morphology.

Ecosystem Approach: An ecosystem is defined as a community of living coexisting organisms (including humans) and the non-living physical and chemical environment in which that community lives. Thus, there is a constant interaction and interdependence between the living and non-living components of the ecosystem. The dynamics of the environment allow for variations in key factors. Indeed, one attribute of an ecosystem is that it is constantly changing.

The concept of an ecosystem can be applied at any level of scale - a wetland, a tributary, or the entire watershed. This ecosystem approach is particularly applicable to land and water management studies because it integrates physical, chemical and biological information, so all of the factors are considered at each scale, in assessing overall environmental quality.

In more straightforward terms, an ecosystem approach considers the following:

- everything is connected to everything else;
- human beings are part of nature and not separate from it;
- human beings are responsible for their actions and associated impacts; and
- economic health and environmental health are mutually inclusive.

Best Management Practice: A Best Management Practice (BMP) is a measure (active or passive) that, when implemented, will assist in protecting, enhancing, or restoring the environmental features. Best Management Practices may be active measures, for example, the construction of a stormwater management facility to control peak flows and reduce pollutant loadings from an urban area. Alternatively, they may be passive, for example, implementation of a top-soil bylaw to minimize erosion during construction or a buffer strip to protect the integrity of the streams. Best Management Practices will be investigated in Phase 2 of the Subwatershed Study.

Stormwater Management Plan: A Stormwater Management Plan involves the implementation of a series of BMPs such that the environment is protected as urbanization occurs.

Terrestrial: Terrestrial resources include: landforms, such as moraines, kettle lakes, escarpments, glacial lake shorelines; natural vegetation features such as woodlands, savannas, prairies, meadows, valley/riparian lands, hedgerows, plantations, wetlands; and, wildlife, including mammals, birds, snakes, reptiles and amphibians.

Natural System Linkages: Natural linkages refer to the inter-relationships between environmental features. These inter-relationships can be described in terms of attribute, function, and linkage.

An **attribute** is a physical characteristic, structure or uniqueness of a natural feature. For example, natural forest areas include mature trees, an understorey of

shrubs and a ground cover of forbs and grasses that may include rare species.

A **function** describes a process or an activity that an area serves within the context of the landscape, for example a forested area provides habitat for wildlife, shade streams to moderate temperatures and slow the rate of runoff into streams.

A **linkage** is a pathway, connection or relationship that an area shares with other areas that is part of a larger complex, for example a forested area may provide a wildlife corridor between two larger natural areas which together, serve to sustain a deer population. Another example of a linkage includes the flow path of water infiltrating into the ground and resurfacing at a discharge location, thereby providing baseflow for aquatic resources.

Subwatershed Management Strategy: is defined as a series or suite of Best Management Practices. Alternative Subwatershed Management Strategies will be investigated in Phase 2 of the Subwatershed Study.

Fluvial Geomorphology: the study of physical features of the earths surface which describe the features of a watercourse. There are many features of a stream channel such as width, depth, velocity, discharge, slope, channel materials, sediment load, and sediment size which form the morphology of watercourses. In a natural watercourse these features are dynamic, yet operate within a given equilibrium. A change in any one of these features could alter the watercourse and result in accelerated channel erosion, loss of channel capacity and deterioration of aquatic habitat.

12.0 REFERENCES

AECOM. 12 December 2008. Arvin Avenue Extension – Schedule C Class Environmental Assessment. Environmental Study Report.

Brown, C. R. 1997. Purple Martin (Progne subis). In The Birds of North America, Number 287. A. Poole and F. Gill, eds. The Academy of Natural Sciences and the American Ornithologists' Union.

City of Hamilton. 2006. Rural Hamilton Official Plan. Volume 1: Policies.

City of Hamilton. 2008. Urban Natural Heritage System: Discussion Paper. 36 pp.

City of Hamilton. 2009. SCUBE West Subwatershed Study Terms of Reference. 6 pp.

City of Hamilton. 2009. Urban Hamilton Official Plan. Volume 1: Parent Plan.

Conant, R. and J.T. Collins. A Field Guide to Reptiles and Amphibians of Eastern and Central North America. Third Edition. Houghton Mifflin Company, New York.

Cook, F.R. 1984. Introduction to Canadian Amphibians and Reptiles. National Museums of Canada. Ottawa. 200 p.

COSEWIC 2000. COSEWIC assessment and update status report on the American ginseng *Panax quinquefolius* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 17 pp.

COSEWIC 2002. COSEWIC assessment and status report on the milksnake *Lampropeltis triangulum* in Canada. Committee on the Status of Endangered Wildlife in Canada. Prepared by L. Fisher. Ottawa. vi + 29 pp.

COSEWIC 2004. COSEWIC assessment and status report on the American chestnut *Castanea dentata* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 19 pp. (www.sararegistry.gc.ca/status/status_e.cfm)

COSEWIC 2005. COSEWIC assessment and update status report on the Blanding's Turtle *Emydoidea blandingii* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. viii + 40 pp.

COSEWIC 2006. COSEWIC assessment and update status report on the American Columbo *Frasera caroliniensis* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 21 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

COSEWIC 2007. COSEWIC assessment and status report on the Chimney Swift *Chaetura pelagic* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 49 pp. (www.sararegistry.gc.ca/status/status_e.cfm)

COSEWIC. 2008. COSEWIC assessment and status report on the Snapping Turtle *Chelydra serpentina* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 47 pp.

COSEWIC 2010. COSEWIC assessment and status report on the Bobolink *Dolichonyx oryzivorus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 42 pp. (www.sararegistry.gc.ca/status/status_e.cfm)

COSEWIC. 2010. COSEWIC assessment and status report on the Cucumber Tree *Magnolia acuminata* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. x + 18 pp.

COSEWIC. 2010. COSEWIC assessment and status report on the Monarch *Danaus plexippus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 43 pp.

Curry, R. 2006. Birds of Hamilton and Surrounding Areas. Robert Curry and the Hamilton Naturalists' Club.

Dillon Consulting Limited. 2010. City of Hamilton Watercourse 5 & 6 Class Environmental Assessment Draft Report. ii + 57 pp.

Dillon Consulting Limited. 2010. Natural Heritage Assessment of Lands Bounded by Fruitland Road, Glover Road, Barton Street and Highway 8. City of Hamilton. ii + 79 pp.

Dobbyn, J.S. 1994. Atlas of the Mammals of Ontario. Federation of Ontario Naturalists.

Dwyer, J.K. (ed). 2003. Nature Counts Project: Hamilton Natural Areas Inventory. Hamilton Naturalists' Club.

Environment Canada. 2010. Recovery Strategy for the Butternut (*Juglans cinerea*) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa vii + 24 pp.

Forman, R.T.T., B. Reineking and A.M. Hersperger. 2002. Road traffic and nearby grassland bird patterns in a suburbanizing landscape.

Genivar Ontario Inc. July 2007. Lewis Road Improvement Class Environmental Assessment from Barton Street to South Service Road. Drainage and Stormwater Management Report. (Draft).

Haire, S.L., C.E. Bock, B.S. Cade and B.C. Bennett. 2000. The role of landscape and habitat characteristics in limiting abundance of grassland nesting songbirds in an urban open space.

Landscape and Urban Planning 48: 65-82

Hamilton Conservation Authority. 2009. Planning & Regulation Policies and Guidelines. 107 pp.

Harding, J.H. 1997. Amphibians and Reptiles of the Great Lakes Region. The University of Michigan Press. Ann Arbor, Michigan. 378 p.

Hughes, J.M. 2001. The ROM Field Guide to Birds of Ontario. Royal Ontario Museum and McClelland & Stewart Limited. Toronto. 416 pp.

Jagger Hims Limited. June 27, 2008. Well Installation and Testing Program. SCUBE East Subwatershed Study, Special Policy Area F.

Kirk, D.A. 1987. Status report on the Spotted Wintergreen (*Chimaphila maculata*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Canadian Wildlife Service, Ottawa. Unpublished report. 36 pp.

Lamond, W. G. 1994. The Reptiles and Amphibians of the Hamilton Area. A Historical Summary and Results of the Hamilton Herpetofaunal Atlas. Hamilton Naturalist Club.

Ministry of Municipal Affairs and Housing. 2005. Greenbelt Plan. 57 pp.

Ministry of Municipal Affairs and Housing. 2005. Provincial Policy Statement. 37 pp.

Ministry of Natural Resources. 1993. Ontario Wetland Evaluation System Southern Manual 3rd Edition (Revised 1994, updates in 2002).

Ministry of Natural Resources. 2000. Significant Wildlife Habitat Technical Guide.

Ministry of Natural Resources. 2009. Chimney Swift (*Chaetura pelagic*). Toronto: Queen's Printer for Ontario. 2 pp.

Ministry of Natural Resources. 2010. Natural Heritage Reference Manual for Natural Heritage Policies of the Provincial Policy Statement, 2005. Second Edition. Toronto: Queen's Printer for Ontario. 248 pp.

Ministry of Natural Resources. 2011. Bobolink (*Dolichonyx oryzivorus*). Toronto: Queen's Printer for Ontario. 2 pp.

Natural Resources Solutions Incorporated. 2007. Ecological Land Classification Field Work.

NatureServe Explorer. http://www.natureserve.org/explorer. Accessed July, 2011.

Niagara Escarpment Commission. 2005. The Niagara Escarpment Plan. Toronto: Queen's Printer for Ontario. 138 pp.

Oldham, M.J. 2009. Natural heritage resources of Ontario: rare vascular plants (4th edition). Natural Heritage Information Centre, Ontario Ministry of Natural Resources, Peterborough.

Ontario Ministry of the Environment (MOE). March 2003. Stormwater Management Planning and Design Manual.

Ontario Ministry of the Environment and Energy (MOEE). 1999. *Revised Stormwater Management Guidelines*, Draft Report.

Parks Canada Agency. 2011. Recovery Strategy for the Red Mulberry (*Morus rubra*) in Canada. Species at Risk Act Recovery Strategy Series. Parks Canada Agency. Ottawa, Ontario. vi + 47 pp.

Philips Engineering Limited. September 2003. Watercourse No. 7 – Creek System Improvements. Class Environmental Assessment.

Philips Engineering Limited. June 2004. Stormwater Quality Management Strategy – Community of Stoney Creek Master Plan.

Riley, J. L. 1989. Distribution and status of the vascular plants of Central Region, Ontario Ministry of Natural Resources, Richmond Hill, Ontario, 110 pp.

Rosgen, D. (1996). Applied river morphology. Wildlife Hydrology, Pagosa Springs, CO.

Sharpe, D.R., Barnett, P.J., Brennand, T.A., Gorrell, G., and Russell, H.A.J., 2001. Digital Surficial Geology Data of the Greater Toronto and Oak Ridges Moraine Area, Southern Ontario, Geological Survey of Canada, 1 December 2001, http://sts.gsc.nrcan.gc.ca/orm/onlinedata documentation.asp.

Smith, K. 2002. COSEWIC status report on the eastern ribbonsnake *Thamnophis sauritus* in Canada. In COSEWIC assessment and status report on the eastern ribbonsnake *Thamnophis sauritus*. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-24 pp.

SNC Lavalin. 1991. Aquatic Habitat and Fisheries Impact Assessment Watercourses 5, 6, 7 and 9. MacLaren Plansearch. 38pp.

Swanson, D.A. February 1996. Nesting Ecology and Nesting Habitat Requirements of Ohio's Grassland-nesting Birds: A Literature Review.

Voss, Edward G. 1985. Michigan flora. Part II. Dicots (Saururaceae--Cornaceae). Bulletin 59. Bloomfield Hills, MI: Cranbrook Institute of Science; Ann Arbor, MI: University of Michigan Herbarium. 724 p.

Wildlands CPR. The Impacts of Railroads on Wildlife. http://www.wildlandscpr.org/node/221. Accessed 8 June 2010.

APPENDIX A:

Hydrologic Modelling

TABLE A.1:
SUMMARY OF LANDUSES AND IMPERVOUS COMPONENTS

Catchment	Area (ha)	Landuse	Coverage (ha)	% Coverage	% Impervious	Steep imp - Roof	Flat imp - Road	Pervious
Watercourse 12								
1213	48.3	Undevelopment/Woods	48.3	100%	0%			
121	80.6	Low-density Residential	13.1	16%	30%	1.70	2.22	9.16
		Residential	7.9	10%	50%	1.91	2.06	3.97
		Total Developed	***21.0***	***26%***	***38%***	***17%***	***20%***	***62%***
		Undevelopment/Woods	59.6	74%	0%			
122	141.0	Low-density Residential	13.4	10%	30%	1.75	2.29	9.41
		Residential	3.0	2%	50%	0.71	0.77	1.48
		Total Developed	***16.4***	***12%***	***34%***	***15%***	***19%***	***66%***
		Undevelopment/Woods	124.6	88%	0%			
123	245.4	Industrial/Commerical	2.6	1%	70%	0.00	1.82	0.78
		Low-density Residential	4.4	2%	20%	0.38	0.49	3.49
		Residential	0.0	0%	50%	0.00	0.00	0.00
		Total Developed	***7.0***	***3%***	***39%***	***5%***	***33%***	***61%***
		Undevelopment/Woods	238.4	97%	0%			
124	14.1	Undevelopment/Woods	14.1	100%	0%			
125	40.7	Highway Interchange	6.3	15%	50%	0.00	3.13	3.13
		Total Developed	***6.3***	***15%***	***50%***	***0%***	***50%***	***50%***
		Undevelopment/Woods	34.4	85%	0%			
1251	7.2	Highway Interchange	4.5	62%	50%	0.00	2.23	2.23
		Total Developed	***4.5***	***62%***	***50%***	***0%***	***50%***	***50%***
		Undevelopment/Woods	2.8	38%	0%			
126	56.5	Low-density Residential	5.7	10%	20%	0.50	0.64	4.56
		Total Developed	***5.7***	***10%***	***20%***	***9%***	***11%***	***80%***
		Undevelopment/Woods	50.8	90%	0%			
127	30.3	Industrial/Commerical	7.1	23%	70%	0.00	4.96	2.12
		Low-density Residential	2.4	8%	20%	0.21	0.27	1.89
		Total Developed	***9.4***	***31%***	***58%***	***2%***	***55%***	***42%***
		Undevelopment/Woods	20.9	69%	0%			
128	2.0	Undevelopment/Woods	2.0	100%	0%			
1281	4.7	Undevelopment/Woods	4.7	100%	0%			
129	14.2	Industrial/Commerical	3.3	24%	70%	0.00	2.34	1.00
		Low-density Residential	4.1	29%	20%	0.36	0.47	3.29
		Total Developed	***7.5***	***53%***	***42%***	***5%***	***38%***	***58%***
		Undevelopment/Woods	6.7	47%	0%			
1291	3.8	Undevelopment/Woods	3.8	100%	0%			
1210	5.7	Industrial/Commerical	0.5	8%	70%	0.00	0.32	0.14
		Low-density Residential	1.8	31%	20%	0.16	0.20	1.43
		Total Developed	***2.2***	***39%***	***30%***	***7%***	***23%***	***70%***
		Undevelopment/Woods	3.5	61%	0%			
1211	25.3	Highway Interchange	4.8	19%	50%	0.00	2.39	2.39
		Low-density Residential	8.5	33%	20%	0.74	0.96	6.77
		Total Developed	***13.2***	***52%***	***31%***	***6%***	***25%***	***69%***
		Undevelopment/Woods	12.1	48%	0%			
1212	11.8	Low-density Residential	9.3	79%	30%	1.21	1.59	6.54
		Total Developed	***9.3***	***79%***	***30%***	***13%***	***17%***	***70%***
		Undevelopment/Woods	2.5	21%	0%			
Watercourse 9								
91	63.6	Low-density Residential	8.3	13%	30%	1.08	1.41	5.82
		Total Developed	***8.3***	***13%***	***30%***	***13%***	***17%***	***70%***
		Undevelopment/Woods	55.3	87%	0%			
92	83.6	Institutional (school)	5.8	7%	30%	0.00	1.75	4.09
		Low-density Residential	27.2	33%	20%	2.37	3.07	21.77
		Total Developed	***33.1***	***40%***	***22%***	***7%***	***15%***	***78%***
		Undevelopment/Woods	50.5	60%	0%			
93	28.6	Residential	19.0	66%	40%	3.65	3.95	11.39
		Low-density Residential	5.9	21%	20%	0.52	0.67	4.74
		Total Developed	***24.9***	***87%***	***35%***	***17%***	***19%***	***65%***
		Undevelopment/Woods	3.7	13%	0%			
96	30.5	Low-density Residential	0.9	3%	20%	0.08	0.11	0.76
		Total Developed	***0.9***	***3%***	***20%***	***9%***	***11%***	***80%***
		Undevelopment/Woods	29.5	97%	0%			
97	16.5	Low-density Residential	2.8	17%	20%	0.24	0.31	2.20
		Total Developed	***2.8***	***17%***	***20%***	***9%***	***11%***	***80%***
		Undevelopment/Woods	13.8	83%	0%			
98	19.0	Residential	10.5	55%	40%	2.01	2.17	6.27
		Low-density Residential	7.8	41%	20%	0.68	0.88	6.22
		Total Developed	***18.2***	***96%***	***31%***	***15%***	***17%***	***69%***
		Undevelopment/Woods	0.8	4%	0%			
99	34.9	Industrial/Commerical	34.9	100%	70%	0.00	24.42	10.46
		Total Developed	***34.9***	***100%***	***70%***	***0%***	***70%***	***30%***
		Undevelopment/Woods	0.0	0%	0%			
910	13.9	Highway Interchange	4.6	33%	50%	0.00	2.30	2.30
		Low-density Residential	3.6	26%	20%	0.31	0.41	2.87
		Total Developed	***8.2***	***59%***	***37%***	***4%***	***33%***	***63%***
		Undevelopment/Woods	5.7	41%	0%			

TABLE A.1 con't:
SUMMARY OF LANDUSES AND IMPERVOUS COMPONENTS

Catchment	Area (ha)	Landuse	Coverage (ha)	% Coverage	% Impervious	Steep imp - Roof	Flat imp - Road	Pervious
Watercourse 10								
101	15.8	Industrial/Commerical	1.8	11%	70%	0.00	1.24	0.53
		Total Developed	***1.8***	***11%***	***70%***	***0%***	***70%***	***30%***
		Undevelopment/Woods	14.1	89%	0%			
102	10.2	Industrial/Commerical	1.2	12%	70%	0.00	0.85	0.36
		Low-density Residential	0.6	6%	20%	0.05	0.07	0.47
		Total Developed	***1.8***	***18%***	***54%***	***3%***	***51%***	***46%***
		Undevelopment/Woods	8.4	82%	0%			
103	10.4	Highway Interchange	1.1	11%	50%	0.00	0.55	0.55
		Low-density Residential	5.5	53%	20%	0.48	0.62	4.40
		Total Developed	***6.6***	***64%***	***25%***	***7%***	***18%***	***75%***
		Undevelopment/Woods	3.8	36%	0%			
104	13.5	Highway Interchange	1.4	10%	50%	0.00	0.70	0.70
		Industrial/Commerical	5.8	43%	70%	0.00	4.05	1.74
		Low-density Residential	0.6	5%	20%	0.05	0.07	0.49
		Total Developed	***7.8***	***58%***	***62%***	***1%***	***62%***	***38%***
		Undevelopment/Woods	5.7	42%	0%			
106	2.2	Highway Interchange	2.2	100%	50%	0.00	1.09	1.09
		Total Developed	***2.2***	***100%***	***50%***	***0%***	***50%***	***50%***
		Undevelopment/Woods	0.0	0%	0%			
107	59.1	Residential	27.9	47%	40%	5.36	5.81	16.76
		Low-density Residential	22.2	38%	20%	1.93	2.51	17.74
		Total Developed	***50.1***	***85%***	***31%***	***15%***	***17%***	***69%***
		Undevelopment/Woods	9.0	15%	0%			
108	27.9	Highway Interchange	1.8	6%	50%	0.00	0.88	0.88
		Low-density Residential	20.7	74%	20%	1.80	2.34	16.56
		Total Developed	***22.4***	***81%***	***22%***	***8%***	***14%***	***78%***
		Undevelopment/Woods	5.4	19%	0%			
109	29.0	Highway Interchange	1.2	4%	50%	0.00	0.62	0.62
		Residential	26.2	90%	40%	5.02	5.44	15.69
		Total Developed	***27.4***	***95%***	***40%***	***18%***	***22%***	***60%***
		Undevelopment/Woods	1.6	5%	0%			
1010	32.6	Highway Interchange	3.8	12%	50%	0.00	1.89	1.89
		Residential	26.7	82%	40%	5.13	10.68	16.02
		Total Developed	***30.5***	***94%***	***41%***	***17%***	***41%***	***59%***
		Undevelopment/Woods	2.1	6%	0%			
1011	**14.7**	Undevelopment/Woods	14.7	100%	0%			
1012	**3.8**	Low-density Residential	0.5	13%	20%	0.04	0.06	0.40
		Total Developed	***0.5***	***13%***	***20%***	***9%***	***11%***	***80%***
		Undevelopment/Woods	3.3	87%	0%			
total:	1193.1							

TABLE A.2:
SUMMARY OF SOILS AND HORTON INFILTRATION PARAMETERS

Catchment	Area (ha)	Soils*	Coverage (ha)	% Coverage	Soil Group**	Fo	Fc	Composite	
								Fo	Fc
Watercourse 12									
1213	48.3	MORLEY, Silty clay loam	1.5	3%	C	125	5	114	6
		TRAFALGAR, Silty clay loam	3.8	8%	D	75	3		
		ONEIDA, Silt loam	11.8	24%	BC	200	13		
		FARMINGTON, loam	6.6	14%	B	200	13		
		CHINGUACOSY, loarmy textures over clay loam till	10.9	23%	C	125	5		
		ESCARPMENT	13.4	28%	N/A				
121	80.6	WINONA, Sandy loam	0.8	1%	AB	250	25	100	5
		MORLEY, Silty clay loam	36.0	45%	C	125	5		
		TRAFALGAR, Silty clay loam	23.3	29%	D	75	3		
		ONEIDA, Silt loam	2.6	3%	BC	200	13		
		FARMINGTON, loam	3.3	4%	B	200	13		
		CHINGUACOSY, loarmy textures over clay loam till	3.5	4%	C	125	5		
		ESCARPMENT	11.6	14%	N/A				
122	141.0	TRAFALGAR, Silty clay loam	11.9	8%	D	75	3	103	5
		WINONA, Sandy loam	0.6	0%	AB	250	25		
		MORLEY, Silty clay loam	54.5	39%	C	125	5		
		FARMINGTON, loam	8.5	6%	B	200	13		
		CHINGUACOSY, loarmy textures over clay loam till	24.4	17%	C	125	5		
		ONEIDA, Silt loam	9.6	7%	BC	200	13		
		STREAM COURSE	2.0	1%	N/A				
		ESCARPMENT	29.7	21%	N/A				
123	245.4	WINONA, Sandy loam	17.1	7%	AB	250	25	124	7
		TRAFALGAR, Silty clay loam	21.3	9%	D	75	3		
		JEDDO Sandy loam	3.1	1%	BC	200	13		
		FARMINGTON, loam	4.2	2%	B	200	13		
		CHINGUACOSY, loarmy textures over clay loam till	29.1	12%	C	125	5		
		ONEIDA, Silt loam	40.7	17%	BC	200	13		
		JEDDO, clay loam till	1.9	1%	C	125	5		
		MORLEY, Silty clay loam	61.1	25%	C	125	5		
		FRANKTOWN, variable textures over bedrock	6.6	3%	B	200	13		
		BROOKE, variable textures over bedrock	10.5	4%	B	200	13		
		STREAM COURSE	2.4	1%	N/A				
		ESCARPMENT	47.2	19%	N/A				
124	14.1	TRAFALGAR, Silty clay loam	2.5	17%	D	75	3	134	10
		WINONA, Sandy loam - JEDDO, Sandy loam	5.6	40%	B	200	13		
		WINONA, Sandy loam	2.4	17%	AB	250	25		
		STREAM COURSE	3.7	26%	N/A				
125	40.4	JEDDO Sandy loam	6.0	15%	BC	200	13	202	15
		WINONA, Sandy loam - JEDDO, Sandy loam	19.7	49%	B	200	13		
		WINONA, Sandy loam	9.3	23%	AB	250	25		
		CHINGUACOSY, loarmy textures over clay loam till	0.4	1%	C	125	5		
		JEDDO, clay loam till	0.9	2%	C	125	5		
		STREAM COURSE	4.0	10%	C	125	5		
126	56.5	JEDDO, clay loam till	23.9	42%	C	125	5	100	5
		CHINGUACOSY, loarmy textures over clay loam till	5.1	9%	C	125	5		
		WINONA, Sandy loam	0.4	1%	AB	250	25		
		WINONA, Sandy loam - JEDDO, Sandy loam	1.3	2%	B	200	13		
		JEDDO Sandy loam	8.5	15%	BC	200	13		
		STREAM COURSE	4.2	7%	N/A				
		NOT MAPPED, includes residential, industrial and recreational land areas	13.0	23%	N/A				
127	30.3	JEDDO Sandy loam	29.2	96%	BC	200	13	200	13
		WINONA, Sandy loam - JEDDO, Sandy loam	1.1	4%	B	200	13		
128	2.0	WINONA, Sandy loam - JEDDO, Sandy loam	2.0	100%	B	200	13	200	13
1281	4.7	WINONA, Sandy loam - JEDDO, Sandy loam	2.8	60%	B	200	13	150	9
		TRAFALGAR, Silty clay loam	1.9	40%	D	75	3		
129	14.2	TRAFALGAR, Silty clay loam	3.6	26%	D	75	3	124	10
		WINONA, Sandy loam	4.6	33%	AB	250	25		
		WINONA, Sandy loam - JEDDO, Sandy loam	0.7	5%	B	200	13		
		TRAFALGAR, Silty clay loam - MORELY, silty clay loam	1.5	11%	CD	125	5		
		STREAM COURSE	3.7	26%	N/A				
1291	3.8	TRAFALGAR, Silty clay loam	2.4	62%	D	75	3	95	4
		TRAFALGAR, Silty clay loam - MORELY, silty clay loam	1.5	39%	CD	125	5		
1210	6.7	WINONA, Sandy loam	5.1	75%	AB	250	25	250	25
		STREAM COURSE	1.6	24%	N/A				
1211	25.3	JEDDO Sandy loam	5.5	22%	BC	200	13	140	10
		WINONA, Sandy loam - JEDDO, Sandy loam	7.9	31%	B	200	13		
		JEDDO, clay loam till	2.0	8%	C	125	5		
		WINONA, Sandy loam	2.5	10%	AB	250	25		
		STREAM COURSE	1.3	5%	N/A				
		NOT MAPPED, includes residential, industrial and recreational land areas	6.1	24%	N/A				
1212	11.8	TRAFALGAR, Silty clay loam - MORELY, silty clay loam	5.3	45%	CD	125	5	97	4
		TRAFALGAR, Silty clay loam	6.5	55%	D	75	3		

TABLE A.2 con't:
SUMMARY OF SOILS AND HORTON INFILTRATION PARAMETERS

Catchment	Area (ha)	Soils*	Coverage (ha)	% Coverage	Soil Group**	Fo	Fc	Composite	
								Fo	Fc
Watercourse 9									
91	63.6	WINONA, Sandy loam	12.8	20%	AB	250	25	140	10
		TRAFALGAR, Silty clay loam	2.3	4%	D	75	3		
		MORLEY, Silty clay loam	17.1	27%	C	125	5		
		ONEIDA, loam	12.3	19%	BC	200	13		
		FARMINGTON, loam	1.9	3%	B	200	13		
		CHINGUACOUSY, Silt loam	3.0	5%	BC	200	13		
		ESCARPMENT	14.3	23%	N/A				
92	83.6	WINONA, Sandy loam - JEDDO, Sandy loam	3.8	5%	B	200	13	170	12
		JEDDO Sandy loam	9.2	11%	BC	200	13		
		MORLEY, Silty clay loam	17.0	20%	C	125	5		
		TRAFALGAR, Silty clay loam	31.3	37%	CD	125	5		
		WINONA, Sandy loam	22.2	27%	AB	250	25		
93	28.6	MORLEY, Silty clay loam	10.9	38%	C	125	5	110	4
		TRAFALGAR, Silty clay loam - MORELY, silty clay loam	9.0	31%	CD	125	5		
		TRAFALGAR, Silty clay loam	8.8	31%	D	75	3		
96	30.5	WINONA, Sandy loam - JEDDO, Sandy loam	15.6	51%	B	200	13	188	12
		JEDDO Sandy loam	12.0	39%	BC	200	13		
		TRAFALGAR, Silty clay loam	2.8	9%	D	75	3		
97	16.5	TRAFALGAR, Silty clay loam	7.4	45%	D	75	3	144	8
		JEDDO Sandy loam	9.1	55%	BC	200	13		
98	19.0	JEDDO Sandy loam	3.3	17%	BC	200	13	104	5
		TRAFALGAR, Silty clay loam	13.9	73%	D	75	3		
		WINONA, Sandy loam - JEDDO, Sandy loam	0.5	2%	B	200	13		
		TRAFALGAR, Silty clay loam - MORELY, silty clay loam	1.4	7%	CD	125	5		
99	34.9	WINONA, Sandy loam - JEDDO, Sandy loam	23.2	66%	B	200	13	199	13
		JEDDO Sandy loam	11.6	33%	BC	200	13		
910	13.9	WINONA, Sandy loam - JEDDO, Sandy loam	10.6	76%	B	200	13	200	13
		JEDDO Sandy loam	3.3	24%	BC	200	13		
Watercourse 10									
101	15.8	JEDDO Sandy loam	13.7	86%	BC	200	13	200	13
		WINONA, Sandy loam - JEDDO, Sandy loam	2.2	14%	B	200	13		
102	10.2	JEDDO Sandy loam	9.7	95%	BC	200	13	198	13
		TRAFALGAR, Silty clay loam	0.2	2%	D	75	3		
		WINONA, Sandy loam - JEDDO, Sandy loam	0.4	4%	B	200	13		
103	10.4	JEDDO Sandy loam	10.4	100%	BC	200	13	200	13
104	13.5	JEDDO Sandy loam	13.5	100%	BC	200	13	200	13
105	7.2	JEDDO Sandy loam	4.2	58%	BC	200	13	200	13
		WINONA, Sandy loam - JEDDO, Sandy loam	3.0	42%	B	200	13		
106	2.2	JEDDO Sandy loam	2.2	100%	BC	200	13	200	13
107	59.1	JEDDO Sandy loam	58.5	99%	BC	200	13	200	13
		WINONA, Sandy loam - JEDDO, Sandy loam	0.6	1%	B	200	13		
108	27.9	JEDDO Sandy loam	27.9	100%	BC	200	13	200	13
109	29.0	JEDDO Sandy loam	29.0	100%	BC	200	13	200	13
1010	32.6	JEDDO Sandy loam	32.6	100%	BC	200	13	200	13
1011	14.7	TRAFALGAR, Silty clay loam - MORELY, silty clay loam	2.5	17%	CD	125	5	128	7
		TRAFALGAR, Silty clay loam	7.0	47%	D	75	3		
		WINONA, Sandy loam - JEDDO, Sandy loam	4.9	33%	B	200	13		
		JEDDO Sandy loam	0.3	2%	BC	200	13		
1012	3.8	TRAFALGAR, Silty clay loam - MORELY, silty clay loam	3.8	100%	CD	125	5	125	5
total:	1193.8								

* Soil Survey Mapping for Hamilton (Wentworth County) and Regional Municipality of Niagara
** MTO Drainage Manual, Chart H2-6A
*** Assuming rural cover (meadows), AMCII

TABLE A.3:
SUMMARY OF SOILS AND "CN" PARAMETERS

Catchment	Area (ha)	Soils*	Coverage (ha)	% Coverage	Soil Group**	CN***	Composite CN	
							AMC II	S II
Watercourse 12								
1213	48.3	MORLEY, Silty clay loam	1.5	3%	C	77	53	227
		TRAFALGAR, Silty clay loam	3.8	8%	D	82		
		ONEIDA, Silt loam	11.8	24%	BC	72		
		FARMINGTON, loam	6.6	14%	B	66		
		CHINGUACOSY, loarmy textures over clay loam till	10.9	23%	C	77		
		ESCARPMENT	13.4	28%	N/A			
121	80.6	WINONA, Sandy loam	0.8	1%	AB	56	67	126
		MORLEY, Silty clay loam	36.0	45%	C	77		
		TRAFALGAR, Silty clay loam	23.3	29%	D	82		
		ONEIDA, Silt loam	2.6	3%	BC	72		
		FARMINGTON, loam	3.3	4%	B	66		
		CHINGUACOSY, loarmy textures over clay loam till	3.5	4%	C	77		
		ESCARPMENT	11.6	14%	N/A			
122	141.0	TRAFALGAR, Silty clay loam	11.9	8%	D	82	59	176
		WINONA, Sandy loam	0.6	0%	AB	56		
		MORLEY, Silty clay loam	54.5	39%	C	77		
		FARMINGTON, loam	8.5	6%	B	66		
		CHINGUACOSY, loarmy textures over clay loam till	24.4	17%	C	77		
		ONEIDA, Silt loam	9.6	7%	BC	72		
		STREAM COURSE	2.0	1%	N/A			
		ESCARPMENT	29.7	21%	N/A			
123	245.4	WINONA, Sandy loam	17.1	7%	AB	56	59	180
		TRAFALGAR, Silty clay loam	21.3	9%	D	82		
		JEDDO Sandy loam	3.1	1%	BC	72		
		FARMINGTON, loam	4.2	2%	B	66		
		CHINGUACOSY, loarmy textures over clay loam till	29.1	12%	C	77		
		ONEIDA, Silt loam	40.7	17%	BC	72		
		JEDDO, clay loam till	1.9	1%	C	77		
		MORLEY, Silty clay loam	61.1	25%	C	77		
		FRANKTOWN, variable textures over bedrock	6.6	3%	B	66		
		BROOKE, variable textures over bedrock	10.5	4%	B	66		
		STREAM COURSE	2.4	1%	N/A			
		ESCARPMENT	47.2	19%	N/A			
124	14.1	TRAFALGAR, Silty clay loam	2.5	17%	D	82	50	256
		WINONA, Sandy loam - JEDDO, Sandy loam	5.6	40%	B	66		
		WINONA, Sandy loam	2.4	17%	AB	56		
		STREAM COURSE	3.7	26%	N/A			
125	40.4	JEDDO Sandy loam	6.0	15%	BC	72	64	141
		WINONA, Sandy loam - JEDDO, Sandy loam	19.7	49%	B	66		
		WINONA, Sandy loam	9.3	23%	AB	56		
		CHINGUACOSY, loarmy textures over clay loam till	0.4	1%	C	77		
		JEDDO, clay loam till	0.9	2%	C	77		
		STREAM COURSE	4.0	10%	C	77		
126	56.5	JEDDO, clay loam till	23.9	42%	C	77	52	233
		CHINGUACOSY, loarmy textures over clay loam till	5.1	9%	C	77		
		WINONA, Sandy loam	0.4	1%	AB	56		
		WINONA, Sandy loam - JEDDO, Sandy loam	1.3	2%	B	66		
		JEDDO Sandy loam	8.5	15%	BC	72		
		STREAM COURSE	4.2	7%	N/A			
		NOT MAPPED, includes residential, industrial and recreational land areas	13.0	23%	N/A			
127	30.3	JEDDO Sandy loam	29.2	96%	BC	72	72	100
		WINONA, Sandy loam - JEDDO, Sandy loam	1.1	4%	B	66		
128	2.0	WINONA, Sandy loam - JEDDO, Sandy loam	2.0	100%	B	66	66	131
1281	4.7	WINONA, Sandy loam - JEDDO, Sandy loam	2.8	60%	B	66	72	98
		TRAFALGAR, Silty clay loam	1.9	40%	D	82		
129	14.2	TRAFALGAR, Silty clay loam	3.6	26%	D	82	51	245
		WINONA, Sandy loam	4.6	33%	AB	56		
		WINONA, Sandy loam - JEDDO, Sandy loam	0.7	5%	B	66		
		TRAFALGAR, Silty clay loam - MORELY, silty clay loam	1.5	11%	CD	80		
		STREAM COURSE	3.7	26%	N/A			
1291	3.8	TRAFALGAR, Silty clay loam	2.4	62%	D	82	82	55
		TRAFALGAR, Silty clay loam - MORELY, silty clay loam	1.5	39%	CD	80		
1210	6.7	WINONA, Sandy loam	5.1	75%	AB	56	42	347
		STREAM COURSE	1.6	24%	N/A			
1211	25.3	JEDDO Sandy loam	5.5	22%	BC	72	48	277
		WINONA, Sandy loam - JEDDO, Sandy loam	7.9	31%	B	66		
		JEDDO, clay loam till	2.0	8%	C	77		
		WINONA, Sandy loam	2.5	10%	AB	56		
		STREAM COURSE	1.3	5%	N/A			
		NOT MAPPED, includes residential, industrial and recreational land areas	6.1	24%	N/A			
1212	11.8	TRAFALGAR, Silty clay loam - MORELY, silty clay loam	5.3	45%	CD	80	81	59
		TRAFALGAR, Silty clay loam	6.5	55%	D	82		

TABLE A.3 con't:
SUMMARY OF SOILS AND "CN" PARAMETERS

Catchment	Area (ha)	Soils*	Coverage (ha)	% Coverage	Soil Group**	CN***	Composite CN	
							AMC II	S II
Watercourse 9								
91	63.6	WINONA, Sandy loam	12.8	20%	AB	56	54	215
		TRAFALGAR, Silty clay loam	2.3	4%	D	82		
		MORLEY, Silty clay loam	17.1	27%	C	77		
		ONEIDA, loam	12.3	19%	BC	72		
		FARMINGTON, loam	1.9	3%	B	66		
		CHINGUACOUSY, Silt loam	3.0	5%	BC	72		
		ESCARPMENT	14.3	23%	N/A			
92	83.6	WINONA, Sandy loam - JEDDO, Sandy loam	3.8	5%	B	66	71	102
		JEDDO Sandy loam	9.2	11%	BC	72		
		MORLEY, Silty clay loam	17.0	20%	C	77		
		TRAFALGAR, Silty clay loam	31.3	37%	CD	80		
		WINONA, Sandy loam	22.2	27%	AB	56		
93	28.6	MORLEY, Silty clay loam	10.9	38%	C	77	79	66
		TRAFALGAR, Silty clay loam - MORELY, silty clay loam	9.0	31%	CD	80		
		TRAFALGAR, Silty clay loam	8.8	31%	D	82		
96	30.5	WINONA, Sandy loam - JEDDO, Sandy loam	15.6	51%	B	66	70	110
		JEDDO Sandy loam	12.0	39%	BC	72		
		TRAFALGAR, Silty clay loam	2.8	9%	D	82		
97	16.5	TRAFALGAR, Silty clay loam	7.4	45%	D	82	76	79
		JEDDO Sandy loam	9.1	55%	BC	72		
98	19.0	JEDDO Sandy loam	3.3	17%	BC	72	80	65
		TRAFALGAR, Silty clay loam	13.9	73%	D	82		
		WINONA, Sandy loam - JEDDO, Sandy loam	0.5	2%	B	66		
		TRAFALGAR, Silty clay loam - MORELY, silty clay loam	1.4	7%	CD	80		
99	34.9	WINONA, Sandy loam - JEDDO, Sandy loam	23.2	66%	B	66	68	121
		JEDDO Sandy loam	11.6	33%	BC	72		
910	13.9	WINONA, Sandy loam - JEDDO, Sandy loam	10.6	76%	B	66	67	123
		JEDDO Sandy loam	3.3	24%	BC	72		
Watercourse 10								
101	15.8	JEDDO Sandy loam	13.7	86%	BC	72	71	103
		WINONA, Sandy loam - JEDDO, Sandy loam	2.2	14%	B	66		
102	10.2	JEDDO Sandy loam	9.7	95%	BC	72	72	97
		TRAFALGAR, Silty clay loam	0.2	2%	D	82		
		WINONA, Sandy loam - JEDDO, Sandy loam	0.4	4%	B	66		
103	10.4	JEDDO Sandy loam	10.4	100%	BC	72	72	99
104	13.5	JEDDO Sandy loam	13.5	100%	BC	72	72	99
105	7.2	JEDDO Sandy loam	4.2	58%	BC	72	69	111
		WINONA, Sandy loam - JEDDO, Sandy loam	3.0	42%	B	66		
106	2.2	JEDDO Sandy loam	2.2	100%	BC	72	72	99
107	59.1	JEDDO Sandy loam	58.5	99%	BC	72	72	99
		WINONA, Sandy loam - JEDDO, Sandy loam	0.6	1%	B	66		
108	27.9	JEDDO Sandy loam	27.9	100%	BC	72	72	99
109	29.0	JEDDO Sandy loam	29.0	100%	BC	72	72	99
1010	32.6	JEDDO Sandy loam	32.6	100%	BC	72	72	99
1011	14.7	TRAFALGAR, Silty clay loam - MORELY, silty clay loam	2.5	17%	CD	80	76	80
		TRAFALGAR, Silty clay loam	7.0	47%	D	82		
		WINONA, Sandy loam - JEDDO, Sandy loam	4.9	33%	B	66		
		JEDDO Sandy loam	0.3	2%	BC	72		
1012	3.8	TRAFALGAR, Silty clay loam - MORELY, silty clay loam	3.8	100%	CD	80	80	63
total:	1193.8							

* Soil Survey Mapping for Hamilton (Wentworth County) and Regional Municipality of Niagara
** MTO Drainage Manual, Chart H2-6A
*** Assuming rural cover (meadows), AMCII

TABLE A.4:
SUMMARY OF SUBCATCHMENT PHYSICAL PARAMETERS

Catchment	Landuse	Area (ha)	Length (m)*	Slope (%)
Watercourse 12				
1213	Undeveloped/Woods	48.3	1191	9.0%
121	Urban	21.4		
	Undeveloped/Woods	72.9	1881	5.7%
122	Urban	16.4		
	Undeveloped/Woods	117.3	2149	5.5%
123	Urban	21.8		
	Undeveloped/Woods	263.0	1907	6.3%
124	Urban	10.3		
	Undeveloped/Woods	41.0	1116	0.4%
125	Urban	12.5		
	Undeveloped/Woods	46.3	1291	0.2%
126	Urban	5.7		
	Undeveloped/Woods	50.8	1534	0.3%
127	Urban	9.4		
	Undeveloped/Woods	20.9	1294	0.4%
128	Undeveloped/Woods	2.0	337	0.6%
1281	Undeveloped/Woods	4.7	232	1.7%
129	Urban	7.5		
	Undeveloped/Woods	6.7	691	0.9%
1291	Undeveloped/Woods	3.8	183	0.5%
1210	Urban	2.2		
	Undeveloped/Woods	3.5	495	0.6%
1211	Urban	13.2		
	Undeveloped/Woods	12.1	859	0.3%
1212	Urban	9.3		
	Undeveloped/Woods	2.5	660	54.4%
Watercourse 9				
91	Urban	10.7		
	Undeveloped/Woods	83.7	1326	8.4%
92	Urban	33.1		
	Undeveloped/Woods	50.5	1700	0.5%
93	Urban	24.9		
	Undeveloped/Woods	3.7	938	0.4%
96	Urban	0.9		
	Undeveloped/Woods	14.8	686	0.9%
97	Urban	2.8		
	Undeveloped/Woods	13.8	831	1.0%
98	Urban	18.3		
	Undeveloped/Woods	1.8	849	0.5%
99	Urban	34.7	1106	0.4%
910	Urban	7.7		
	Undeveloped/Woods	5.6	541	1.1%

TABLE A.4 con't:
SUMMARY OF SUBCATCHMENT PHYSICAL PARAMETERS

Catchment	Landuse	Area (ha)	Length (m)*	Slope (%)
Watercourse 10				
101	Urban	1.8		
	Undeveloped/Woods	14.1	452	0.9%
102	Urban	1.8		
	Undeveloped/Woods	8.4	423	0.9%
103	Urban	6.6		
	Undeveloped/Woods	3.8	603	0.7%
104	Urban	7.8		
	Undeveloped/Woods	5.7	698	0.6%
105	Urban	4.5		
	Undeveloped/Woods	2.8	696	0.6%
106	Urban	2.2		
	Undeveloped/Woods	0.0	374	0.3%
107	Urban	50.1		
	Undeveloped/Woods	9.0	1158	0.4%
108	Urban	4.8		
	Undeveloped/Woods	23.1	1175	0.7%
109	Urban	23.6		
	Undeveloped/Woods	5.3	1176	0.7%
1010	Urban	30.5		
	Undeveloped/Woods	2.1	1089	0.7%
1011	Urban	23.6		
	Undeveloped/Woods	5.3	880	0.5%
1012	Urban	3.3		
	Undeveloped/Woods	5.8	448	0.4%

* catchment length as measured along flow path

Table 4.5:
MIKE-11 Model Subcatchment Parameters - Nam approach

	Surface-Rootzone							Ground Water		Snow Melt	
Name	**Umax**	**Lmax**	**CQOF**	**CKIF**	**CK1,2**	**TOF**	**TIF**	**TG**	**CKBF**	**Csnow**	**T0**
91B	9	86	0.35	1000	1.22	0.2	0.1	0.55	1000	2	0
92B	11	81.6	0.2	1000	4.44	0.2	0.1	0.1	2000	2	0
93B	11	52.8	0.2	1000	3.016	0.2	0.1	0.1	2000	2	0
96B	11	88	0.2	1000	1.772	0.2	0.1	0.1	2000	2	0
97B	11	63.2	0.2	1000	1.984	0.2	0.1	0.1	2000	2	0
98B	11	52	0.2	1000	2.68	0.2	0.1	0.1	2000	2	0
910B	11	98.4	0.2	1000	1.336	0.2	0.1	0.1	2000	2	0
101B	11	82.4	0.2	1000	1.268	0.2	0.1	0.1	2000	2	0
102B	11	77.6	0.2	1000	1.172	0.2	0.1	0.1	2000	2	0
103B	11	79.2	0.2	1000	1.78	0.2	0.1	0.1	2000	2	0
104B	11	79.2	0.2	1000	2.12	0.2	0.1	0.1	2000	2	0
105B	11	88.8	0.2	1000	2.112	0.2	0.1	0.1	2000	2	0
107B	11	79.2	0.2	1000	3.536	0.2	0.1	0.1	2000	2	0
108B	11	79.2	0.2	1000	2.992	0.2	0.1	0.1	2000	2	0
109B	11	79.2	0.2	1000	2.992	0.2	0.1	0.1	2000	2	0
1010B	11	79.2	0.2	1000	2.732	0.2	0.1	0.1	2000	2	0
1011	11	64	0.2	1000	2.788	0.2	0.1	0.1	2000	2	0
1012B	11	50.4	0.2	1000	1.648	0.2	0.1	0.1	2000	2	0
121B	9	50.4	0.35	1000	1.56	0.2	0.1	0.55	1000	2	0
122B	9	70.4	0.35	1000	1.76	0.2	0.1	0.55	1000	2	0
123B	11	144	0.2	1000	1.51	0.2	0.1	0.1	2000	2	0
124	11	205	0.2	1000	2.82	0.2	0.1	0.1	2000	2	0
125B	11	113	0.2	1000	4.84	0.2	0.1	0.1	2000	2	0
126B	11	186.4	0.2	1000	4.12	0.2	0.1	0.1	2000	2	0
127B	11	80	0.2	1000	3.364	0.2	0.1	0.1	2000	2	0
128	11	105	0.2	1000	0.98	0.2	0.1	0.1	2000	2	0
129B	11	196	0.2	1000	1.49	0.2	0.1	0.1	2000	2	0
1210B	11	278	0.2	1000	1.32	0.2	0.1	0.1	2000	2	0
1211B	11	222	0.2	1000	2.53	0.2	0.1	0.1	2000	2	0
1213	9	90.8	0.2	1000	1.09	0.2	0.1	0.1	2000	2	0
1281	11	78.4	0.2	1000	0.58	0.2	0.1	0.1	2000	2	0
1291	11	44	0.2	1000	1.79	0.2	0.1	0.1	2000	2	0
1212	11	47.2	0.2	1000	2.61	0.2	0.1	0.1	2000	2	0

Table 4.6:
MIKE-11 Model Subcatchment Parameters - Urban approach

Name	**Length**	**Slope**	**Impervious Suface, Roof**			**Impervious Surface, Flat Area**				**Perious Surface**							
			Area	**Wetting**	**Manning**	**Area**	**Wetting**	**Storage**	**Manning**	**Area**	**Wetting**	**Storage**	**Start Infiltration**	**End Infiltration**	**Exponent**	**Inverse Horton's equation**	**Manning Number**
91A	1326	8.40%	13%	0.05	77	17%	0.05	0.6	77	70%	0.05	2.5	140	10	2	0.005	22
92A	1700	0.50%	7%	0.05	77	15%	0.05	0.6	77	78%	0.05	2.5	170	12	2	0.005	22
93A	938	0.40%	17%	0.05	77	19%	0.05	0.6	77	65%	0.05	2.5	110	4	2	0.005	22
96A	686	0.90%	9%	0.05	77	11%	0.05	0.6	77	80%	0.05	2.5	188	12	2	0.005	22
97A	831	1.00%	9%	0.05	77	11%	0.05	0.6	77	80%	0.05	2.5	144	8	2	0.005	22
98A	849	0.50%	15%	0.05	77	17%	0.05	0.6	77	68%	0.05	2.5	104	5	2	0.005	22
99	1106	0.40%	0%	0.05	77	70%	0.05	0.6	77	30%	0.05	2.5	199	13	2	0.005	22
910A	541	1.10%	4%	0.05	77	33%	0.05	0.6	77	63%	0.05	2.5	200	13	2	0.005	22
101A	452	0.90%	0%	0.05	77	70%	0.05	0.6	77	30%	0.05	2.5	200	13	2	0.005	22
102A	423	0.90%	3%	0.05	77	51%	0.05	0.6	77	46%	0.05	2.5	198	13	2	0.005	22
103A	603	0.70%	7%	0.05	77	18%	0.05	0.6	77	75%	0.05	2.5	200	13	2	0.005	22
104A	698	0.60%	1%	0.05	77	62%	0.05	0.6	77	37%	0.05	2.5	200	13	2	0.005	22
105A	696	0.60%	0%	0.05	77	50%	0.05	0.6	77	50%	0.05	2.5	200	13	2	0.005	22
106	374	0.30%	0%	0.05	77	50%	0.05	0.6	77	50%	0.05	2.5	200	13	2	0.005	22
107A	1158	0.40%	15%	0.05	77	17%	0.05	0.6	77	68%	0.05	2.5	200	13	2	0.005	22
108A	1175	0.70%	6%	0.05	77	25%	0.05	0.6	77	69%	0.05	2.5	200	13	2	0.005	22
109A	1176	0.70%	18%	0.05	77	22%	0.05	0.6	77	60%	0.05	2.5	200	13	2	0.005	22
1010A	1089	0.70%	17%	0.05	77	24%	0.05	0.6	77	59%	0.05	2.5	200	13	2	0.005	22
1012A	448	0.40%	9%	0.05	77	11%	0.05	0.6	77	80%	0.05	2.5	125	5	2	0.005	22
121A	1881	5.70%	17%	0.05	77	20%	0.05	0.6	77	62%	0.05	2.5	100	5	2	0.005	22
122A	2149	5.50%	15%	0.05	77	19%	0.05	0.6	77	66%	0.05	2.5	103	5	2	0.005	22
123A	1907	6.30%	5%	0.05	77	33%	0.05	0.6	77	61%	0.05	2.5	124	7	2	0.005	22
125A	1291	0.20%	0%	0.05	77	50%	0.05	0.6	77	50%	0.05	2.5	202	15	2	0.005	22
126A	1534	0.30%	9%	0.05	77	11%	0.05	0.6	77	80%	0.05	2.5	100	5	2	0.005	22
127A	1294	0.40%	2%	0.05	77	55%	0.05	0.6	77	43%	0.05	2.5	200	13	2	0.005	22
129A	691	0.90%	5%	0.05	77	38%	0.05	0.6	77	58%	0.05	2.5	124	10	2	0.005	22
1210A	495	0.60%	7%	0.05	77	23%	0.05	0.6	77	70%	0.05	2.5	250	25	2	0.005	22
1211A	859	0.30%	6%	0.05	77	25%	0.05	0.6	77	69%	0.05	2.5	140	10	2	0.005	22
1212	660	0.30%	13%	0.05	77	17%	0.05	0.6	77	70%	0.05	2.5	97	4	2	0.005	22

TABLE A.7:
SUMMARY OF LANDUSES AND IMPERVOUS COMPONENTS - Future Landuse

Catchment	Area (ha)	Landuse	Coverage (ha)	% Coverage	% Impervious	Steep imp - Roof	Flat imp - Road	Pervious
Watercourse 12								
1213	48.3	Undevelopment/Woods	48.3	100%	0%			
121	80.6	Low-density Residential	13.1	16%	30%	1.70	2.22	9.16
		Residential	7.9	10%	50%	1.91	2.06	3.97
		Total Developed	***21.0***	***26%***	***38%***	***17%***	***20%***	***62%***
		Undevelopment/Woods	59.6	74%	0%			
122	141.0	Low-density Residential	13.4	10%	30%	1.75	2.29	9.41
		Residential	3.0	2%	50%	0.71	0.77	1.48
		Total Developed	***16.4***	***12%***	***34%***	***15%***	***19%***	***66%***
		Undevelopment/Woods	124.6	88%	0%			
123	245.4	Industrial/Commerical	2.6	1%	70%	0.00	1.82	0.78
		Low-density Residential	4.4	2%	20%	0.38	0.49	3.49
		Residential	0.0	0%	50%	0.00	0.00	0.00
		Total Developed	***7.0***	***3%***	***39%***	***5%***	***33%***	***61%***
		Undevelopment/Woods	238.4	97%	0%			
124	14.1	Undevelopment/Woods	14.1	100%	0%			
125	40.7	Highway Interchange	6.3	15%	50%	0.00	3.13	3.13
		Industrial/Commerical	34.4	85%	80%	0.00	27.55	6.89
		Total Developed	***40.7***	***100%***	***75%***	***0%***	***75%***	***25%***
		Undevelopment/Woods	0.0	0%	0%			
1251	7.2	Highway Interchange	4.5	62%	50%	0.00	2.23	2.23
		Industrial/Commerical	2.8	38%	80%	0.00	2.21	0.55
		Total Developed	***7.2***	***100%***	***61%***	***0%***	***61%***	***39%***
		Undevelopment/Woods	0.0	0%	0%			
126	56.5	Low-density Residential	5.7	10%	20%	0.50	0.64	4.56
		Total Developed	***5.7***	***10%***	***20%***	***9%***	***11%***	***80%***
		Undevelopment/Woods	50.8	90%	0%			
127	30.3	Industrial/Commerical	7.1	23%	70%	0.00	4.96	2.12
		Low-density Residential	2.4	8%	20%	0.21	0.27	1.89
		Total Developed	***9.4***	***31%***	***58%***	***2%***	***55%***	***42%***
		Undevelopment/Woods	20.9	69%	0%			
128	2.0	Undevelopment/Woods	2.0	100%	0%			
1281	4.7	Undevelopment/Woods	4.7	229%	0%			
129	14.2	Industrial/Commerical	3.3	24%	70%	0.00	2.34	1.00
		Low-density Residential	4.1	29%	20%	0.36	0.47	3.29
		Total Developed	***7.5***	***53%***	***42%***	***5%***	***38%***	***58%***
		Undevelopment/Woods	6.7	47%	0%			
1291	3.8	Undevelopment/Woods	3.8	186%	0%			
1210	5.7	Industrial/Commerical	0.5	8%	70%	0.00	0.32	0.14
		Low-density Residential	1.8	31%	20%	0.16	0.20	1.43
		Total Developed	***2.2***	***39%***	***30%***	***7%***	***23%***	***70%***
		Undevelopment/Woods	3.5	61%	0%			
1211	25.3	Highway Interchange	4.8	19%	50%	0.00	2.39	2.39
		Low-density Residential	8.5	33%	20%	0.74	0.96	6.77
		Total Developed	***13.2***	***52%***	***31%***	***6%***	***25%***	***69%***
		Undevelopment/Woods	12.1	48%	0%			
1212	11.8	Low-density Residential	9.3	79%	30%	1.21	1.59	6.54
		Total Developed	***9.3***	***79%***	***30%***	***13%***	***17%***	***70%***
		Undevelopment/Woods	2.5	21%	0%			
Watercourse 9								
91	63.6	Low-density Residential	8.3	13%	30%	1.08	1.41	5.82
		Total Developed	***8.3***	***13%***	***30%***	***13%***	***17%***	***70%***
		Undevelopment/Woods	55.3	87%	0%			
92	83.6	Institutional (school)	0.0	0%	30%	0.00	0.00	0.00
		Low-density Residential	0.0	0%	20%	0.00	0.00	0.00
		Residential	83.6	100%	50%	20.06	21.73	41.80
		Total Developed	***83.6***	***100%***	***50%***	***24%***	***26%***	***50%***
93	28.6	Residential	19.0	66%	40%	3.65	3.95	11.39
		Low-density Residential	5.9	21%	20%	0.52	0.67	4.74
		Total Developed	***24.9***	***87%***	***35%***	***17%***	***19%***	***65%***
		Undevelopment/Woods	3.7	13%	0%			
96	30.5	Low-density Residential	0.0	0%	20%	0.00	0.00	0.00
		Industrial/Commerical	30.5	100%	80%	0.00	24.38	6.09
		Total Developed	***30.5***	***100%***	***0%***	***0%***	***80%***	***20%***
		Undevelopment/Woods	0.0	0%	0%			
97	16.5	Low-density Residential	0.0	0%	20%	0.00	0.00	0.00
		Industrial/Commerical	16.5	100%	80%	0.00	13.21	3.30
		Total Developed	***16.5***	***100%***	***80%***	***0%***	***80%***	***20%***
		Undevelopment/Woods	0.0	0%	0%			
98	19.0	Residential	10.5	55%	40%	2.01	2.17	6.27
		Low-density Residential	7.8	41%	20%	0.68	0.88	6.22
		Total Developed	***18.2***	***96%***	***31%***	***15%***	***17%***	***69%***
		Undevelopment/Woods	0.8	4%	0%			
99	34.9	Industrial/Commerical	34.9	100%	80%	0.00	27.90	6.98
		Total Developed	***34.9***	***100%***	***80%***	***0%***	***80%***	***20%***
		Undevelopment/Woods	0.0	0%	0%			
910	13.9	Highway Interchange	4.6	33%	50%	0.00	2.30	2.30
		Low-density Residential	3.6	26%	20%	0.31	0.41	2.87
		Total Developed	***8.2***	***59%***	***37%***	***4%***	***33%***	***63%***
		Undevelopment/Woods	5.7	41%	0%			

TABLE A.7 con't:
SUMMARY OF LANDUSES AND IMPERVOUS COMPONENTS - Future Landuse

Catchment	Area (ha)	Landuse	Coverage (ha)	% Coverage	% Impervious	Steep imp - Roof	Flat imp - Road	Pervious
Watercourse 10								
101	15.8	Industrial/Commerical	15.8	100%	80%	0.00	12.67	3.17
		Total Developed	***15.8***	***100%***	***80%***	***0%***	***80%***	***20%***
		Undevelopment/Woods	0.0	0%	0%			
102	10.2	Industrial/Commerical	10.2	100%	80%	0.00	8.18	2.05
		Low-density Residential	0.0	0%	20%	0.00	0.00	0.00
		Total Developed	***10.2***	***100%***	***80%***	***0%***	***80%***	***20%***
		Undevelopment/Woods	0.0	0%	0%			
103	10.4	Highway Interchange	1.1	11%	50%	0.00	0.55	0.55
		Industrial/Commerical	9.3	89%	80%	0.00	7.41	1.85
		Total Developed	***10.4***	***100%***	***77%***	***0%***	***77%***	***23%***
		Undevelopment/Woods	0.0	0%	0%			
104	13.5	Highway Interchange	1.4	10%	50%	0.00	0.70	0.70
		Industrial/Commerical	12.1	90%	80%	0.00	9.67	2.42
		Total Developed	***13.5***	***100%***	***77%***	***0%***	***77%***	***23%***
		Undevelopment/Woods	0.0	0%	0%			
106	2.2	Highway Interchange	2.2	100%	50%	0.00	1.09	1.09
		Total Developed	***2.2***	***100%***	***50%***	***0%***	***50%***	***50%***
		Undevelopment/Woods	0.0	0%	0%			
107	59.1	Residential	27.9	47%	40%	5.36	5.81	16.76
		Low-density Residential	22.2	38%	20%	1.93	2.51	17.74
		Total Developed	***50.1***	***85%***	***31%***	***15%***	***17%***	***69%***
		Undevelopment/Woods	9.0	15%	0%			
108	27.9	Highway Interchange	1.8	6%	50%	0.00	0.88	0.88
		Low-density Residential	20.7	74%	20%	1.80	2.34	16.56
		Total Developed	***22.4***	***81%***	***22%***	***8%***	***14%***	***78%***
		Undevelopment/Woods	5.4	19%	0%			
109	29.0	Highway Interchange	1.2	4%	50%	0.00	0.62	0.62
		Residential	26.2	90%	40%	5.02	5.44	15.69
		Total Developed	***27.4***	***95%***	***40%***	***18%***	***22%***	***60%***
		Undevelopment/Woods	1.6	5%	0%			
1010	32.6	Highway Interchange	3.8	12%	50%	0.00	1.89	1.89
		Residential	26.7	82%	40%	5.13	10.68	16.02
		Total Developed	***30.5***	***94%***	***41%***	***17%***	***41%***	***59%***
		Undevelopment/Woods	2.1	6%	0%			
1011	14.7	Residential	14.7	100%	50%	3.53	3.83	7.36
		Total Developed	***14.7***	***100%***	***50%***	***24%***	***26%***	***50%***
1012	3.8	Low-density Residential	0.5	13%	20%	0.04	0.06	0.40
		Total Developed	***0.5***	***13%***	***405%***	***9%***	***11%***	***80%***
		Undevelopment/Woods	3.3	87%	0%			
total:	1193.1							

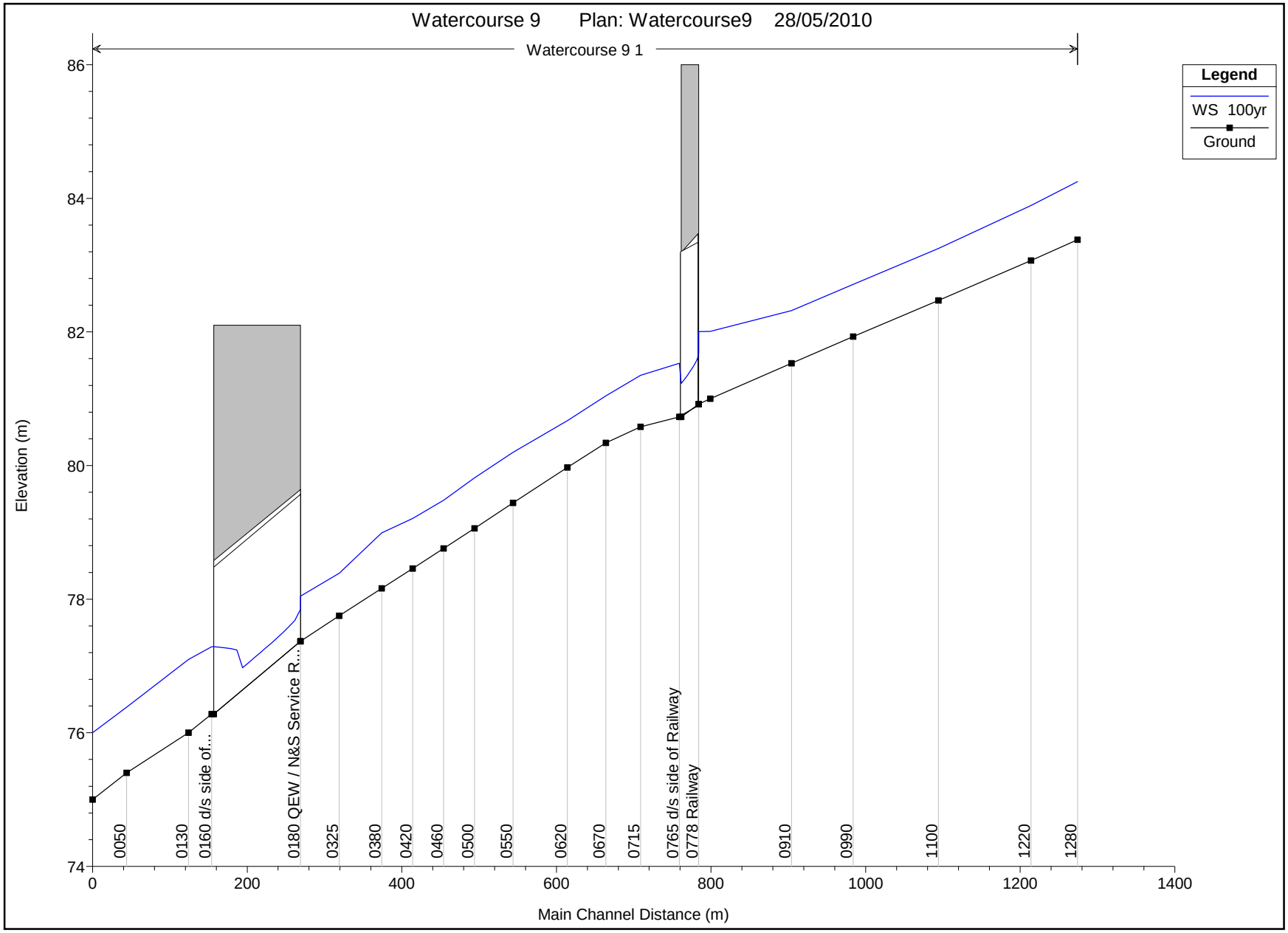
Table 4.8:
MIKE-11 Model Subcatchment Parameters - Urban approach - Future Landuse

Name	Length	Slope	Impervious Suface, Roof			Impervious Surface, Flat Area				Perious Surface							
			Area	Wetting	Manning	Area	Wetting	Storage	Manning	Area	Wetting	Storage	Start Infiltration	End Infiltration	Exponent	Inverse Horton's equation	Manning Number
91A	1326	8.40%	13%	0.05	77	17%	0.05	0.6	77	70%	0.05	2.5	140	10	2	0.005	22
92A	1700	0.50%	24%	0.05	77	26%	0.05	0.6	77	50%	0.05	2.5	170	12	2	0.005	22
93A	938	0.40%	17%	0.05	77	19%	0.05	0.6	77	65%	0.05	2.5	110	4	2	0.005	22
96A	686	0.90%	0%	0.05	77	80%	0.05	0.6	77	20%	0.05	2.5	188	12	2	0.005	22
97A	831	1.00%	0%	0.05	77	80%	0.05	0.6	77	20%	0.05	2.5	144	8	2	0.005	22
98A	849	0.50%	15%	0.05	77	17%	0.05	0.6	77	68%	0.05	2.5	104	5	2	0.005	22
99	1106	0.40%	0%	0.05	77	80%	0.05	0.6	77	20%	0.05	2.5	199	13	2	0.005	22
910A	541	1.10%	4%	0.05	77	33%	0.05	0.6	77	63%	0.05	2.5	200	13	2	0.005	22
101A	452	0.90%	0%	0.05	77	80%	0.05	0.6	77	20%	0.05	2.5	200	13	2	0.005	22
102A	423	0.90%	0%	0.05	77	80%	0.05	0.6	77	20%	0.05	2.5	198	13	2	0.005	22
103A	603	0.70%	0%	0.05	77	77%	0.05	0.6	77	23%	0.05	2.5	200	13	2	0.005	22
104A	698	0.60%	0%	0.05	77	77%	0.05	0.6	77	23%	0.05	2.5	200	13	2	0.005	22
1251A	696	0.60%	0%	0.05	77	61%	0.05	0.6	77	39%	0.05	2.5	200	13	2	0.005	22
106	374	0.30%	0%	0.05	77	50%	0.05	0.6	77	50%	0.05	2.5	200	13	2	0.005	22
107A	1158	0.40%	15%	0.05	77	17%	0.05	0.6	77	68%	0.05	2.5	200	13	2	0.005	22
108A	1175	0.70%	6%	0.05	77	25%	0.05	0.6	77	69%	0.05	2.5	200	13	2	0.005	22
109A	1176	0.70%	18%	0.05	77	22%	0.05	0.6	77	60%	0.05	2.5	200	13	2	0.005	22
1010A	1089	0.70%	17%	0.05	77	24%	0.05	0.6	77	59%	0.05	2.5	200	13	2	0.005	22
1012A	448	0.40%	9%	0.05	77	11%	0.05	0.6	77	80%	0.05	2.5	125	5	2	0.005	22
121A	1881	5.70%	17%	0.05	77	20%	0.05	0.6	77	62%	0.05	2.5	100	5	2	0.005	22
122A	2149	5.50%	15%	0.05	77	19%	0.05	0.6	77	66%	0.05	2.5	103	5	2	0.005	22
123A	1907	6.30%	5%	0.05	77	33%	0.05	0.6	77	61%	0.05	2.5	124	7	2	0.005	22
125A	1291	0.20%	0%	0.05	77	75%	0.05	0.6	77	25%	0.05	2.5	202	15	2	0.005	22
126A	1534	0.30%	9%	0.05	77	11%	0.05	0.6	77	80%	0.05	2.5	100	5	2	0.005	22
127A	1294	0.40%	2%	0.05	77	55%	0.05	0.6	77	43%	0.05	2.5	200	13	2	0.005	22
129A	691	0.90%	5%	0.05	77	38%	0.05	0.6	77	58%	0.05	2.5	124	10	2	0.005	22
1210A	495	0.60%	7%	0.05	77	23%	0.05	0.6	77	70%	0.05	2.5	250	25	2	0.005	22
1211A	859	0.30%	6%	0.05	77	25%	0.05	0.6	77	69%	0.05	2.5	140	10	2	0.005	22
1212A	660	0.30%	13%	0.05	77	17%	0.05	0.6	77	70%	0.05	2.5	97	4	2	0.005	22
1011	880	0.50%	24%	0.05	77	26%	0.05	0.6	77	50%	0.05	2.5	128	7	2	0.005	22

APPENDIX B:

Hydraulic Modelling

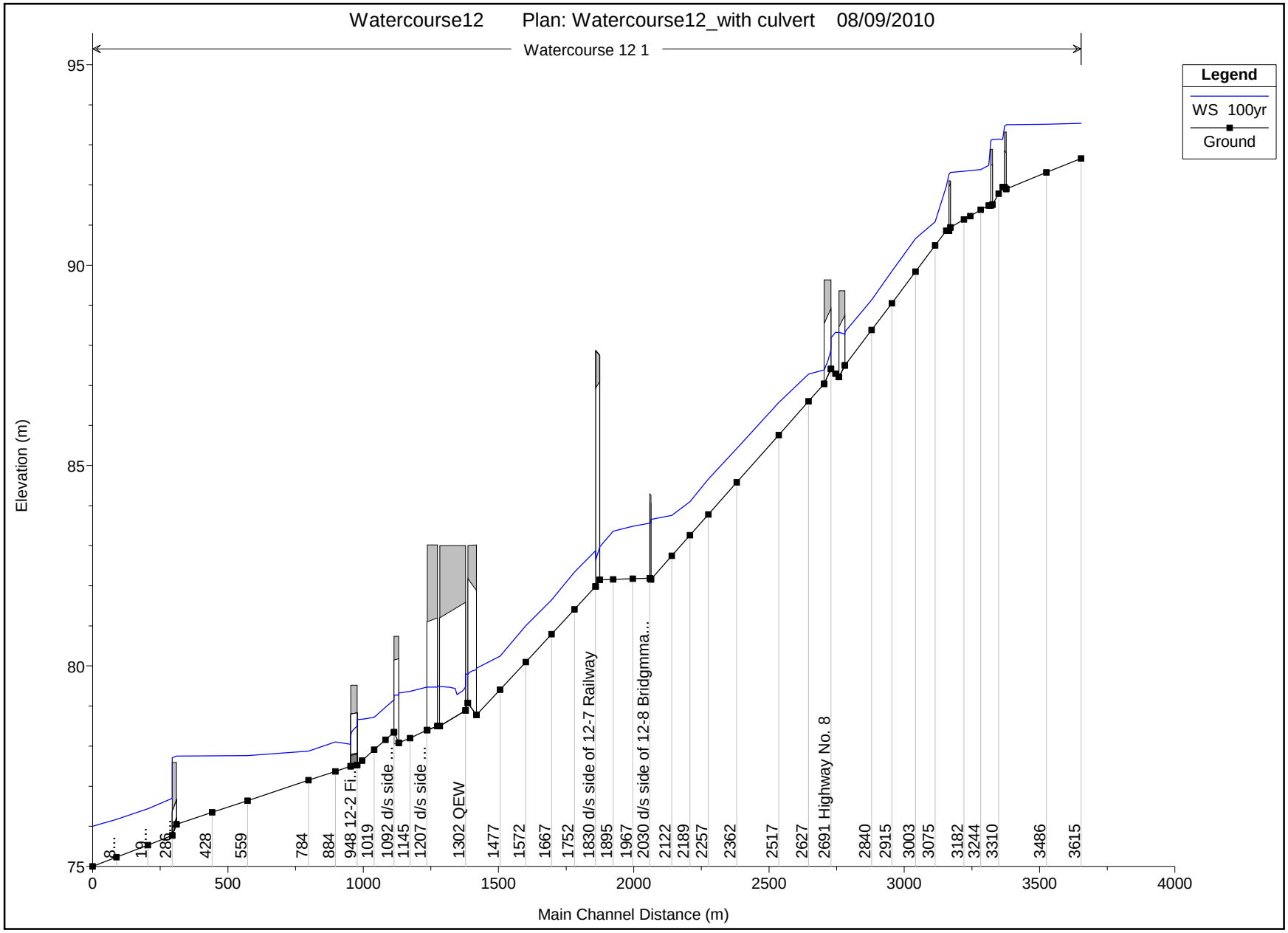
Watercourse 9 – Existing Landuse


Watercourse 9 Plan: Watercourse9 28/05/2010
Watercourse 9 1
Legend
WS 100yr
Ground
Elevation (m)
Main Channel Distance (m)
86
84
82
80
78
76
74
0
200
400
600
800
1000
1200
1400
0050
0130
0160 d/s side of...
0180 QEW / N&S Service R...
0325
0380
0420
0460
0500
0550
0620
0670
0715
0765 d/s side of Railway
0778 Railway
0910
0990
1100
1220
1280

HEC-RAS Plan: WC 9 River: Watercourse 9 Reach: 1 Profile: 100yr

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
1	1280	100yr	5.10	83.38	84.25	84.25	84.69	0.012624	2.93	1.74	8.65	1.00
1	1220	100yr	5.10	83.07	83.89	83.67	83.97	0.004562	1.21	4.20	8.20	0.54
1	1100	100yr	5.10	82.47	83.25		83.34	0.006020	1.36	3.76	7.66	0.62
1	0990	100yr	5.10	81.93	82.71		82.78	0.004364	1.13	4.51	9.54	0.53
1	0910	100yr	5.10	81.53	82.32		82.40	0.005120	1.25	4.09	8.38	0.57
1	0805	100yr	5.10	81.00	82.01		82.05	0.002158	0.94	5.41	8.72	0.38
1	0790	100yr	5.10	80.92	82.00	81.39	82.05	0.000135	0.94	5.41	12.03	0.29
1	0778		Culvert									
1	0765	100yr	5.20	80.73	81.53	81.21	81.62	0.002770	1.30	4.01	9.92	0.46
1	0715	100yr	5.20	80.58	81.35		81.43	0.005227	1.24	4.21	8.94	0.57
1	0670	100yr	5.20	80.34	81.04		81.14	0.007498	1.40	3.71	8.52	0.68
1	0620	100yr	5.20	79.97	80.67		80.77	0.007468	1.40	3.72	8.61	0.68
1	0550	100yr	5.20	79.44	80.20		80.29	0.006301	1.35	3.84	8.15	0.63
1	0500	100yr	5.20	79.06	79.82		79.94	0.007890	1.54	3.39	6.96	0.70
1	0460	100yr	5.20	78.76	79.48		79.60	0.008745	1.56	3.33	7.25	0.74
1	0420	100yr	5.20	78.46	79.21		79.30	0.006332	1.34	3.88	8.39	0.63
1	0380	100yr	5.20	78.16	78.99	78.78	79.07	0.004892	1.27	4.10	7.85	0.56
1	0325	100yr	5.20	77.75	78.39	78.39	78.60	0.016801	2.05	2.53	5.93	1.00
1	0275	100yr	5.20	77.37	78.04	77.80	78.13	0.000474	1.29	4.04	8.69	0.50
1	0180		Culvert									
1	0160	100yr	5.70	76.28	77.29	76.73	77.33	0.001078	0.94	6.05	7.17	0.30
1	0130	100yr	5.70	76.00	77.10		77.24	0.005960	1.68	3.39	4.19	0.60
1	0050	100yr	5.70	75.40	76.38		76.61	0.010613	2.10	2.71	3.51	0.76
1	0006	100yr	5.70	75.00	76.00	75.81	76.18	0.008339	1.90	3.00	4.00	0.70

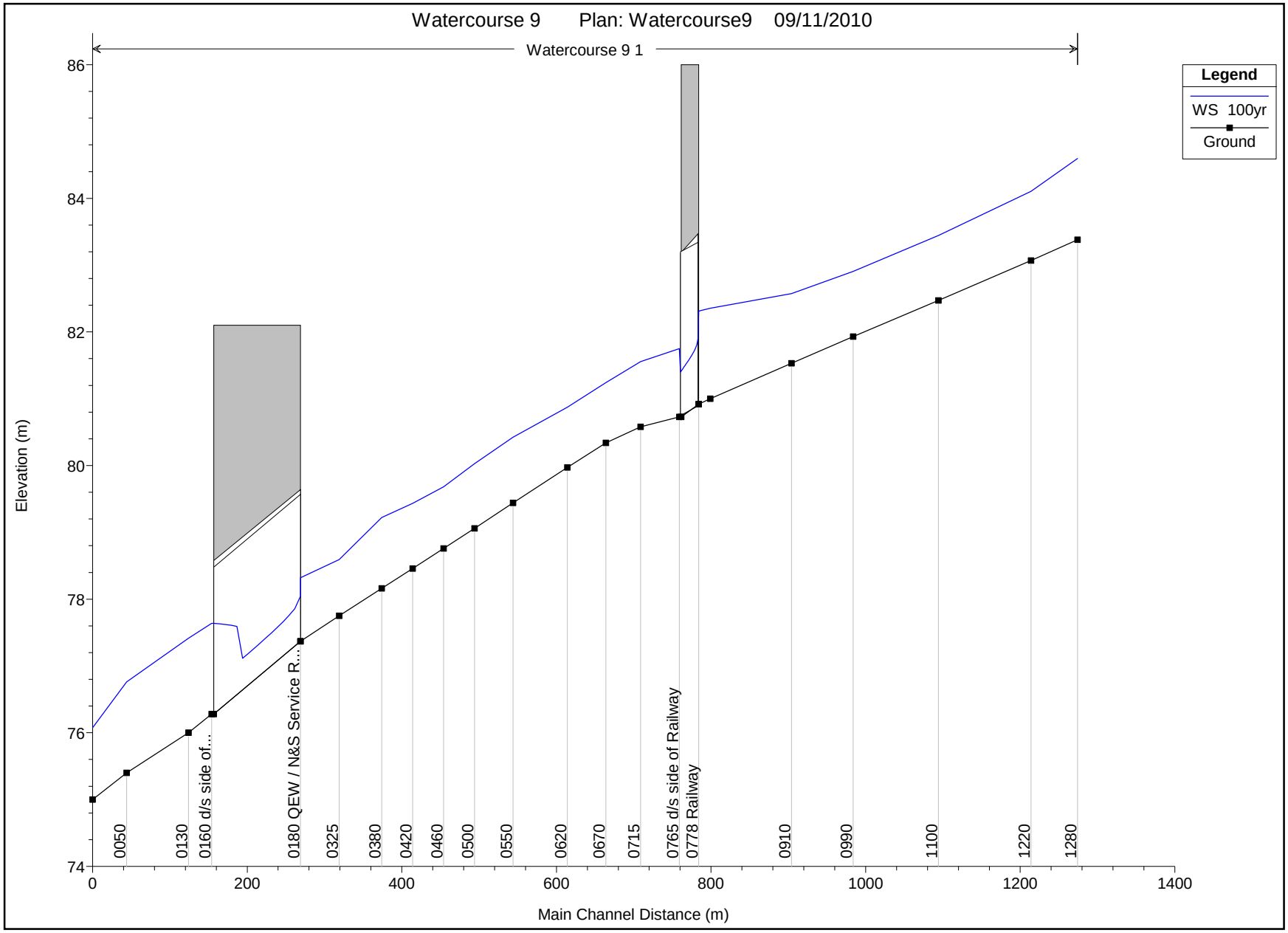
Watercourse 12 – Existing Landuse


Watercourse12 Plan: Watercourse12_with culvert 08/09/2010
Watercourse 12 1
Legend
WS 100yr
Ground
Elevation (m)
Main Channel Distance (m)
95
90
85
80
75
0
500
1000
1500
2000
2500
3000
3500
4000
8...
19...
286...
428
559
784
884
948 12-2 Fi...
1019
1092 d/s side ...
1145
1207 d/s side ...
1302 QEW
1477
1572
1667
1752
1830 d/s side of 12-7 Railway
1895
1967
2030 d/s side of 12-8 Bridgmma...
2122
2189
2257
2362
2517
2627
2691 Highway No. 8
2840
2915
3003
3075
3182
3244
3310
3486
3615

HEC-RAS Plan: 2 River: Watercourse 12 Reach: 1 Profile: 100yr

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
1	3615	100yr	4.20	92.66	93.54	93.39	93.55	0.001179	0.75	14.73	69.03	0.28
1	3486	100yr	4.20	92.31	93.52		93.52	0.000102	0.28	39.35	105.43	0.09
1	3338	100yr	4.20	91.90	93.50	92.87	93.51	0.000055	0.33	25.07	67.38	0.10
1	3332		Culvert									
1	3325	100yr	4.20	91.95	93.14	92.85	93.15	0.000697	0.59	8.33	30.08	0.22
1	3310	100yr	4.20	91.78	93.14		93.14	0.000081	0.28	38.81	88.35	0.08
1	3287	100yr	4.20	91.51	93.14	92.75	93.14	0.000028	0.26	55.46	101.17	0.07
1	3280		Culvert									
1	3273	100yr	4.20	91.49	92.49	92.49	92.60	0.004846	1.61	3.95	10.43	0.57
1	3244	100yr	4.20	91.38	92.39	92.16	92.46	0.002955	1.31	4.78	11.91	0.46
1	3205	100yr	4.20	91.22	92.36		92.38	0.000957	0.82	10.15	26.94	0.27
1	3182	100yr	4.20	91.14	92.34		92.36	0.000777	0.78	11.25	31.67	0.24
1	3132	100yr	4.20	90.94	92.31	92.10	92.34	0.000326	0.80	12.46	32.29	0.24
1	3124		Culvert									
1	3116	100yr	4.20	90.86	91.96	91.96	92.02	0.002174	1.19	5.33	11.90	0.40
1	3075	100yr	4.20	90.49	91.08	91.26	91.63	0.045731	3.28	1.30	3.65	1.61
1	3003	100yr	4.20	89.84	90.67	90.62	90.77	0.006026	1.60	4.46	18.21	0.63
1	2915	100yr	4.20	89.05	89.85	89.82	90.06	0.010873	2.09	2.36	6.11	0.84
1	2840	100yr	4.20	88.38	89.13	89.13	89.27	0.009622	1.86	3.55	14.27	0.78
1	2742	100yr	4.20	87.50	88.34	88.03	88.44	0.000647	1.43	2.93	13.00	0.50
1	2734		Culvert									
1	2726	100yr	4.20	87.21	88.32	87.74	88.38	0.001840	1.08	3.88	18.51	0.33
1	2714	100yr	4.20	87.29	88.32		88.35	0.000887	0.76	6.33	10.30	0.26
1	2697	100yr	4.20	87.41	88.18	87.94	88.31	0.000824	1.55	2.71	15.60	0.56
1	2691		Culvert									
1	2685	100yr	4.20	87.04	87.39	87.57	88.00	0.077789	3.48	1.21	3.50	1.89
1	2627	100yr	4.20	86.60	87.28	87.22	87.45	0.009802	1.84	2.48	6.75	0.79
1	2517	100yr	4.20	85.76	86.58		86.69	0.004952	1.51	2.85	4.54	0.58
1	2362	100yr	6.10	84.58	85.42		85.63	0.008689	2.06	3.25	6.18	0.77
1	2257	100yr	6.10	83.78	84.67		84.83	0.006575	1.86	3.94	8.63	0.68
1	2189	100yr	6.10	83.26	84.10		84.31	0.008918	2.07	3.25	6.36	0.78
1	2122	100yr	6.10	82.75	83.75		83.88	0.004051	1.61	4.53	8.03	0.55
1	2045	100yr	6.10	82.16	83.66	83.02	83.80	0.000428	1.66	3.68	27.12	0.43
1	2038		Culvert									
1	2030	100yr	6.10	82.19	83.56	83.05	83.73	0.003383	1.81	3.36	21.59	0.49
1	1967	100yr	6.10	82.18	83.49		83.55	0.001390	1.15	6.61	8.65	0.34
1	1895	100yr	6.10	82.16	83.36		83.43	0.001897	1.26	6.12	9.22	0.39
1	1845	100yr	7.00	82.15	82.97	82.97	83.27	0.001777	2.45	3.49	8.39	0.94
1	1838		Bridge									
1	1830	100yr	7.00	81.98	82.87	82.82	83.07	0.007937	2.05	4.16	10.30	0.75
1	1752	100yr	7.00	81.41	82.34		82.50	0.006226	1.88	4.99	12.12	0.67
1	1667	100yr	7.00	80.79	81.65	81.62	81.86	0.009222	2.15	4.20	11.08	0.80
1	1572	100yr	7.00	80.10	81.00		81.14	0.006010	1.80	5.96	18.12	0.65
1	1477	100yr	7.00	79.41	80.24	80.24	80.43	0.009207	2.10	4.85	16.15	0.80
1	1390	100yr	7.00	78.78	79.94	79.33	80.00	0.000208	1.10	6.39	26.06	0.32
1	1380		Culvert									
1	1358	100yr	7.00	79.08	79.79	79.63	79.95	0.006175	1.79	3.91	24.38	0.68
1	1350	100yr	7.00	78.89	79.80	79.48	79.93	0.000470	1.57	4.47	27.79	0.52
1	1302		Culvert									
1	1254	100yr	7.00	78.50	79.49	79.09	79.59	0.002607	1.45	4.84	44.48	0.46
1	1246	100yr	6.90	78.50	79.51	79.00	79.57	0.000198	1.09	6.34	46.60	0.35
1	1226		Culvert									
1	1207	100yr	6.90	78.40	79.47	78.90	79.53	0.001162	1.02	6.76	21.03	0.31
1	1145	100yr	6.90	78.20	79.37		79.44	0.001709	1.20	6.81	9.41	0.37
1	1103	100yr	6.90	78.08	79.33	78.72	79.41	0.000209	1.29	5.36	16.00	0.37
1	1097		Culvert									
1	1092	100yr	6.90	78.35	79.15	78.99	79.36	0.006510	1.99	3.46	11.32	0.71
1	1061	100yr	6.90	78.16	78.97		79.13	0.006864	1.83	4.53	11.37	0.69
1	1019	100yr	6.90	77.91	78.72		78.85	0.005999	1.71	5.61	18.26	0.65
1	974	100yr	6.90	77.64	78.67		78.71	0.001454	1.01	12.46	34.54	0.33
1	956	100yr	6.90	77.53	78.66	77.94	78.69	0.000284	0.72	9.59	8.76	0.22
1	948		Culvert									
1	940	100yr	6.90	77.50	78.05	77.92	78.17	0.007115	1.53	4.50	8.32	0.66
1	884	100yr	6.90	77.37	78.10	78.00	78.10	0.000017	0.08	100.97	124.82	0.03
1	784	100yr	6.90	77.15	77.88	77.88	78.08	0.010180	2.05	4.21	14.40	0.83
1	559	100yr	6.90	76.64	77.76	77.14	77.76	0.000019	0.12	106.29	151.81	0.04
1	428	100yr	6.90	76.35	77.76	77.00	77.76	0.000015	0.13	113.86	154.16	0.04
1	296	100yr	6.90	76.05	77.75	76.60	77.76	0.000033	0.31	62.18	93.04	0.08
1	291		Culvert									
1	286	100yr	6.90	75.77	76.70	76.32	76.79	0.003671	1.36	5.07	5.55	0.46
1	196	100yr	6.90	75.53	76.44	76.27	76.49	0.002632	1.23	10.07	34.81	0.44
1	80	100yr	6.90	75.23	76.18	75.97	76.22	0.002048	1.12	11.39	37.17	0.39
1	0000	100yr	6.90	75.00	76.00	75.73	76.05	0.001877	1.12	10.47	28.85	0.38

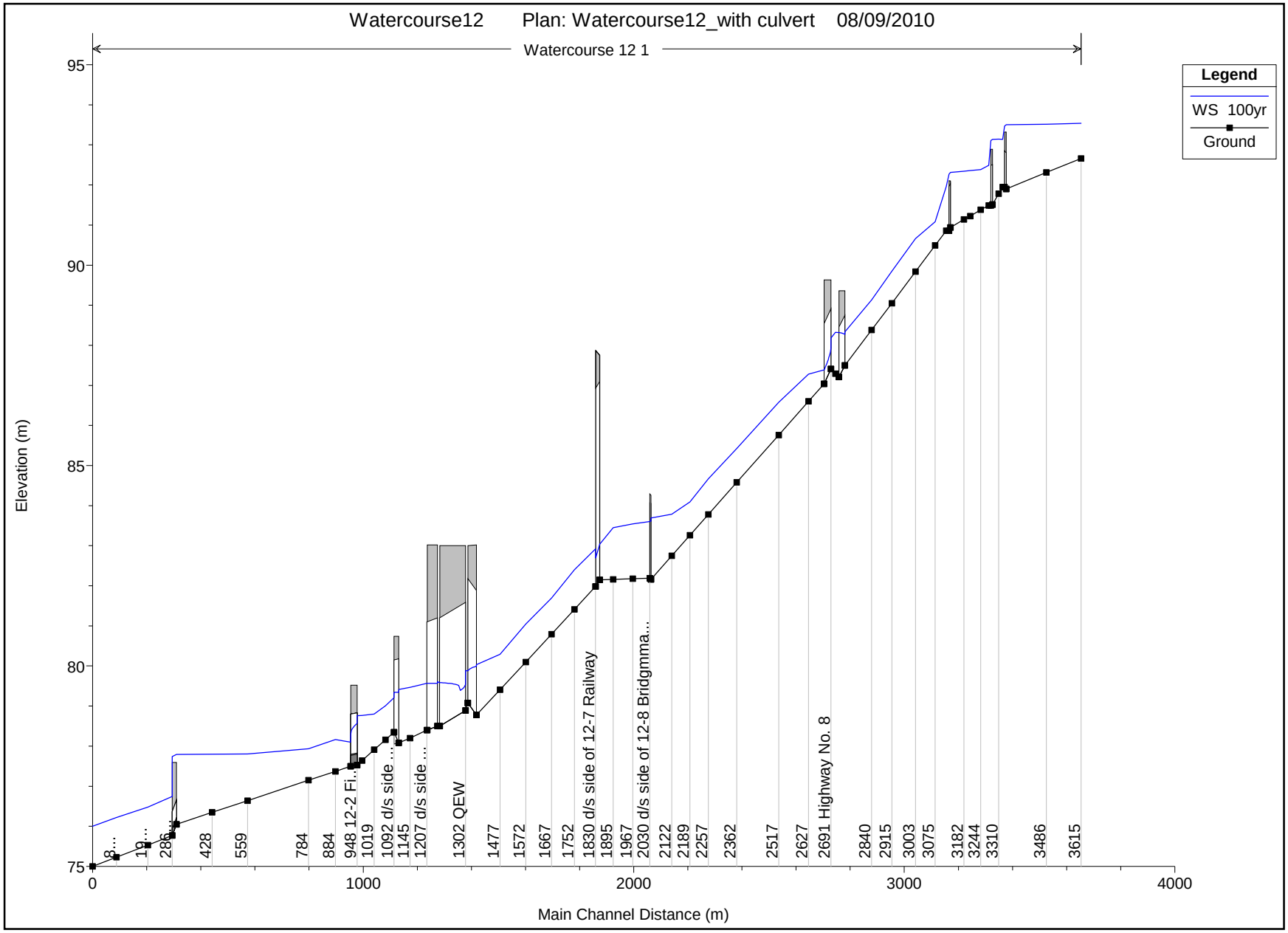
Watercourse 9 – Future Landuse


Watercourse 9 Plan: Watercourse9 09/11/2010
Watercourse 9 1
Legend
WS 100yr
Ground
Elevation (m)
Main Channel Distance (m)
86
84
82
80
78
76
74
0
200
400
600
800
1000
1200
1400
0050
0130
0160 d/s side of...
0180 QEW / N&S Service R...
0325
0380
0420
0460
0500
0550
0620
0670
0715
0765 d/s side of Railway
0778 Railway
0910
0990
1100
1220
1280

HEC-RAS Plan: WC 9 River: Watercourse 9 Reach: 1 Profile: 100yr

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
1	1280	100yr	8.40	83.38	84.60	84.60	85.20	0.011204	3.45	2.44	11.30	1.00
1	1220	100yr	8.40	83.07	84.10	83.84	84.20	0.004536	1.38	6.10	9.79	0.56
1	1100	100yr	8.40	82.47	83.44		83.57	0.006187	1.56	5.39	9.07	0.65
1	0990	100yr	8.40	81.93	82.91		82.99	0.004306	1.28	6.56	11.44	0.54
1	0910	100yr	8.40	81.53	82.58		82.66	0.003961	1.29	6.51	10.46	0.52
1	0805	100yr	8.40	81.00	82.35		82.40	0.001572	0.95	8.81	11.02	0.34
1	0790	100yr	8.40	80.92	82.31	81.58	82.39	0.000159	1.21	6.96	14.04	0.33
1	0778		Culvert									
1	0765	100yr	9.00	80.73	81.75	81.42	81.91	0.003693	1.76	5.11	11.27	0.56
1	0715	100yr	9.00	80.58	81.56		81.66	0.005416	1.44	6.25	10.80	0.60
1	0670	100yr	9.00	80.34	81.24		81.37	0.007525	1.62	5.56	10.34	0.70
1	0620	100yr	9.00	79.97	80.87		81.00	0.007273	1.59	5.65	10.51	0.69
1	0550	100yr	9.00	79.44	80.42		80.54	0.005926	1.52	5.91	10.00	0.63
1	0500	100yr	9.00	79.06	80.03		80.19	0.008139	1.79	5.02	8.36	0.74
1	0460	100yr	9.00	78.76	79.68		79.85	0.008965	1.82	4.95	8.73	0.77
1	0420	100yr	9.00	78.46	79.44		79.55	0.005792	1.49	6.02	10.35	0.63
1	0380	100yr	9.00	78.16	79.22	78.98	79.33	0.004980	1.47	6.11	9.49	0.59
1	0325	100yr	9.00	77.75	78.59	78.59	78.87	0.015761	2.32	3.88	7.19	1.01
1	0275	100yr	9.00	77.37	78.32	77.98	78.45	0.000449	1.58	5.71	9.81	0.52
1	0180		Culvert									
1	0160	100yr	9.30	76.28	77.64	76.91	77.70	0.001063	1.14	8.14	7.58	0.31
1	0130	100yr	9.30	76.00	77.42		77.60	0.006059	1.92	4.83	4.83	0.61
1	0050	100yr	9.30	75.40	76.76	76.52	77.02	0.008812	2.24	4.15	4.10	0.71
1	0006	100yr	9.30	75.00	76.07	76.07	76.48	0.017029	2.81	3.30	4.15	1.01

Watercourse 12 – Future Landuse


Watercourse12 Plan: Watercourse12_with culvert 08/09/2010
Watercourse 12 1
Legend
WS 100yr
Ground
Elevation (m)
Main Channel Distance (m)
95
90
85
80
75
0
1000
2000
3000
4000
8....
19....
286....
428
559
784
884
948 12-2 Fi...
1019
1092 d/s side ...
1145
1207 d/s side ...
1302 QEW
1477
1572
1667
1752
1830 d/s side of 12-7 Railway
1895
1967
2030 d/s side of 12-8 Bridgmma...
2122
2189
2257
2362
2517
2627
2691 Highway No. 8
2840
2915
3003
3075
3182
3244
3310
3486
3615

HEC-RAS Plan: 2 River: Watercourse 12 Reach: 1 Profile: 100yr

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
1	3615	100yr	4.20	92.66	93.54	93.39	93.55	0.001179	0.75	14.73	69.03	0.28
1	3486	100yr	4.20	92.31	93.52		93.52	0.000102	0.28	39.35	105.43	0.09
1	3338	100yr	4.20	91.90	93.50	92.87	93.51	0.000055	0.33	25.07	67.38	0.10
1	3332		Culvert									
1	3325	100yr	4.20	91.95	93.14	92.85	93.15	0.000697	0.59	8.33	30.08	0.22
1	3310	100yr	4.20	91.78	93.14		93.14	0.000081	0.28	38.81	88.35	0.08
1	3287	100yr	4.20	91.51	93.14	92.75	93.14	0.000028	0.26	55.46	101.17	0.07
1	3280		Culvert									
1	3273	100yr	4.20	91.49	92.49	92.49	92.60	0.004846	1.61	3.95	10.43	0.57
1	3244	100yr	4.20	91.38	92.39	92.16	92.46	0.002955	1.31	4.78	11.91	0.46
1	3205	100yr	4.20	91.22	92.36		92.38	0.000957	0.82	10.15	26.94	0.27
1	3182	100yr	4.20	91.14	92.34		92.36	0.000777	0.78	11.25	31.67	0.24
1	3132	100yr	4.20	90.94	92.31	92.10	92.34	0.000326	0.80	12.46	32.29	0.24
1	3124		Culvert									
1	3116	100yr	4.20	90.86	91.96	91.96	92.02	0.002174	1.19	5.33	11.90	0.40
1	3075	100yr	4.20	90.49	91.08	91.26	91.63	0.045731	3.28	1.30	3.65	1.61
1	3003	100yr	4.20	89.84	90.67	90.62	90.77	0.006026	1.60	4.46	18.21	0.63
1	2915	100yr	4.20	89.05	89.85	89.82	90.06	0.010873	2.09	2.36	6.11	0.84
1	2840	100yr	4.20	88.38	89.13	89.13	89.27	0.009622	1.86	3.55	14.27	0.78
1	2742	100yr	4.20	87.50	88.34	88.03	88.44	0.000647	1.43	2.93	13.00	0.50
1	2734		Culvert									
1	2726	100yr	4.20	87.21	88.32	87.74	88.38	0.001840	1.08	3.88	18.51	0.33
1	2714	100yr	4.20	87.29	88.32		88.35	0.000887	0.76	6.33	10.30	0.26
1	2697	100yr	4.20	87.41	88.18	87.94	88.31	0.000824	1.55	2.71	15.60	0.56
1	2691		Culvert									
1	2685	100yr	4.20	87.04	87.39	87.57	88.00	0.077789	3.48	1.21	3.50	1.89
1	2627	100yr	4.20	86.60	87.28	87.22	87.45	0.009840	1.85	2.48	6.75	0.79
1	2517	100yr	4.20	85.76	86.58		86.69	0.004926	1.51	2.85	4.55	0.58
1	2362	100yr	6.10	84.58	85.42		85.63	0.008744	2.06	3.24	6.17	0.78
1	2257	100yr	6.10	83.78	84.67		84.83	0.006517	1.85	3.96	8.65	0.68
1	2189	100yr	6.10	83.26	84.09		84.31	0.009062	2.08	3.23	6.34	0.79
1	2122	100yr	6.10	82.75	83.79		83.90	0.003523	1.53	4.80	8.30	0.51
1	2045	100yr	6.10	82.16	83.69	83.02	83.83	0.000398	1.62	3.77	27.90	0.42
1	2038		Culvert									
1	2030	100yr	6.10	82.19	83.61	83.05	83.76	0.003069	1.76	3.46	22.48	0.47
1	1967	100yr	6.10	82.18	83.55		83.60	0.001158	1.08	7.12	8.99	0.31
1	1895	100yr	6.10	82.16	83.45		83.51	0.001377	1.13	7.00	9.90	0.33
1	1845	100yr	8.00	82.15	83.04	83.04	83.35	0.001679	2.53	4.04	9.28	0.93
1	1838		Bridge									
1	1830	100yr	8.00	81.98	82.92	82.87	83.13	0.008006	2.15	4.59	11.12	0.76
1	1752	100yr	8.00	81.41	82.40		82.57	0.006165	1.96	5.68	13.14	0.67
1	1667	100yr	8.00	80.79	81.70	81.68	81.92	0.009296	2.25	4.75	12.02	0.81
1	1572	100yr	8.00	80.10	81.04		81.19	0.006139	1.89	6.74	19.57	0.67
1	1477	100yr	8.00	79.41	80.29	80.29	80.49	0.008884	2.15	5.67	17.90	0.79
1	1390	100yr	8.00	78.78	80.03	79.38	80.10	0.000212	1.16	6.88	28.83	0.33
1	1380		Culvert									
1	1358	100yr	8.00	79.08	79.88	79.68	80.05	0.005481	1.82	4.39	26.70	0.65
1	1350	100yr	8.00	78.89	79.89	79.54	80.02	0.000456	1.64	4.88	29.92	0.52
1	1302		Culvert									
1	1254	100yr	8.00	78.50	79.59	79.15	79.70	0.002484	1.50	5.32	48.42	0.46
1	1246	100yr	8.00	78.50	79.61	79.05	79.67	0.000195	1.15	6.97	50.56	0.35
1	1226		Culvert									
1	1207	100yr	8.00	78.40	79.57	78.95	79.63	0.001177	1.09	7.36	22.34	0.32
1	1145	100yr	8.00	78.20	79.47		79.54	0.001647	1.25	7.78	10.07	0.37
1	1103	100yr	8.00	78.08	79.41	78.79	79.51	0.000225	1.40	5.72	17.27	0.39
1	1097		Culvert									
1	1092	100yr	8.00	78.35	79.21	79.05	79.45	0.007102	2.17	3.68	12.43	0.75
1	1061	100yr	8.00	78.16	79.01		79.19	0.007495	1.98	4.99	12.17	0.73
1	1019	100yr	8.00	77.91	78.80		78.92	0.005016	1.68	7.17	21.62	0.60
1	974	100yr	8.00	77.64	78.77		78.80	0.001144	0.95	16.11	40.00	0.30
1	956	100yr	8.00	77.53	78.76	77.99	78.79	0.000293	0.77	10.38	8.80	0.22
1	948		Culvert									
1	940	100yr	8.00	77.50	78.10	77.96	78.24	0.007000	1.62	4.94	8.34	0.67
1	884	100yr	8.00	77.37	78.16	78.00	78.16	0.000018	0.09	108.56	127.51	0.04
1	784	100yr	8.00	77.15	77.94	77.94	78.14	0.009456	2.10	5.11	16.78	0.81
1	559	100yr	8.00	76.64	77.80	77.14	77.80	0.000021	0.13	112.47	153.10	0.04
1	428	100yr	8.00	76.35	77.80	77.00	77.80	0.000017	0.14	120.08	155.24	0.04
1	296	100yr	8.00	76.05	77.79	76.66	77.80	0.000039	0.35	65.88	95.89	0.08
1	291		Culvert									
1	286	100yr	8.00	75.77	76.75	76.38	76.86	0.004181	1.49	5.35	5.56	0.49
1	196	100yr	8.00	75.53	76.48	76.32	76.54	0.002616	1.27	11.75	38.19	0.44
1	80	100yr	8.00	75.23	76.22	76.02	76.27	0.002073	1.17	13.12	40.39	0.39
1	0000	100yr	8.00	75.00	76.00	75.79	76.06	0.002523	1.30	10.47	28.85	0.44

APPENDIX C:

Groundwater Recharge Calculations

TABLE C.1:
Potential Infiltration Deficit Estimates

Soil / Landuse Scenario	Hypothetical Catchment Area (ha)	*Pre-development Condition*					*Post-development Condition*					Infiltration Deficit	
		Area (ha)	Landuse	Soil Types	Infiltration depth (mm/yr)	Infiltration volume (m3/yr)	Area (ha)	Landuse	Soil Types	Infiltration depth (mm/yr)	Infiltration volume (m3/yr)	(m3/yr)	(mm/yr)
clay / silt soils with proposed residential development	10.0	10.0	Agricultural	clay-silt	140	14,000	5.0	Impervious Surface	clay-silt	0	0		
		0.0	paved	clay-silt	140	0	5.0	Lawns / open	clay-silt	140	7,000		
					Total	**14,000**				**Total**	**7,000**	**7,000**	**70.0**
clay / silt soils with proposed industrial/commercial development	10.0	10.0	Agricultural	clay-silt	140	14,000	8.0	Impervious Surface	clay-silt	0	0		
		0.0	paved	clay-silt	140	0	2.0	Lawns / open	clay-silt	140	2,800		
					Total	**14,000**				**Total**	**2,800**	**11,200**	**112.0**
sand / gravel soils with proposed residential development	10.0	10.0	Agricultural	clay-silt	230	23,000	5.0	Impervious Surface	clay-silt	0	0		
		0.0	paved	clay-silt	230	0	5.0	Lawns / open	clay-silt	230	11,500		
					Total	**23,000**				**Total**	**11,500**	**11,500**	**115.0**

TABLE C.2:
Detemination of Infiltration Targets for Future Development

Soil / Landuse Scenario No.	Hypothetical Catchment Area (ha)	Potential Infiltration Deficit (mm/yr)	Portion(s) Contributing to Infiltration: Component(s)	Area (ha)	Target Infiltration Depth (mm)	Rainfall Distribution and Infiltration Volumes:	1-4mm	4-8mm	8-12mm	12-16mm	16-20mm	20-24mm	24-28mm	>28mm	Resulting Annual Infiltration (m3/yr)	(mm/yr over catchment)	meets or exceeds deficit target?
						rainfall range:	1-4mm	4-8mm	8-12mm	12-16mm	16-20mm	20-24mm	24-28mm	>28mm			
						avg of range:	2	6	10	14	18	22	26	33			
						No. of events/yr:	18.4	10.9	5.1	2.9	2	1.8	1.2	2.7			
clay / silt soils with proposed residential development	10	70.0	whole catchment:	10.0	1.6	Infiltration Volume (m3/event):	160	160	160	160	160	160	160	160			
						Annual Infiltration volume (m3/yr):	2944	1744	816	464	320	288	192	432	7,200.00	72	YES
			roofs and rear lots only (50%):	5	4.0	Infiltration Volume (m3/event):	100	200	200	200	200	200	200	200			
						Annual Infiltration volume (m3/yr):	1840	2180	1020	580	400	360	240	540	7,160.00	71.6	YES
clay / silt soils with proposed industrial/commercial development	10	112.0	whole catchment:	10.0	3.0	Infiltration Volume (m3/event):	200	300	300	300	300	300	300	300			
						Annual Infiltration volume (m3/yr):	3680	3270	1530	870	600	540	360	810	11,660.00	116.6	YES
			roofs and lawns only (50%):	5	8.0	Infiltration Volume (m3/event):	100	300	400	400	400	400	400	400			
						Annual Infiltration volume (m3/yr):	1840	3270	2040	1160	800	720	480	1080	11,390.00	113.9	YES
sand / gravel soils with proposed residential development	10	115.0	whole catchment:	10.0	3.0	Infiltration Volume (m3/event):	200	300	300	300	300	300	300	300			
						Annual Infiltration volume (m3/yr):	3680	3270	1530	870	600	540	360	810	11,660.00	116.6	YES
			roofs and rear lots only (50%):	5	9.0	Infiltration Volume (m3/event):	100	300	450	450	450	450	450	450			
						Annual Infiltration volume (m3/yr):	1840	3270	2295	1305	900	810	540	1215	12,175.00	121.75	YES

APPENDIX D:

Public Consultation

Public Information Centre #1

Welcome

WELCOME:

to the First

PUBLIC OPEN HOUSE

for the

STONEY CREEK URBAN BOUNDARY EXPANSION AREA

(SCUBE) SUBWATERSHED STUDY – PHASE 1

Study Area

The Subwatershed Study Area consists of the drainage boundaries of the watercourses which drain the proposed future development areas, namely Watercourses 7.2, 9, 10 and Fifty Creek (Watercourse 12).

Study Overview

The purpose of the Phase 1 study is to investigate and inventory the natural resources of the SCUBE study area, and to identify environmental constraints and opportunities associated with existing/proposed landuses. These constraints and opportunities will then be used in subsequent phases of the Subwatershed Study to develop a Management Plan which is designed to allow environmentally responsible resource management and municipal planning decisions to be made as land use changes occur within the subwatershed.

Phase I: Establish Environmental Conditions

- define existing environmental conditions;
- identify and evaluate natural features and functions of the study area and their potential interrelationship with other natural features; and
- develop constraints mapping to identify developable lands, non-developable lands, and lands requiring environmental mitigation before development can occur.

Key objectives of the Subwatershed Study will be to ensure that future development does not:

- encroach on the Regulatory Floodplain; or
- result in unacceptable increases in downstream flooding.

Protection of groundwater quantity and quality as future development occurs.

Protection of surface water quality as future development occurs.

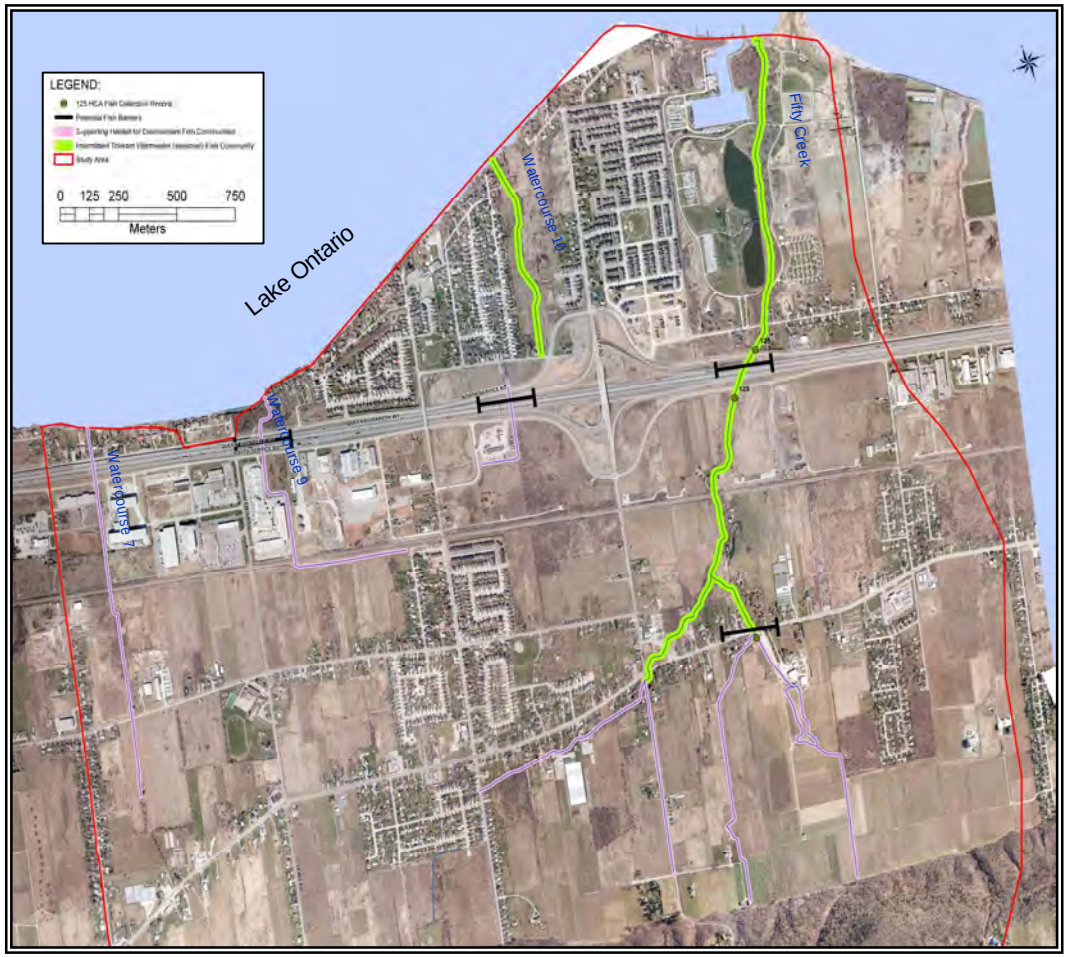
Aquatic Resources

Findings

Watercourses include Fifty Mile Creek and several other small drainage features that drain directly to Lake Ontario. With the exception of Fifty Mile Creek, these small drainage features are highly altered both north and south of the QEW, and have been channelized or piped. There are a few remnant channels and some small wetland/upland habitats adjacent to Lake Ontario.

Fifty Mile Creek supports a tolerant warmwater fish community consisting of golden shiner, white sucker and fathead minnow. In addition to these species, other species may also be present such as creek chub, blacknose/longnose dace and bluntnose minnow. These fish species are tolerant of a wide range of habitat and water quality conditions.

Within the watershed, direct fish habitat is considered to exist in Fifty Creek downstream of Highway 8 and also in a small tributary west of Fifty Creek downstream of the QEW. The remaining drainage features are considered to represent supporting habitat for downstream fish communities.



Stream Morphology

Assessment of stream geomorphology was undertaken within the study area to identify opportunities to manage and restore natural stream morphology under future land use changes.

Stream Characteristics

Fifty Creek main branch and east tributary (Lake Ontario to Hwy 8) – defined alluvial channels generally in wooded corridor, largely influenced by tree roots and woody debris.

- **Fifty Creek main branch (Hwy 8 to Winona Rd)** – artificially straight channelized reaches (ditch-like) through private yards, with local influences by landscaping and driveway crossings.
- **Fifty Creek Tributaries (south of Hwy 8)** – include a variety of straight agricultural drains, ditches, local storm sewers, and escarpment gullies.
- **Watercourse 10.1** – highly modified ephemeral drainage channels (agricultural drains, ditches) outletting to Lake Ontario.
- **Watercourse 9** – engineered channel (trapezoidal and armourstone) north of CNR draining agricultural areas south of the CNR, outletting to Lake Ontario.
- **Watershed 7** – straight agricultural drains and ditches, with a narrow catchment extending north from the escarpment to Lake Ontario.

Terrestrial Resources

Terrestrial Resources include plant and animal communities, including mammals, amphibians and birds.

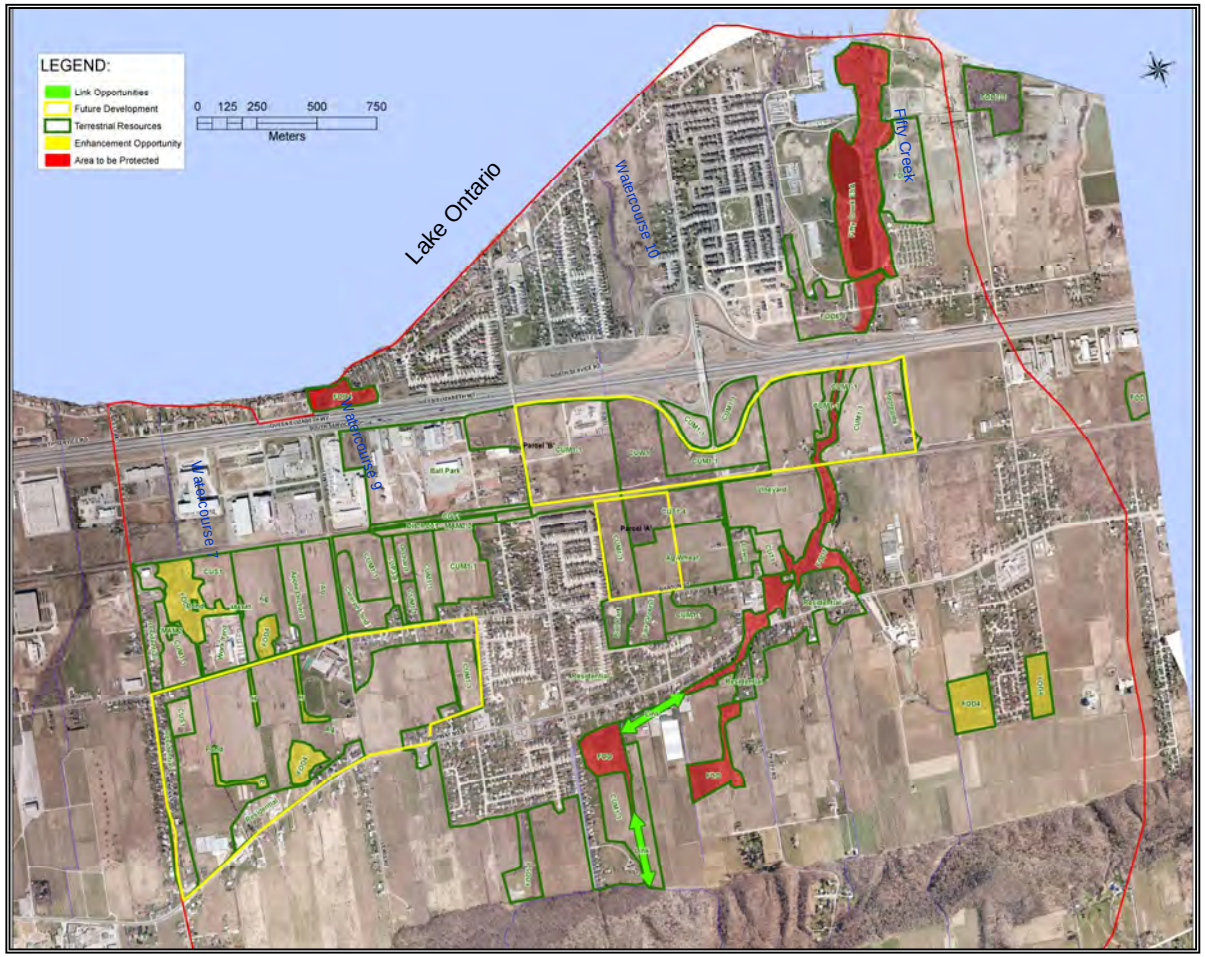
Findings

Ecological Land Classification mapping was completed for the study area and in general natural communities are sparcely distributed and limited to a few woodlots, some hedgerows and some riparian communities. There were no special status species recorded in the study area.

Forest communities are generally young to mid-age deciduous forests dominated by sugar maple, white ash, Manitoba maple, black walnut, buckthorn, willow and aspen. There are a number of pine plantations and orchards.

The majority of features in the study area are cultural meadows, plantations, savannahs and woodlands that exist in a highly disturbed and/or early successional state. The most dominant community type is mineral cultural meadow, of which old field communities are a typical example.

Overall, the natural communities within the study area are cultural in nature and generally have limited value as wildlife habitat, typical of an intensive agricultural area.



Hamilton Public Works
Capital Planning & Implementation Division
Strategy Planning Section
www.hamilton.ca/cpi
Aquafor Beech Limited

Surface Water Resources

Water Quantity / Flood Hazards

The primary function of a floodplain is the conveyance of flood waters during extreme storm events and spring melts. Future urban development is not permitted within the Regulatory Floodplain limits. Future developments will also have to incorporate stormwater controls to prevent increased flood flows downstream.

Analysis

- Computer modelling was undertaken to establish flood flows and flood elevations for Watercourse 9 and Fifty Creek (Watercourse 12).

Findings

The resulting floodlines are plotted on the accompanying map.

Water Quality

Surface water quality is a general term that defines the chemical characteristics of water and their impacts on the environment. Surface water may become polluted by development and human impacts, and may contain one or more of the following:

- suspended sediment from erosion;
- bacteria, including fecal coliform and E. Coli;
- nutrients, such as nitrogen and phosphorus compounds;
- pesticides and herbicides;
- petroleum hydrocarbons, such as fuels and oils;
- toxic heavy metals, such as copper, lead, cadmium, chromium; and
- organic compounds, such as PCBs or industrial solvents.

Water quality is one of the key components of a healthy aquatic habitat, and it also determines the suitability of water for drinking, recreation, fishing, wildlife and general aesthetics.

Findings:

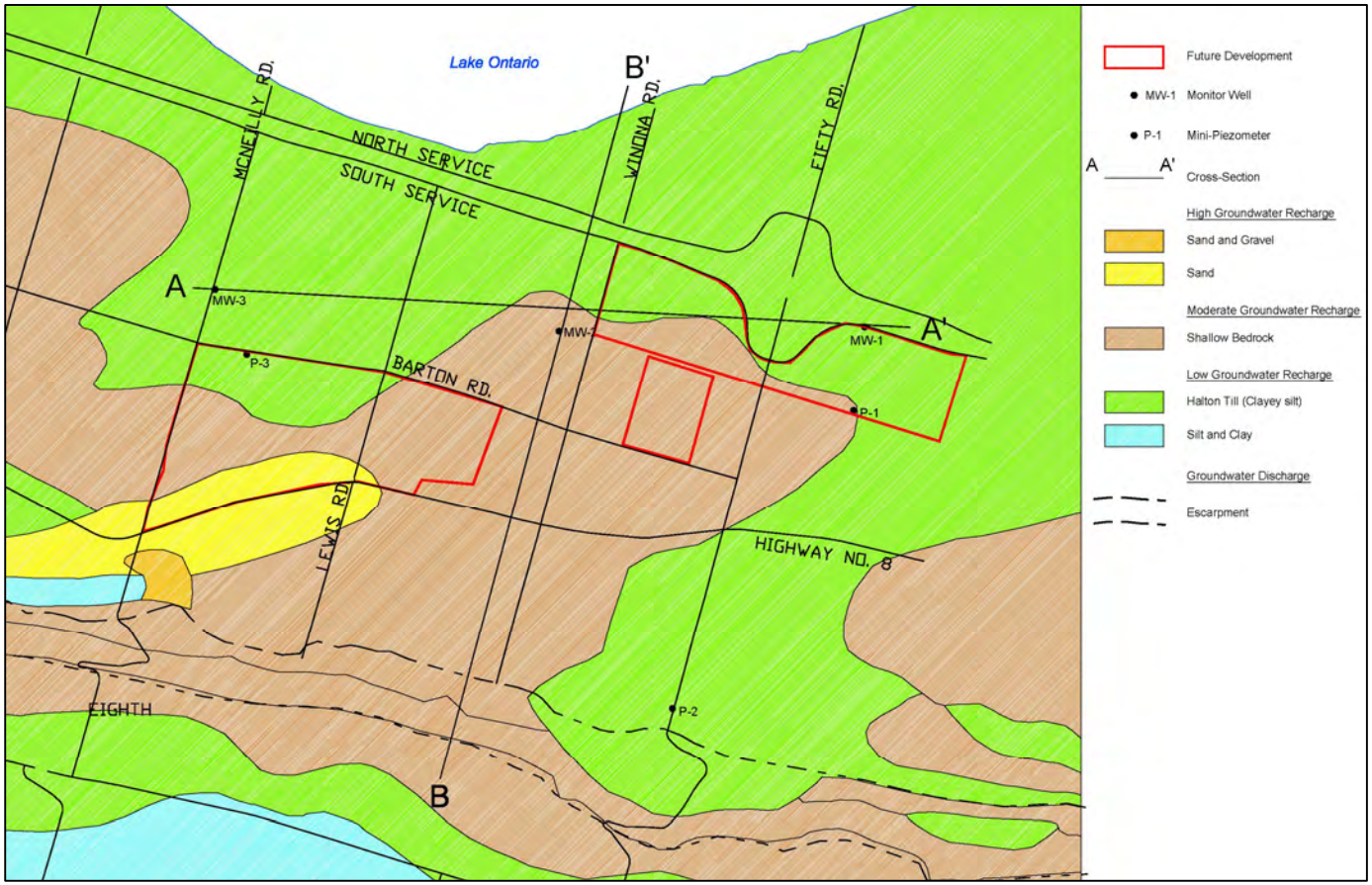
- General water quality sampling by HCA suggested that dissolved oxygen levels are low, indicating a combination of lack of flow, as well as nutrient enrichment from agricultural land use activities, consistent with intensive agricultural land use practices.

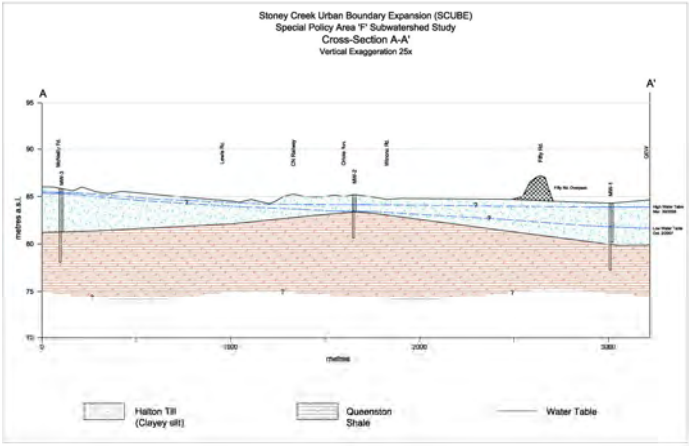
Hamilton Public Works

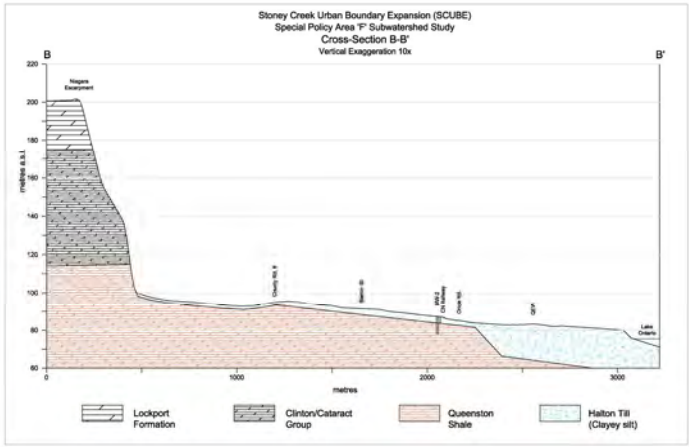
Capital Planning & Implementation Division
Strategy Planning Section
www.hamilton.ca/cpi

Aquafor Beech Limited

Groundwater Resources







Groundwater Resources

Introduction

Hydrogeology is the study of water movement below the ground surface.

Analysis

Water well records, geology, and soils maps were reviewed to characterize the groundwater system within the study area. In addition, a series of monitoring wells and piezometers were installed to assess groundwater levels and chemistry.

Findings

- North of the escarpment, the geology of the SCUBE area can be divided into two distinct zones:
  - The south part of the site (Barton Street to the CN rail tracks) is characterized by a thin layer of soil (<1 metre) overlying a shelf of Queenston shale bedrock; and
  - North of the CN tracks and extending to the Lake Ontario shoreline, the bedrock shelf drops off rapidly. Immediately north of the QEW, the overburden thicknesses exceeds 20 metres. This overburden has been mapped as the Halton Till, consisting of a silty clay till with fine sand lenses.
- The water table is 1m to 2m below the ground surface, and varies by almost 3m seasonally.
- Piezometer readings in the vicinity of Fifty Creek (Watercourse 12) indicate that the groundwater table is located below the stream bed and therefore does not supply any significant baseflow to the stream. This is supported by observations of intermittent flow.
- Piezometer readings in the western portion of the study area (Watercourse 7.2) indicate that the groundwater table is located above the stream bed, suggesting that portion of the stream is a localized groundwater discharge area.
- The sand and gravel deposits associated with the Lake Iroquois shoreline have a relatively high groundwater recharge potential (approx. 250mm/year).
- The areas overlain by Halton Till have a low-to-moderate groundwater recharge potential (approx. 150mm/year).
- Groundwater quality sampling indicated the following:
  - both shallow and deep wells near the QEW experience high levels of chlorides (salt) and sulphates, as well as elevated levels of hardness, conductivity, and ammonia;
  - heavy metals levels were generally low, with the exception of uranium, iron and manganese;
  - bacteria levels were generally low;
  - variable levels of nutrients (phosphorus and nitrogen) were noted.

Opportunities & Constraints

Within the subwatershed area and the future development area, there are a number of environmental protection and enhancement measures to be considered. These measures represent constraints to development, as well as opportunities to enhance the natural environment, as outlined below.

CONSTRAINTS

Preservation Areas (No Development)
Regulatory floodplain limits
Environmental Corridors

- Fisheries setbacks: 1) 30 m warmwater fishery setback; 2) 15 m marginal fishery setback
- Slope Stability allowance
- Top of Bank allowance (valley features)
- Environmental/access setback
- Fifty Creek ESA (shown in Red)
- Riparian features and adjacent forested lands (shown in Red)

Mitigation Areas (Additional Study Required)

- Other woodlot features (shown in Yellow)
- A 50 m buffer around forested lands (shown in Red)
- Slope stability reaches

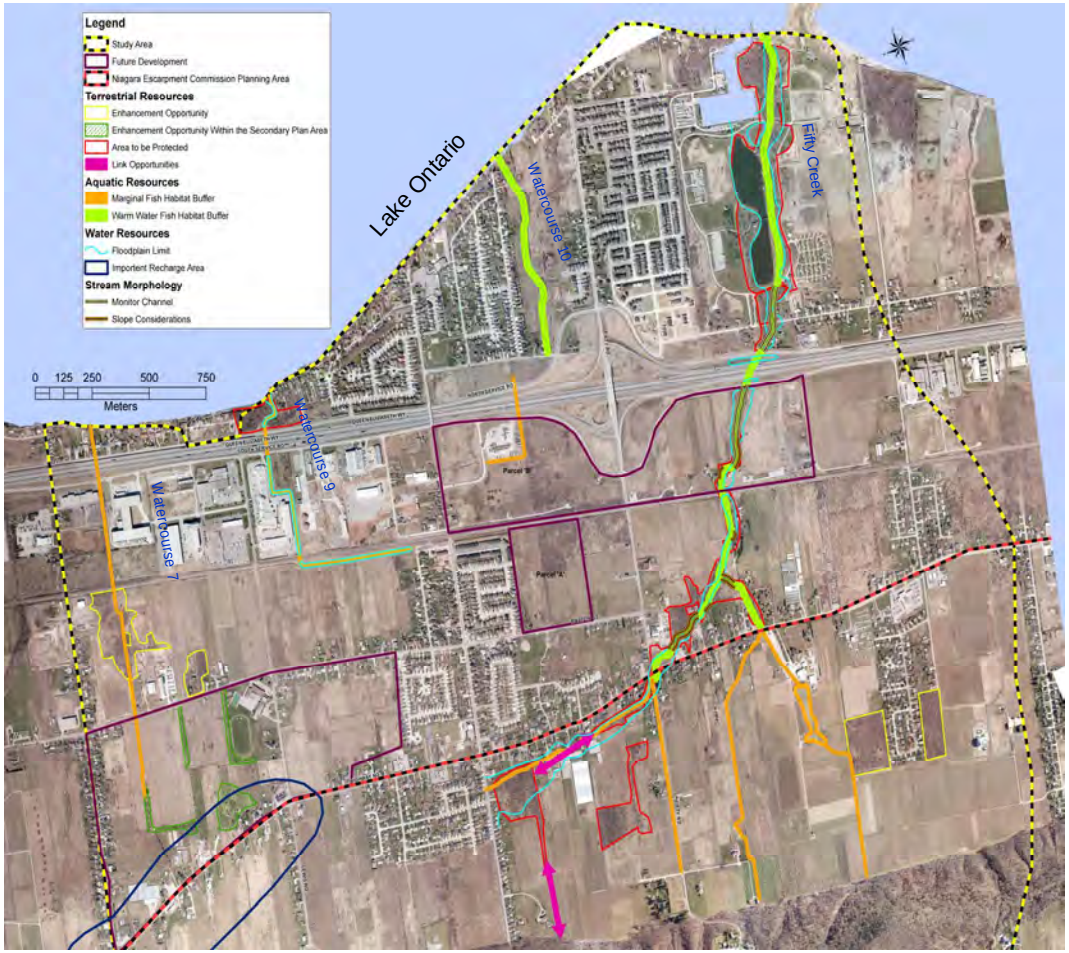
Developable Areas (Stormwater Management Requirements)

- Enhanced level of water quality treatment
- Erosion Control
- Flood Control
- Source Controls to maintain infiltration in important recharge area

OPPORTUNITIES

- Preservation of Hedgerows and forest (shown in Green)
- Enhancement of riparian vegetation along warmwater streams
- Protection of important groundwater recharge area through rural land stewardship practices
- Revegetation wildlife corridors along linkage areas through stewardship measures
- Implement infiltration measures to promote groundwater recharge in future development areas

Generally the stream systems are stable, however there are several locations where monitoring should be done to assess the need for future erosion works.



Hamilton Public Works

Capital Planning & Implementation Division
Strategy Planning Section
www.hamilton.ca/cpi

Aquafor Beech Limited

Next Steps

Following completion of the Phase 1 Study, in 2009 the remaining Subwatershed Study Phases will be completed:

- Phase II: Evaluate Alternative Subwatershed Management Strategies
- Phase III: Select a Recommended Subwatershed Plan
- Phase IV: Develop an Implementation Plan

Public Information Centre #2

WELCOME

to the Second

PUBLIC INFORMATION CENTER

for the

STONEY CREEK URBAN BOUNDARY EXPANSION AREA EAST

(SCUBE) SUBWATERSHED STUDY – PHASE 2

Hamilton Public Works

Environment and Sustainable Infrastructure Division
Public Works, City of Hamilton

Aquafor Beech Limited

STUDY AREA

THE STUDY

- The City of Hamilton is undertaking a Subwatershed Study for the East Stoney Creek Urban Boundary Expansion (SCUBE) Area. The study area encompasses most of the lands between McNeilly Road to the City boundary, and from Lake Ontario to just above the Niagara Escarpment.

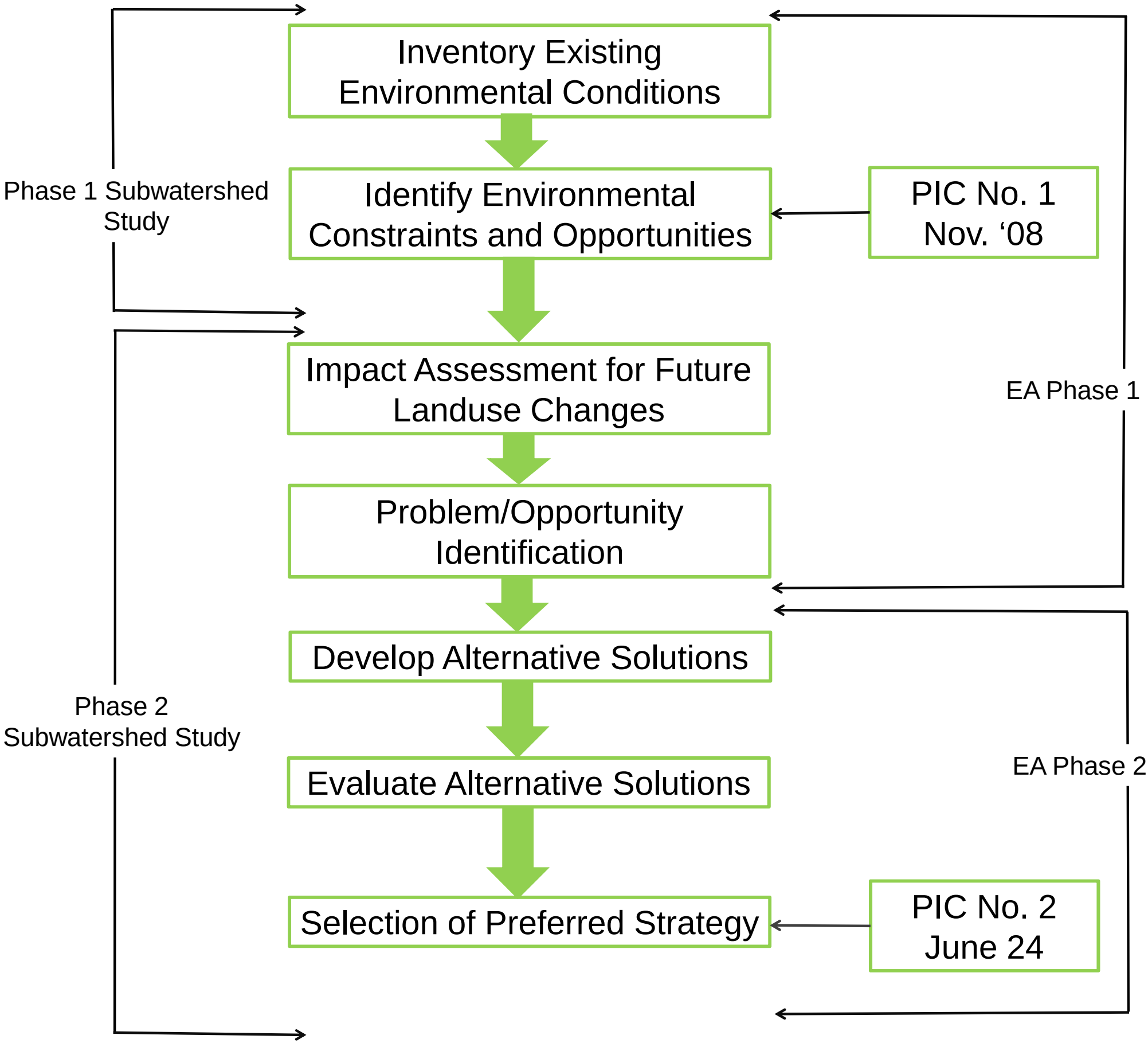
- Phase 2 of the study will develop a management strategy to protect and enhance the ecological process, functions and significant natural features of the study area as future land use changes occur in the Subwatershed. Phase 1 Subwatershed Study findings for the SCUBE East study area were presented at an earlier Public Information Centre in November 2008. A future third phase of the study will develop an implementation plan for the strategy.

PURPOSE OF TONIGHT'S MEETING

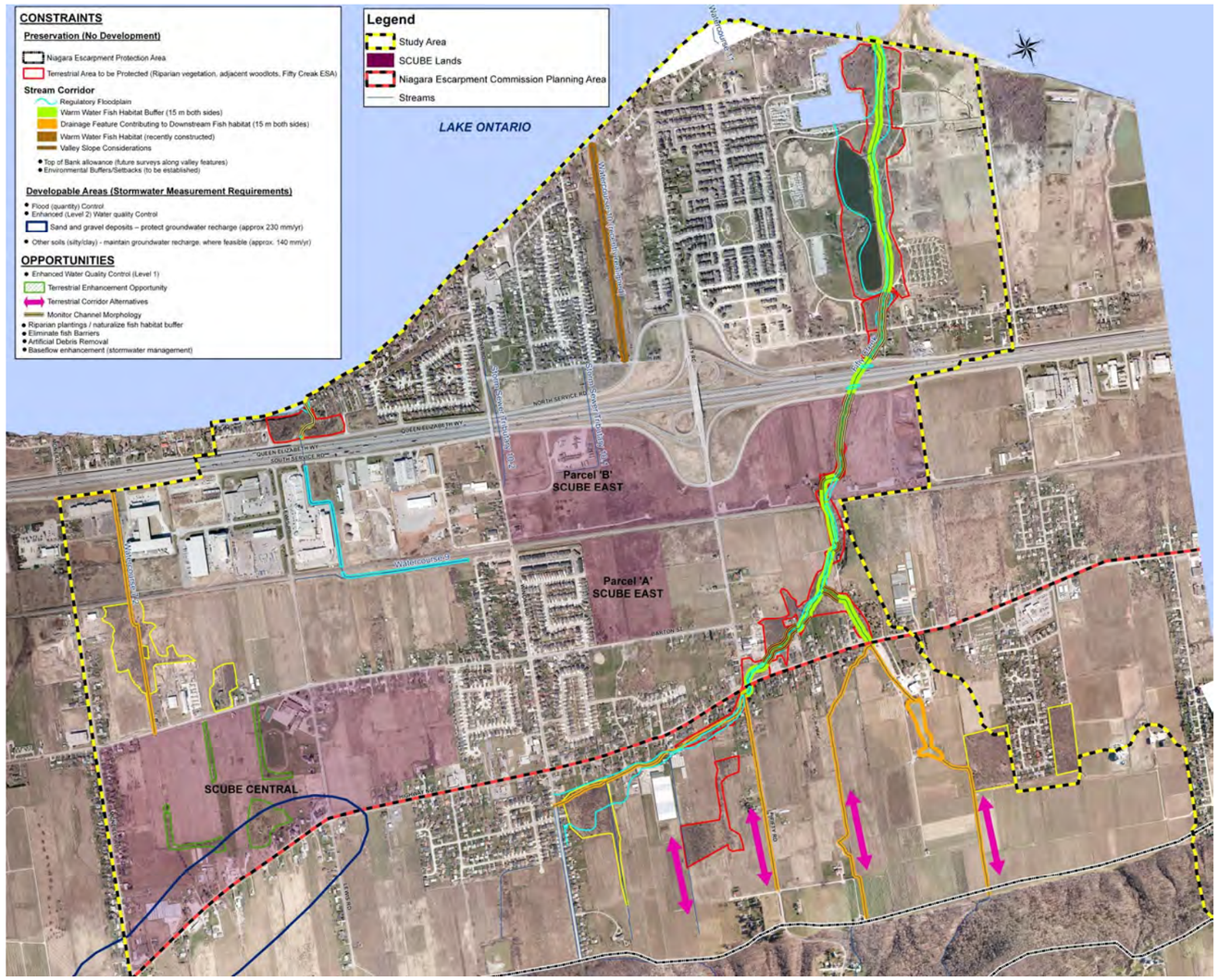
- Tonight's Open House provides an opportunity for the public to review and comment on the findings to date and to obtain feedback and public input to the evaluation and selection of alternative storm water management strategies. Your comments will assist the project team to refine the preliminary preferred alternative.

ENVIRONMENTAL ASSESSMENT PROCESS

The Study is being conducted as a Master Plan and is intended to satisfy Phases 1 and 2 of the Municipal Engineers Association (MEA) Municipal Class Environment Assessment Act (Class EA) process. This will involve a process of problem / opportunity identification, evaluation of alternative solutions, and selection of a preferred solution. Stakeholder consultation is an important part of the EA process, and a key component of the study.



BACKGROUND - PHASE 1 SUBWATERSHED STUDY FINDINGS



Within the subwatershed area and the future development area, there are a number of environmental protection and enhancement measures to be considered. These measures represent constraints to development, as well as opportunities to enhance the natural environment, as outlined below.

CONSTRAINTS

Preservation Areas (No Development)
Regulatory floodplain limits
Stream/Environmental Corridors

- Fisheries setbacks (from each streambank): 1) 15 m warmwater fishery setback; 2) 15 m indirect support habitat setback
- Slope Stability allowance
- Top of Bank allowance (valley features)
- Environmental/access setback
- Fifty Creek ESA (shown in Red)
- Riparian features and adjacent forested lands (shown in Red)

Mitigation Areas (EIS/Geotechnical Study Required)

- Other woodlot/hedgerow features (shown in Green)
- A 50 m Adjacent Land Buffer around forested lands (shown in Red)
- Slope stability assessment on identified reaches

Developable Areas (Stormwater Management Requirements)

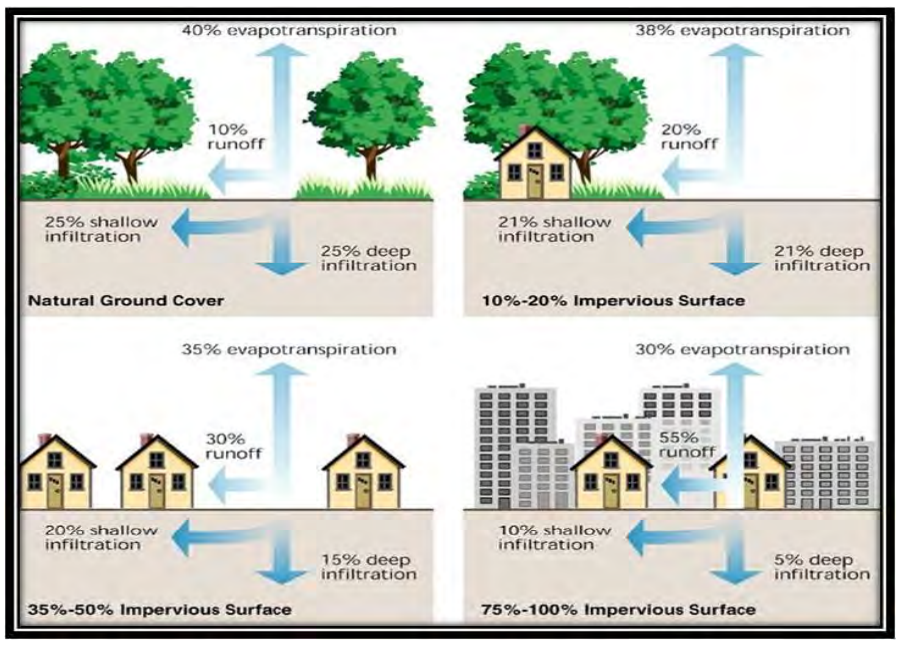
- Basic level of water quality treatment (level 2)
- Flood Control
- Source Controls to maintain groundwater recharge area

OPPORTUNITIES

- Preservation of Hedgerows and forest (shown in Green)
- Enhancement of riparian vegetation along warmwater streams
- Protection of important groundwater recharge area through rural land stewardship practices
- Revegetation of potential wildlife corridors along linkage areas through stewardship measures

IMPACTS FROM FUTURE DEVELOPMENT

- Increased runoff volumes
- Increased flood flow
- Decreased water quality
- Lower groundwater recharge
- Potential decreased baseflow
- Negative impacts to downstream fisheries



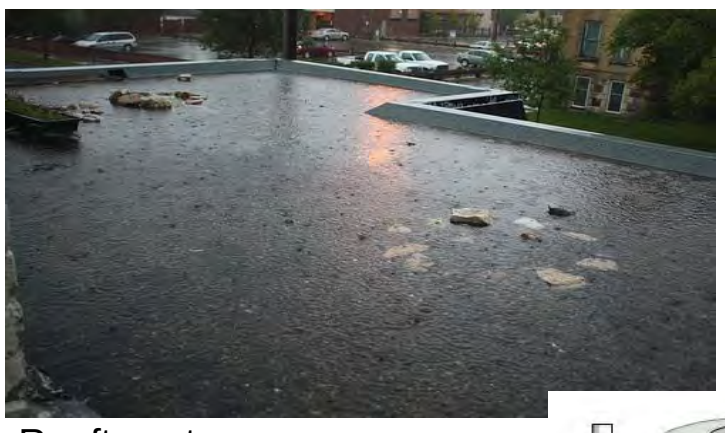
STORMWATER MANAGEMENT (SWM) ALTERNATIVES

Do Nothing

This option involves developing the SCUBE East lands without stormwater management. This alternative would result in a substantial increase in runoff, flooding, erosion and also water quality degradation.

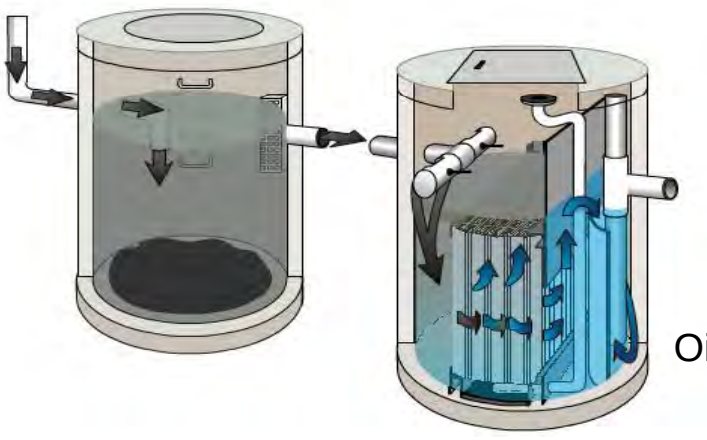
Traditional Source Controls

These measures are typically used within high-density forms of development such as commercial or industrial landuses. Rooftops, parking lots, or oversized storm sewers can be used to temporarily store rainfall from large storm events, while oil-grit separator devices can improve water quality.



Rooftop storage

Parking lot storage



Oil & Grit separator

Low Impact Development (LID) Source Controls

This option involves addressing SWM using lot level controls/source controls that encourage the infiltration of water into the ground and reduce stormwater runoff. These systems would be integrated into the design of further urban developments and can include green roofs, permeable pavement, soakaway pits, bioretention, downspout disconnection etc.

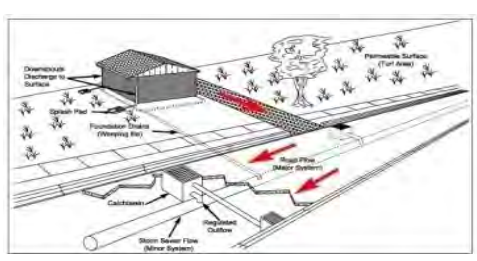
STORMWATER MANAGEMENT (SWM) ALTERNATIVES

Conveyance Controls

These controls are linear stormwater transport systems that are generally located within the road right-of-way where they encourage infiltration of water into the ground, improve water quality and reduce runoff. They can include traditional curb and gutter systems, bio-swales, grassed channels and subsurface perforated pipe systems.







End-of-pipe Controls

This option involves addressing SWM using conventional stormwater facilities at the end of the flow conveyance system. These facilities are utilized for erosion, water quantity and quality control applications.


Wet pond


Dry pond


Wetland

Stream Restoration

This option involves the replanting of floodplain and native stream side vegetation to improve stream corridor functions and water quality, slowing runoff, moderating stream temperatures, reducing erosion and improving aquatic and terrestrial habitat conditions.


Created channel


Wetland feature


Linear wetland feature


Naturalized corridor

EVALUATION PROCESS

The project team has developed a set of Stormwater Management Alternatives for the SCUBE East lands. In order to manage the complexity and constraints inherent within the study area for stormwater management and to ensure a transparent selection process that considers all possible design alternatives, a two-phased approach has been used.

Screening Level Assessment

This phase is intended to identify those alternatives that are feasible (and infeasible) for use in the SCUBE East lands. Nine (9) screening level assessment criteria have been utilized to determine which SWM alternatives are to be carried forward to the more detailed assessment phase.

Are the Alternatives feasible?

Yes

No

Detailed Assessment

The feasible option carried forward from screening level assessment have been used to develop SWM alternatives for SCUBE East lands. Alternatives are made up of both individual approaches and combinations of approaches (consistent with the MOE's treatment train approach to SWM).

The Detailed Assessment is a much more rigorous and thorough assessment of each alternative, based on a set of evaluation criteria. Each alternative is given an aggregate score indicating its rank based on social, economic and environmental criteria.

Score the Alternatives & Rank

Rank 1

Rank 2 …etc

Select Preferred Alternative

Implementation Considerations

This step involves identifying which specific techniques are best suited for each landuse within the study area, together with cost estimates, construction / phasing considerations, and funding responsibilities. This will be completed as part of a future Third Phase of the Subwatershed Study.

Identify individual stormwater techniques that make up the Preferred Alternative

SCREENING LEVEL ASSESSMENT

Screening Level Criteria

The primary criteria used in the evaluation include:

- Technical feasibility;
- Ability to meet targets;
- Flooding, Water quality, Erosion and Water balance;
- Cost effectiveness;
- Land requirements;
- Public acceptance; and
- Regulatory agency approval.

	Technical Feasibility	Flooding	Water Quality	Erosion	Water Balance	Cost Effectiveness	Land Requirements	Public Acceptance	Regulatory Agency Approval	Overall
Do Nothing	E	NA	NA	NA	NA	E	E	NA	NA	NA
Source Control Measures										
Traditional Source Control (storage)	E	E	P	G	P	G	G	G	F	G
LID Source Control (infiltration / filtration)	E	P	E	E	E	P	F	G	E	G
Conveyance Control Measures										
LID Conveyance (infiltration / filtration)	E	F	G	G	G	G	G	G	G	G
End-of Pipe Measures										
Wet pond	E	E	G	F	P	G	F	E	E	G
Wetland	E	E	E	G	P	P	NA	G	G	NA
Dry Pond	E	E	P	G	P	G	F	NA	P	NA
Stream Restoration	G	P	G	E	F	P	G	G	E	G
	E=Excellent, G= Good, F = Fair, P=Poor, NA = Not Acceptable									

Source Control Measures, including both traditional and LID methods, together with Conveyance Control Measures, End-of-Pipe Wet Ponds and Stream Restoration meet the screening-level criteria and are carried forward to the detailed assessment.

End-of-Pipe Wetlands tend to be inconsistent with higher-density urban settings due to the relatively large land area requirements, while Dry Ponds rank poorly in several categories and are not generally favored by the public or regulatory agencies. These techniques, together with the "Do Nothing" alternative, which is not acceptable under several categories, were not carried forward to the detailed assessment.

DETAILED ASSESSMENT CRITERIA

Physical and Natural Environment

- Impact on vegetation, fish, and wildlife, surface drainage and groundwater, soils and geology;
- Meeting legislated criteria for flooding, water quality, and erosion;
- Impact on terrestrial and aquatic habitat: Connectivity, Diversity and Sustainability

Social, Economic and Cultural Environment

- Impact on existing and proposed development;
- Aesthetic value;
- Potential benefit to community and public acceptance; and
- Coordination with proposed roadway design.

Technical Factors

- Level of service- proven effectiveness;
- e- v vffp

Financial Factors

Next Steps

Following this Public Information Center, the following tasks will be completed:

- Finalize the recommended Stormwater Management Plan
- Finalize the recommended Natural Heritage System
- Develop an Implementation Plan

If you have any questions, comments, please contact.

Monirul Islam
Environmental and sustainable Infrastructure Division
Public Works
City of Hamilton
Phone: 905-580-2424 ext. 6230
Email: monirul.islam@hamilton.ca

Dave Maunder
Aquafor Beech Limited
Phone: 905-629-0099 ext. 290
Email: maunder.d@aquaforbeech.com

APPENDIX E:

Consolidated Species Lists

Table 1: Plants recorded from the study area of the SCUBE Subwatershed Study. See Table 5 for footnotes.

		Status						Source					
											City of Hamilton		
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Conservation Coefficient[6]	Dillon[7]	NRSI[8]	NHIC[9]	Fifty Creek Valley ESA[10]	Devil's PunchBowl Escarpment ESA – Plants[11]	Devil's PunchBowl Escarpment ESA - Rare Species[12]
Bacidia trachona	A Lichen			G5	S1S2					•			
Diplotomma epipolium	A Lichen			GNR	S1S2					•			
Rhamnus frangula	Alder Buckthorn			G?	SE5	I						•	
Medicago sativa sativa	Alfalfa			G?T?	SE5	I						•	
Trifolium hybridum ssp. elegans	Alsike Clover			G?	SE5	I	0	•					
Cornus alternifolia	Alternate-leaved Dogwood			G5	S5							•	
Fagus grandifolia	American Beech			G5	S5		6	•				•	
Matteuccia struthiopteris var. pensylvanica	American Ostrich Fern			G5	S5							•	
Urtica dioica gracilis	American Stinging Nettle			G5T5	S5							•	
Lycopus americanus	American Waterhorehound			G5	S5							•	
Poa annua	Annual Blue Grass			G?	SE5	I						•	
Erigeron annuus	Annual Fleabane			G5	S5		0	•		•		•	
Stylurus spiniceps	Arrow Clubtail			G5	S2				•				
Aster urophyllus	Arrow-leaved Aster			G4	S4		6	•				•	
Asparagus officinalis	Asparagus			G5?	SE5	I	0	•	•			•	
Agrostis perennans	Autumn Bent Grass			G5	S5							•	
Geum sp	Avens Species							•					
Carex stipata	Awl-fruited Sedge			G5	S5							•	
Aster oolentangiensis	Azure Aster			G5	S4							•	
Echinochloa crusgalli	Barnyard Grass			G?	SE5	I	0	•				•	
Tilia americana	Basswood			G5	S5		4	•	•			•	
Carex bebbii	Bebb's Sedge			G5	S5		3	•					
Epifagus virginiana	Beech-drops			G5	S5							•	

		Status						Source					
											City of Hamilton		
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Conservation Coefficient[6]	Dillon[7]	NRSI[8]	NHIC[9]	Fifty Creek Valley ESA[10]	Devil's PunchBowl Escarpment ESA – Plants[11]	Devil's PunchBowl Escarpment ESA - Rare Species[12]
Bidens tripartita	Beggar-ticks			G5	S5		4		•				
Lotus corniculatis	Birds-foot Trefoil			G?	SE5	I	0	•				•	
Mitella diphylla	Bishop's Cap			G5	S5							•	
Rumex obtusifolius obtusifolius	Bitter Dock			G?	SE5	I						•	
Carya cordiformis	Bitternut Hickory			G5	S5							•	
Solanum dulcamara	Bittersweet Nightshade			G?	SE5	I	0	•				•	
Scirpus atrovirens	Black Bulrush			G5?	S5		3	•				•	
Prunus serotina	Black Cherry			G5	S5		3	•				•	
Robinia pseudoacacia	Black Locust			G5	SE5	I			•			•	
Acer saccharum nigrum	Black Maple			G5T5	S4?							•	
Medicago lupulina	Black Medick			G?	SE5	I	0	•				•	
Brassica nigra	Black Mustard			G?	SE5	I	0	•					
Rubus occidentalis	Black Raspberry			G5	S5		2	•				•	
Juglans nigra	Black Walnut			G5	S4		5	•	•			•	
Salix nigra	Black Willow			G5	S4?							•	
Rudbeckia hirta	Black-eyed Susan			G5	S5		0	•					
Staphylea trifolia	Bladdernut			G5	S4							•	
Sanguinaria canadensis	Bloodroot			G5	S5							•	
Carpinus caroliniana	Blue Beech			G5	S5	H	6	•					
Caulophyllum thalictroides	Blue Cohosh			G4G5	S5							•	
Phlox divaricata	Blue Phlox			G5	S4							•	
Verbena hastata	Blue Vervain			G5	S5		4	•	•				
Clintonia borealis	Bluebead Lily			G5	S5		7	•					
Solidago caesia	Blue-stem Goldenrod			G5	S5							•	
Echium vulgare	Blueweed			G?	SE5	I						•	

		Status						Source					
											City of Hamilton		
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Conservation Coefficient[6]	Dillon[7]	NRSI[8]	NHIC[9]	Fifty Creek Valley ESA[10]	Devil's PunchBowl Escarpment ESA – Plants[11]	Devil's PunchBowl Escarpment ESA - Rare Species[12]
Elymus hystrix	Bottle-brush Grass			G5	S5							•	
Picris echioides	Bristly Ox-tongue			G?	SE1	I						•	
Typha latifolia	Broad-leaved Cattail			G5	S5		3	•	•				
Carex platyphylla	Broad-leaved Sedge			G5	S5							•	
Claytonia caroliniana	Broad-leaved Spring Beauty			G5	S5							•	
Cystopteris bulbifera	Bulblet Fern			G5	S3					•		•	
Cirsium vulgare	Bull Thistle			G5	SE5	I	0	•				•	
Quercus macrocarpa	Bur Oak			G5	S5		5	•	•				
Carex sparganioides	Bur-reed Sedge			G5	S5							•	
Diervilla lonicera	Bush-honeysuckle			G5	S5							•	
Linaria vulgaris	Butter-and-eggs			G?	SE5	I	0	•				•	
Juglans cinerea	Butternut	END	END	G4	S3?						•		•
Poa compressa	Canada Blue Grass			G?	SE5							•	
Bromus pubescens	Canada Brome			G5	S4	h						•	
Solidago canadensis var. canadensis	Canada Goldenrod			G5	S5		1	•	•			•	
Cirsium arvense	Canada Thistle			G?	SE5	I	0	•	•			•	
Viola canadensis	Canada Violet			G5	S5							•	
Hydrophyllum canadense	Canada Waterleaf			G5	S4							•	
Smilax herbacea	Carrion-flower			G5	S4							•	
Nepeta cataria	Catnip			G?	SE5	I	0	•				•	
Sinapis arvensis	Charlock			G?	SE5	I						•	
Bromus secalinus secalinus	Cheat			G?	SE4	I						•	
Cichorium intybus	Chicory			G?	SE5	I	0	•	•			•	
Prunus virginiana ssp. virginiana	Choke Cherry			G5	S5		2	•				•	
Polystichum acrostichoides	Christmas Fern			G5	S5							•	

		Status						Source					
											City of Hamilton		
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Conservation Coefficient[6]	Dillon[7]	NRSI[8]	NHIC[9]	Fifty Creek Valley ESA[10]	Devil's PunchBowl Escarpment ESA – Plants[11]	Devil's PunchBowl Escarpment ESA - Rare Species[12]
Pilea pumila	Clearweed			G5	S5		5		•			•	
Galium aparine	Cleavers			G5	S5		4	•				•	
Celastrus scandens	Climbing Bittersweet			G5	S5		3	•				•	
Rhus radicans negundo	Climbing Poison-ivy			G5T5	S5		5	•	•			•	
Paronychia fastigiata	Cluster-stemmed Nailwort			G5	S1					•			
Tussilago farfara	Coltsfoot			G?	SE5	I	0	•					
Malus pumila	Common Apple			G5	SE5	I	0	•	•				
Berberis vulgaris	Common Barberry			G?	SE5	I	0	•					
Rubus allegheniensis	Common Blackberry			G5	S5		2	•				•	
Viola sororia	Common Blue Violet			G5	S5							•	
Rhamnus cathartica	Common Buckthorn			G?	SE5	I	0	•	•			•	
Arctium minus	Common Burdock			G?T?	SE5	I	0	•	•			•	
Stellaria media	Common Chickweed			G?	SE5	I						•	
Potentilla simplex	Common Cinquefoil			G5	S5		3	•				•	
Symphytum officinale officinale	Common Comfrey			G?	SE5	I						•	
Taraxacum officinale	Common Dandelion			G5	SE5	I	0	•	•			•	
Sambucus canadensis	Common Elder			G5	S5							•	
Oenothera biennis	Common Evening-primrose			G5	S5		0	•					
Myosotis scorpioides	Common Forget-me-not			G5	SE5	I	0	•					
Senecio vulgaris	Common Groundsel			G?	SE5	I						•	
Hieracium vulgatum	Common Hawkweed							•					
Syringa vulgaris	Common Lilac			G?	SE5	I	0	•	•				
Malva neglecta	Common Mallow			G?	SE5	I						•	
Asclepias syriaca	Common Milkweed			G5	S5		0	•	•			•	
Mentha arvensis	Common Mint			G5	S5		3		•				

		Status						Source					
											City of Hamilton		
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Conservation Coefficient[6]	Dillon[7]	NRSI[8]	NHIC[9]	Fifty Creek Valley ESA[10]	Devil's PunchBowl Escarpment ESA – Plants[11]	Devil's PunchBowl Escarpment ESA - Rare Species[12]
Cerastium fontanum	Common Mouse-ear Chickweed			G?	SE5	I	0	•				•	
Verbascum thapsus	Common Mullein			G?	SE5	I	0	•				•	
Pyrus communis	Common Pear			G5	SE4	I	0	•	•				
Vinca minor	Common Periwinkle			G?	SE5	I						•	
Plantago major	Common Plantain			G5	SE5	I	0	•	•			•	
Ambrosia artemisiifolia	Common Ragweed			G5	S5		0	•				•	
Phragmites australis	Common Reed			G5	S5		0	•	•			•	
Tragopogon porrifolius	Common Salsify			G?	SE4?	I						•	
Sonchus oleraceus	Common Sow-thistle			G?	SE5	I	0	•				•	
Veronica officinalis	Common Speedwell			G5	SE5	I						•	
Hypericum perforatum	Common St. John's Wort			G?	SE5	I	0	•	•			•	
Fragaria virginiana ssp. virginiana	Common Strawberry			G5	S5		2	•	•			•	
Helianthus annuus ssp. annuus	Common Sunflower			G5	SE4		0	•					
Dipsacus fullonum ssp. sylvestris	Common Teasel			G?	SE5	I	0	•	•			•	
Vicia sativa ssp. nigra	Common Vetch			G?	SE5	I	0	•	•				
Alisma plantago-aquatica	Common Water-plantain			G5	S5		3	•				•	
Triticum aestivum	Common Wheat			G?	SE1	I						•	
Luzula multiflora multiflora	Common Wood Rush			G5T5	S5							•	
Achillea millefolium ssp. millefolium	Common Yarrow			G5	SE		0	•	•			•	
Veronica arvensis	Corn Speedwell			G?	SE5	I						•	
Vicia cracca	Cow Vetch			G?	SE5	I	0	•				•	
Malus sp	Crabapple Species							•					
Salix fragilis	Crack Willow			G?	SE5	I	0	•	•				
Agrostis stolonifera	Creeping Bent Grass			G5	S5							•	
Juniperus horizontalis	Creeping Juniper			G5	S5		10		•				

		Status						Source					
											City of Hamilton		
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Conservation Coefficient[6]	Dillon[7]	NRSI[8]	NHIC[9]	Fifty Creek Valley ESA[10]	Devil's PunchBowl Escarpment ESA – Plants[11]	Devil's PunchBowl Escarpment ESA - Rare Species[12]
Coronilla varia	Crown-vetch			G?	SE5	I						•	
Magnolia acuminata	Cucumber Tree	END	END	G5	S2					•			
Rumex crispus	Curly Dock			G?	SE5	I	0	•	•			•	
Ranunculus sceleratus sceleratus	Cursed Buttercup			G5	S5							•	
Geum laciniatum	Cutleaf Avens			G5	S4							•	
Cardamine concatenata	Cutleaf Toothwort			G5	S5							•	
Hesperis matronalis	Dame's Rocket			G4G5	SE5	I						•	
Dianthus armeria	Deptford Pink			G?	SE5	I	0	•	•			•	
Bidens frondosa	Devil's Beggar-ticks			G5	S5		3	•				•	
Carex laxiflora	Distant-flowered Sedge			G5	S5							•	
Rosa canina	Dog Rose			G?	SE2	I						•	
Viola conspersa	Dog Violet			G5	S5							•	
Crataegus punctata	Dotted Hawthorn			G5	S5							•	
Viburnum rafinesquianum	Downy Arrow-wood			G5	S5							•	
Bromus tectorum	Downy Chess			G?	SE5	I						•	
Crataegus mollis	Downy Hawthorn			G5	S5	H						•	
Amelanchier arborea	Downy Serviceberry			G5	S5		5	•				•	
Viola pubescens	Downy Yellow Violet			G5T5	S5							•	
Juncus dudleyi	Dudley's Rush			G5	S5							•	
Dicentra cucullaria	Dutchman's-breeches			G5	S5	h						•	
Solidago juncea	Early Goldenrod			G5	S5		3	•				•	
Thalictrum dioicum	Early Meadow-rue			G5	S5							•	
Vaccinium pallidum	Early Sweet Blueberry			G5	S4							•	
Solanum ptycanthum	Eastern Black Nightshade			G5	S5							•	
Populus deltoides deltoides	Eastern Cottonwood			G5T?	SU		4	•				•	

		Status						Source					
											City of Hamilton		
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Conservation Coefficient[6]	Dillon[7]	NRSI[8]	NHIC[9]	Fifty Creek Valley ESA[10]	Devil's PunchBowl Escarpment ESA – Plants[11]	Devil's PunchBowl Escarpment ESA - Rare Species[12]
Carex oligocarpa	Eastern Few-fruited Sedge			G4	S3	H				•			
Tsuga canadensis	Eastern Hemlock			G5	S5							•	
Juniperus virginiana	Eastern Red Cedar			G5	S5		4	•				•	
Thuja occidentalis	Eastern White Cedar			G5	S5		4	•	•				
Circaea lutetiana canadensis	Enchanter's Nightshade			G5	S5		3	•				•	
Crataegus monogyna	English Hawthorn			G5	SE5	I	0	•	•			•	
Sporobolus vaginiflorus	Ensheathed Dropseed			G5	S4							•	
Aster ericoides ssp.	Ericoides Heath Aster			G5	S5							•	
Allium schoenoprasum var. schoenoprasum	European Chives			G5	SE2	I	0	•					
Urtica dioica ssp. dioica	European Stinging Nettle			G5T?	SE2	I	0	•					
Panicum dichotomiflorum	Fall Panic Grass			G5	SE5	I						•	
Convolvulus arvensis	Field Bindweed			G?	SE5	I	0	•	•			•	
Hieracium caespitosum ssp. caespitosum	Field Hawkweed			G?	SE5	I	0	•				•	
Equisetum arvense	Field Horsetail			G5	S5							•	
Thlaspi arvense	Field Penny-cress			G?	SE5	I	0	•				•	
Lepidium campestre	Field Pepper-grass			G?	SE5	I						•	
Antennaria neglecta	Field Pussytoes			G5	S5		3	•				•	
Sonchus arvensis ssp. arvensis	Field Sow-thistle			G?	SE5	I	0	•				•	
Abies sp.	Fir species (non-native)							•					
Cornus florida	Flowering Dogwood	END	END	G5	S2	h				•		•	•
Lonicera canadensis	Fly-honeysuckle			G5	S5							•	
Aethusa cynapium	Fool's Parsley			G?	SE1							•	
Glyceria striata	Fowl Manna Grass			G5T5	S4S5							•	
Poa palustris	Fowl Meadow Grass			G5	S5							•	
Carex vulpinoidea	Fox Sedge			G5	S5		3	•				•	

		Status						Source					
											City of Hamilton		
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Conservation Coefficient[6]	Dillon[7]	NRSI[8]	NHIC[9]	Fifty Creek Valley ESA[10]	Devil's PunchBowl Escarpment ESA – Plants[11]	Devil's PunchBowl Escarpment ESA - Rare Species[12]
Carex alopecoidea	Foxtail Sedge			G5	S5	h						•	
Acer X freemanii	Freeman's Maple			G?	S5			•					
Lysimachia ciliata	Fringed Loosestrife			G5	S5							•	
Ribes rubrum	Garden Red Currant			G4G5	SE5	I						•	
Alliaria petiolata	Garlic Mustard			G?	SE5	I	0	•				•	
Solidago gigantea	Giant Goldenrod			G5	S5		4	•				•	
Dryopteris intermedia	Glandular Wood Fern			G5	S5							•	
Tragopogon dubius	Goat's-beard			G?	SE5	I						•	
Dryopteris goldiana	Goldie's Wood Fern			G4	S4	H						•	
Carex gracillima	Graceful Sedge			G5	S5		4	•					
Euthamia graminifolia	Grass-leaved Goldenrod			G5	S5		2	•	•			•	
Stellaria graminea	Grass-leaved Stitchwort			G?	SE5	I						•	
Solidago nemoralis nemoralis	Gray Goldenrod			G5T5	S5							•	
Arctium lappa	Great Burdock			G?	SE5	I						•	
Chelidonium majus	Greater Celandine			G?	SE5	I						•	
Setaria viridis	Green Foxtail			G?	SE5	I	0	•				•	
Cornus foemina racemosa	Grey Dogwood			G5	S5		2	•	•			•	
Glechoma hederacea	Ground Ivy			G?	SE5	I	0	•				•	
Viburnum opulus	Guelder-rose			G5	SE4	I						•	
Aster pilosus var. pilosus	Hairy Aster			G5T?	S5							•	
Penstemon hirsutus	Hairy Beard-tongue			G4	S4							•	
Bromus commutatus	Hairy Chess			G?	SE4	I						•	
Carex hirtifolia	Hairy Sedge			G5	S5							•	
Scirpus acutus	Hardstem Bulrush			G5	S5	H	6	•					
Crataegus succulenta	Hawthorn			G5	S4S5							•	

		Status						Source					
											City of Hamilton		
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Conservation Coefficient[6]	Dillon[7]	NRSI[8]	NHIC[9]	Fifty Creek Valley ESA[10]	Devil's PunchBowl Escarpment ESA – Plants[11]	Devil's PunchBowl Escarpment ESA - Rare Species[12]
Crataegus sp	Hawthorn Species							•					
Carex cephaloidea	Head-like Sedge			G5	S5	H						•	
Aster cordifolius	Heart-leaved Aster			G5	S5							•	
Aster ericoides var. ericoides	Heath Aster			G5	S5		4	•					
Calystegia sepium	Hedge Bindweed			G5	S5			•				•	
Sisymbrium officinale	Hedge Mustard			G?	SE5	I	0	•					
Torilis japonica	Hedge Parsley			G?	SE4	I						•	
Epipactis helleborine	Helleborine			G?	SE5	I						•	
Galeopsis tetrahit	Hemp-nettle			G?	SE5	I						•	
Geranium robertianum	Herb Robert			G5	SE5	I	0	•				•	
Viburnum trilobum	Highbush-cranberry			G5T5	S5							•	
Carex hitchcockiana	Hitchcock's Sedge			G5	S5							•	
Amphicarpaea bracteata	Hog-peanut			G5	S5		4		•			•	
Cryptotaenia canadensis	Honewort			G5	S5							•	
Gleditsia triacanthos	Honey Locust			G5	S2(I to Ham)	I						•	
Ranunculus recurvatus	Hooked Buttercup			G5	S5							•	
Ostrya virginiana	Hop Hornbeam			G5	S5		4	•				•	
Aesculus hippocastanum	Horse-chestnut			G?	SE2	I			•			•	
Conyza canadensis	Horseweed			G5	S5		0	•					
Cynoglossum officinale	Hound's-tongue			G?	SE5	I						•	
Actaea x ludovici	Hybrid Baneberry			HYB	SE1							•	
Monotropa uniflora	Indian-pipe			G5	S5							•	
Arisaema triphyllum ssp. triphyllum	Jack-in-the-pulpit			G5	S5		5	•				•	
Berberis thunbergii	Japanese Barberry			G?	SE5	I						•	
Bromus japonicus	Japanese Brome			G?	SE4	I						•	

		Status						Source					
											City of Hamilton		
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Conservation Coefficient[6]	Dillon[7]	NRSI[8]	NHIC[9]	Fifty Creek Valley ESA[10]	Devil's PunchBowl Escarpment ESA – Plants[11]	Devil's PunchBowl Escarpment ESA - Rare Species[12]
Polygonum cuspidatum	Japanese Knotweed			G?	SE4	I						•	
Polygonum virginianum	Jumpseed			G5	S4							•	
Poa pratensis pratensis	Kentucky Blue Grass			G5T5?	S5		0					•	
Ranunculus abortivus	Kidney-leaf Buttercup			G5	S5		2	•				•	
Polygonum persicaria	Lady's Thumb			G?	SE5	I	0	•	•			•	
Chenopodium album var album	Lamb's-quarters			G5T?	SE5	I	0	•				•	
Digitaria sanguinalis	Large Crab Grass			G5	SE5	I						•	
Uvularia grandiflora	Large-flowered Bellwort			G5	S5							•	
Aster macrophyllus	Large-leaved Aster			G5	S5		5	•				•	
Populus grandidentata	Largetooth Aspen			G5	S5		5	•	•			•	
Viola rostrata	Long-spurred Violet			G5	S5							•	
Carex laxiculmis	Loose-stemmed Sedge			G5T4T5	S4							•	
Phryma leptostachya	Lopseed			G5	S4S5							•	
Vaccinium angustifolium	Lowbush Blueberry			G5	S5							•	
Cystopteris tenuis	Mackay's Fragile Fern			G4G5	S5							•	
Acer negundo	Manitoba Maple			G5	S5		0	•	•			•	
Chenopodium simplex	Maple-leaved Goosefoot			G5	S5	h						•	
Viburnum acerifolium	Maple-leaved Viburnum			G5	S5							•	
Dryopteris marginalis	Marginal Wood Fern			G5	S5							•	
Polygonum hydropiper	Marshpepper Smartweed			G5	SE5	I						•	
Podophyllum peltatum	Mayapple			G5	S5		5	•				•	
Festuca pratensis	Meadow Fescue			G5	SE5	I						•	
Tragopogon pratensis pratensis	Meadow Goat'sbeard			G?T?	SE5	I						•	
Lysimachia nummularia	Moneywort			G?	SE5	I	0	•					
Menispermum canadense	Moonseed			G5	S4							•	

		Status						Source					
											City of Hamilton		
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Conservation Coefficient[6]	Dillon[7]	NRSI[8]	NHIC[9]	Fifty Creek Valley ESA[10]	Devil's PunchBowl Escarpment ESA – Plants[11]	Devil's PunchBowl Escarpment ESA - Rare Species[12]
Leonurus cardiaca cardiaca	Motherwort			G?	SE5	I	0	•	•			•	
Acer spicatum	Mountain Maple			G5	S5							•	
Rosa multiflora	Multiflora Rose			G?	SE4	I						•	
Viburnum lentago	Nannyberry			G5	S5		4	•				•	
Typha angustifolia	Narrow-leaved Cattail			G5	SE5							•	
Spiraea alba	Narrow-leaved Meadowsweet			G5	S5		3	•	•				
Claytonia virginica	Narrow-leaved Spring Beauty			G5	S5		5	•				•	
Aster novae-angliae	New England Aster			G5	S5		2	•	•			•	
Muhlenbergia schreberi	Nimble Will			G5	S4	H						•	
Oryzopsis racemosa	Nodding Mountainrice			G5	S4	h						•	
Athyrium filixfemina angustum	Northeastern Lady Fern			G5T5	S5							•	
Adiantum pedatum	Northern Maidenhair Fern			G5	S5							•	
Epilobium ciliatum ssp. glandulosum	Northern Willow-herb			G5	SU		6	•					
Acer platanoides	Norway Maple			G?	SE5	i	0	•				•	
Chenopodium glaucum glaucum	Oak-leaved Goosefoot			G5T?	SE5	I						•	
Aster lateriflorus	One-sided Aster			G5	S5		3	•				•	
Hemerocallis fulva	Orange Day-lily			G?	SE5	I						•	
Hieracium aurantiacum	Orange Hawkweed			GNR	SNA	I			•				
Dactylis glomerata	Orchard Grass			G?	SE5	I	0	•				•	
Carex cephalophora	Oval-headed Sedge			G5	S5							•	
Chrysanthemum leucanthemum	Ox-eye Daisy			G?	SE5	I	0	•	•			•	
Picris hieracioides hieracioides	Ox-tongue			G5	SE5	I						•	
Impatiens pallida	Pale Touch-me-not			G5	S5							•	
Hieracium paniculatum	Panicled Hawkweed			G5	S2	H						•	
Rosa carolina	Pasture Rose			G4G5	S4		6	•					

		Status						Source					
											City of Hamilton		
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Conservation Coefficient[6]	Dillon[7]	NRSI[8]	NHIC[9]	Fifty Creek Valley ESA[10]	Devil's PunchBowl Escarpment ESA – Plants[11]	Devil's PunchBowl Escarpment ESA - Rare Species[12]
Juncus tenuis	Path Rush			G5	S5		0	•				•	
Asimina triloba	Pawpaw			G5	S3					•			
Salix amygdaloides	Peach-leaved Willow			G5	S5							•	
Carex pedunculata	Peduncled Sedge			G5	S5							•	
Carex pensylvanica	Pennsylvania Sedge			G5	S5		5	•				•	
Lepidium ruderale	Pepper-grass			G?	SE3	I						•	
Mentha x piperita	Peppermint			HYB	SE4	I						•	
Uvularia perfoliata	Perfoliate Bellwort			G5	S1	H				•			
Erigeron philadelphicus philadelphicus	Philadelphia Fleabane			G5T5	S5				•			•	
Erechtites hieracifolia	Pilewort			G5	S5	H						•	
Matricaria matricarioides	Pineapple Weed			G5	SE5	I						•	
Polygonum pensylvanicum	Pink Knotweed			G5	S5		3	•					
Cardamine douglassii	Pink Spring Cress			G5	S4							•	
Antennaria parlinii fallax	Plantain-leaved Everlasting			G4G5T?	SU							•	
Carex plantaginea	Plantain-leaved Sedge			G5	S5							•	
Luzula acuminata	Pointed Wood Rush			G5	S5							•	
Desmodium glutinosum	Pointed-leaved Ticktrefoil			G5	S4							•	
Phytolacca americana	Pokeweed			G5	S4	h						•	
Ribes cynosbati	Prickly Gooseberry			G5	S5							•	
Lactuca serriola	Prickly Lettuce			G?	SE5	I	0	•				•	
Rosa acicularis	Prickly Rose			G5	S5	H	7		•				
Zanthoxylum americanum	Prickly-ash			G5	S5		3	•				•	
Ligustrum vulgare	Privet			G?	SE5	I						•	
Lythrum salicaria	Purple Loosestrife			G5	SE5	I	0	•	•			•	
Trillium erectum	Purple Trillium			G5	S5							•	

		Status						Source					
											City of Hamilton		
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Conservation Coefficient[6]	Dillon[7]	NRSI[8]	NHIC[9]	Fifty Creek Valley ESA[10]	Devil's PunchBowl Escarpment ESA – Plants[11]	Devil's PunchBowl Escarpment ESA - Rare Species[12]
Rubus odoratus	Purple-flowering Raspberry			G5	S5							•	
Epilobium coloratum	Purple-leaved Willow-herb			G5	S5		3	•					
Veronica peregrina peregrina	Purslane Speedwell			G5T5	S5	h						•	
Salix discolor	Pussy Willow			G5	S5							•	
Elymus repens	Quack Grass			G5	SE5	I	0	•				•	
Daucus carota	Queen Anne's Lace			G?	SE5	I			•			•	
Fraxinus pennsylvanica	Red Ash			G5	S5		3	•	•			•	
Actaea rubra	Red Baneberry			G5	S5							•	
Trifolium pratense	Red Clover			G?	SE5	I	0	•				•	
Ulmus rubra	Red Elm			G5	S5							•	
Acer rubrum	Red Maple			G5	S5		4	•					
Quercus rubra	Red Oak			G5	S5		6	•	•			•	
Eleocharis erythropoda	Red-based Spike-rush			G5	S5							•	
Sambucus racemosa pubens	Red-berried Elder			G5	S5							•	
Cornus stolonifera	Red-osier Dogwood			G5	S5		2	•	•			•	
Amaranthus retroflexus	Redroot Pigweed			G?	SE5	I	0	•				•	
Agrostis gigantea	Redtop			G4G5	SE5	I	0	•				•	
Phalaris arundinacea	Reed Canary Grass			G5	S5		0	•	•			•	
Puccinellia distans	Reflexed Saltmarsh Grass			G5	SE5	I						•	
Plantago lanceolata	Ribgrass			G5	SE5	I	0	•				•	
Vitis riparia	Riverbank Grape			G5	S5		0	•	•			•	
Streptopus roseus	Rose Twisted Stalk			G5	S5		7	•					
Erigeron strigosus	Rough Fleabane			G5	S5							•	
Solidago rugosa rugosa	Rough Goldenrod			G5	S5							•	
Potentilla recta	Rough-fruited Cinquefoil			G?	SE5	I	0	•	•			•	

		Status						Source					
											City of Hamilton		
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Conservation Coefficient[6]	Dillon[7]	NRSI[8]	NHIC[9]	Fifty Creek Valley ESA[10]	Devil's PunchBowl Escarpment ESA – Plants[11]	Devil's PunchBowl Escarpment ESA - Rare Species[12]
Cornus rugosa	Round-leaved Dogwood			G5	S5							•	
Plantago rugelii	Rugel's Plantain			G5	S5							•	
Euonymus obovata	Running Strawberrybush			G5	S5							•	
Muhlenbergia mexicana	Satin Grass			G5	S5	H						•	
Matricaria perforata	Scentless Chamomile			G?	SE	I	0	•					
Pinus sylvestris	Scots Pine			G?	SE5	I	0	•	•				
Carex radiata	Sedge			G4	S4							•	
Prunella vulgaris ssp. Vulgaris	Selfheal			G5	S5	I	0	•				•	
Onoclea sensibilis	Sensitive Fern			G5	S5							•	
Carya ovata	Shagbark Hickory			G5	S5		6	•	•				
Anemone acutiloba	Sharped-lobed Hepatica			G5	S5							•	
Capsella bursapastoris	Shepherd's-purse			G?	SE5	I						•	
Cornus amomum obliqua	Silky Dogwood			G5T?	S5							•	
Acer saccharinum	Silver Maple			G5	S5		5	•	•				
Deparia acrostichoides	Silvery Spleenwort			G5	S4							•	
Symplocarpus foetidus	Skunk Cabbage			G5	S5							•	
Sphenopholis intermedia	Slender Wedge Grass			G5	S4S5							•	
Myosotis laxa	Small Forget-me-not			G5	S5		6	•					
Oenothera parviflora	Small-flowered Evening-primrose			G4?	S4?							•	
Epilobium parviflorum	Small-flowered Willow-herb			G?	SE4	I						•	
Bromus inermis inermis	Smooth Brome Grass			G5T?	SE5	I	0	•	•			•	
Arabis laevigata	Smooth Rock-cress			G5	S5	h						•	
Carex blanda	Smooth Sedge			G5?	S5							•	
Amelanchier laevis	Smooth Serviceberry			G4G5Q	S5		5	•					
Rosa blanda	Smooth Wild Rose			G5	S5							•	

		Status						Source					
											City of Hamilton		
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Conservation Coefficient[6]	Dillon[7]	NRSI[8]	NHIC[9]	Fifty Creek Valley ESA[10]	Devil's PunchBowl Escarpment ESA – Plants[11]	Devil's PunchBowl Escarpment ESA - Rare Species[12]
Symphoricarpos albus	Snowberry			G5T5	S4S5							•	
Juncus pylaei	Soft Rush			G5T?	S5?							•	
Scirpus validus	Softstem Bulrush			G?	S5		5	•	•				
Polygonatum pubescens	Solomon's-seal			G5	S5							•	
Oxalis stricta	Sorrel			G5	S5			•				•	
Vicia tetrasperma	Sparrow Vetch			G?	SE5	I						•	
Mentha spicata	Spearmint			G?	SE4	I	0	•					
Atriplex patula	Spearscale			G5	S5	h	0	•				•	
Veronica sp	Speedwell Species							•					
Carex spicata	Spiked Sedge			G?	SE5	I						•	
Dryopteris carthusiana	Spinulose Wood Fern			G5	S5							•	
Corallorhiza maculata	Spotted Coral-root			G5	S5	H						•	
Geranium maculatum	Spotted Crane's-bill			G5	S5		6	•				•	
Centaurea maculosa	Spotted Knapweed			G?	SE5	I	0	•					
Chamaesyce nutans	Spotted Spurge			G?	S4S5	h						•	
Hypericum punctatum	Spotted St. John'swort			G5	S5							•	
Impatiens capensis	Spotted Touch-menot			G5	S5		4	•				•	
Apocynum androsaemifolium ssp. androsaemifolium	Spreading Dogbane			G5	S5		3	•					
Cerastium semidecandrum	Spring Mouse-eared Chickweed			G?	SE5	I						•	
Picea sp	Spruce Species							•					
Conopholis americana	Squawroot			G5	S4?	H						•	
Dicentra canadensis	Squirrel-corn			G5	S5							•	
Hordeum jubatum jubatum	Squirrel-tail Grass			G5T5	SE5	I	0	•	•			•	
Rhus typhina	Staghorn Sumac			G5	S5		1	•	•			•	

		Status						Source					
											City of Hamilton		
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Conservation Coefficient[6]	Dillon[7]	NRSI[8]	NHIC[9]	Fifty Creek Valley ESA[10]	Devil's PunchBowl Escarpment ESA – Plants[11]	Devil's PunchBowl Escarpment ESA - Rare Species[12]
Maianthemum stellatum	Starry False Solomon's-seal			G5	S5							•	
Hackelia virginiana	Stickseed			G5	S5							•	
Epilobium ciliatum	Sticky Willow-herb			G5	S5							•	
Polygonum achoreum	Striate Knotweed			G5	S5	H						•	
Acer saccharum saccharum	Sugar Maple			G5T5	S5		4	•	•			•	
Vitis aestivalis	Summer Grape			G5	S4							•	
Ribes triste	Swamp Red Currant			G5	S5							•	
Prunus avium	Sweet Cherry			G?	SE4	I	0	•				•	
Lathyrus odoratus	Sweet Pea			G?	SE1		0	•					
Rosa eglanteria	Sweetbrier					I		•					
Galium triflorum	Sweet-scented Bedstraw			G5	S5							•	
Bidens vulgata	Tall Beggar-ticks			G5	S5							•	
Ranunculus acris	Tall Buttercup			G5	SE5	I						•	
Maianthemum racemosum racemosum	Tall False Solomon's seal			G5	S5		4	•				•	
Solidago altissima var. altissima	Tall Goldenrod			G?	S5		1	•				•	
Aster lanceolatus lanceolatus	Tall White Aster			G5	S5							•	
Tanacetum vulgare	Tansy			G?	SE5	I						•	
Lonicera tatarica	Tartarian Honeysuckle			G?	SE5	I	0	•	•			•	
Parthenocissus inserta	Thicket Creeper			G5	S5							•	
Anemone virginiana var. virginiana	Thimbleweed			G5	S5							•	
Acalypha virginica var. rhomboidea	Three-seeded Mercury			G5	S5							•	
Arenaria serpyllifolia	Thyme-leaved Sandwort			G?	SE5	I						•	
Agrostis hyemalis	Tickle Grass			G5	S1	H	4	•					
Phleum pratense	Timothy			G?	SE5	I	0	•				•	
Juncus torreyi	Torrey's Rush			G5	S5							•	

		Status						Source					
											City of Hamilton		
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Conservation Coefficient[6]	Dillon[7]	NRSI[8]	NHIC[9]	Fifty Creek Valley ESA[10]	Devil's PunchBowl Escarpment ESA – Plants[11]	Devil's PunchBowl Escarpment ESA - Rare Species[12]
Ailanthus altissima	Tree-of-Heaven			G?	SE5	I						•	
Populus tremuloides	Trembling Aspen			G5	S5		2	•	•			•	
Carex molesta	Troublesome Sedge			G4	S4?							•	
Carex stricta	Tussock Sedge			G5	S5		4	•					
Cardamine diphylla	Twin-leaved Toothwort			G5	S5							•	
Geum urbanum	Urban Avens			G5	SE2	I						•	
Crataegus macrosperma	Variable Hawthorn			G5	S5							•	
Abutilon theophrasti	Velvetleaf			G?	SE5	I	0	•					
Viola sp	Violet Species							•					
Parthenocissus quinquefolia	Virginia Creeper			G5	S4?		6	•	•				
Hydrophyllum virginianum	Virginia Waterleaf			G5	S5							•	
Calla palustris	Water Arum			G5	S5		8	•					
Nasturtium officinale	Water-cress			G?	SE	I	0	•					
Lycopus uniflorus	Water-horehound			G5	S5							•	
Rhus radicans ssp. rydbergii	Western Poison-ivy			G5T5	S5		0	•				•	
Fraxinus americana	White Ash			G5	S5		4	•	•			•	
Geum canadense	White Avens			G5	S5							•	
Actaea pachypoda	White Baneberry			G5	S5							•	
Betula papyrifera	White Birch			G5	S5		2		•			•	
Trifolium repens	White Clover			G?	SE5	I	0	•	•			•	
Ulmus americana	White Elm			G5?	S5		3	•	•			•	
Leersia virginica	White Grass			G5	S4							•	
Prenanthes alba	White Lettuce			G5	S5		6	•				•	
Morus alba	White Mulberry			G?	SE5	I						•	
Quercus alba	White Oak			G5	S5		6	•	•			•	

		Status						Source					
											City of Hamilton		
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Conservation Coefficient[6]	Dillon[7]	NRSI[8]	NHIC[9]	Fifty Creek Valley ESA[10]	Devil's PunchBowl Escarpment ESA – Plants[11]	Devil's PunchBowl Escarpment ESA - Rare Species[12]
Pinus strobus	White Pine			G5	S5		4		•			•	
Eupatorium rugosum	White Snakeroot			G5	S5							•	
Picea glauca	White Spruce			G5	S5		6	•	•				
Melilotus alba	White Sweet-clover			G5	SE5	I	0	•	•			•	
Trillium grandiflorum	White Trillium			G5	S5							•	
Verbena urticifolia	White Vervain			G5	S5		4	•				•	
Salix alba	White Willow			G5	SE4	I	0	•				•	
Carex albursina	White-bear Sedge			G5	S5							•	
Ribes americanum	Wild Black Currant			G5	S5		4	•					
Aquilegia canadensis	Wild Columbine			G5	S5							•	
Echinocystis lobata	Wild Cucumber			G5	S5		3	•					
Allium canadense	Wild Garlic			G5	S5							•	
Asarum canadense	Wild Ginger			G5	S5							•	
Lonicera dioica	Wild Honeysuckle			G5	S5							•	
Allium tricoccum	Wild Leek			G5	S5							•	
Galium circaezans	Wild Licorice			G5	S5							•	
Maianthemum canadense	Wild Lily-of-the-valley			G5	S5							•	
Pastinaca sativa	Wild Parsnip			G?	SE5	I						•	
Rubus idaeus ssp. melanolasius	Wild Red Raspberry			G5	S5		0	•	•			•	
Aralia nudicaulis	Wild Sarsaparilla			G5	S5							•	
Panicum capillare	Witch Grass			G5	S5							•	
Hamamelis virginiana	Witch-hazel			G5	S5							•	
Laportea canadensis	Wood Nettle			G5	S5							•	
Anemone quinquefolia	Wood-anemone			G5	S5							•	
Fragaria vesca americana	Woodland Strawberry			G5	S5							•	

		Status						Source					
											City of Hamilton		
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Conservation Coefficient[6]	Dillon[7]	NRSI[8]	NHIC[9]	Fifty Creek Valley ESA[10]	Devil's PunchBowl Escarpment ESA – Plants[11]	Devil's PunchBowl Escarpment ESA - Rare Species[12]
Scirpus cyperinus	Wool Grass			G5	S5		4	•					
Erysimum cheiranthoides cheiranthoides	Wormseed Mustard			G5	SE5	I						•	
Agrimonia gryposepala	Yellow Agrimony			G5	S5		2	•				•	
Aureolaria flava	Yellow False Foxglove			G5	S3	H						•	
Setaria pumila	Yellow Foxtail			G?	SE5	I						•	
Barbarea vulgaris	Yellow Rocket			G?	SE5	I	0	•				•	
Melilotus officinalis	Yellow Sweet-clover			G?	SE5	I	0	•				•	
Erythronium americanum americanum	Yellow Trout-lily			G5T5	S5		5	•				•	
Yucca filamentosa	Yucca											•	
Solidago flexicaulis	Zig-zag Goldenrod			G5	S5							•	

Table 2: Mammals recorded from the study area of the SCUBE Subwatershed Study. See Table 5 for footnotes.

		Status					Source			
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Dillon[7]	NRSI[8]	North South[13]	Fifty Creek Valley ESA[10]
Canis latrans	Coyote	NAR	NAR	G5	S5			•		
Sylvilagus floridanus	Eastern Cottontail	NAR	NAR	G5	S5		•	•	•	
Sciurus carolinensis	Grey Squirrel	NAR	NAR	G5	S5		•	•	•	•
Microtus pennsylvanicus	Meadow Vole	NAR	NAR	G5	S5		•			
Blarina brevicauda	Northern Short-tailed Shrew	NAR	NAR	G5	S5		•			
Procyon lotor	Raccoon	NAR	NAR	G5	S5		•	•		•
Odocoileus virginianus	White-tailed Deer	NAR	NAR	G5	S5		•	•	•	•
Marmota monax	Woodchuck	NAR	NAR	G5	S5					•

Table 3: Birds recorded from the study area of the SCUBE Subwatershed Study. See Table 5 for footnotes.

		Status					Source								
														City of Hamilton	
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Dillon[7]	NRSI[8]	NHIC[9]	North South[13]	EBIRD[14]	GBBC[15]	OBBA2PC[16]	Fifty Creek Valley ESA[10]	Devil's PunchBowl Escarpment ESA - Rare Species[12]
Anas rubripes	American Black Duck			G5	S4	H					•				
Fulica americana	American Coot	NAR	NAR	G5	S4B	ex					•				
Corvus brachyrhynchos	American Crow			G5	S5B, SZN		•	•			•		•	•	
Carduelis tristis	American Goldfinch			G5	S5B,SZN		•			•	•	•	•	•	
Falco sparverius	American Kestrel			G5	S5B,SZN	h		•			•			•	
Setophaga ruticilla	American Redstart			G5	S5B,SZN	h	•				•				
Turdus migratorius	American Robin			G5	S5B,SZN		•	•		•	•		•	•	
Spizella arborea	American Tree Sparrow			G5	S4B						•	•			
Anas americana	American Wigeon			G5	S4	H					•				
Scolopax minor	American Woodcock			G5	S5B,SZN		•								
Haliaeetus leucocephalus	Bald Eagle	NAR	SC	G4	S2N,S4B						•				
Icterus galbula	Baltimore Oriole			G5	S5B,SZN		•			•	•		•		
Riparia riparia	Bank Swallow			G5	S5B					•	•			•	
Tyto alba	Barn Owl	END	END	G5	S1	ex					•				
Hirundo rustica	Barn Swallow			G5	S5B,SZN		•	•		•	•		•		
Bucephala islandica	Barrow's Goldeneye			G5	SNA						•				
Ceryle alcyon	Belted Kingfisher			G5	S5B,SZN	h		•		•	•				
Melanitta nigra	Black Scoter			G5	S4B,S4N						•				
Chlidonias niger	Black Tern	NAR	SC	G4	S3B	ex			•						
Mniotilta varia	Black-and-white Warbler			G5	S5B	h					•				
Poecile atricapillus	Black-capped Chickadee			G5	S5		•			•	•		•	•	
Nycticoraz nycticorax	Black-crowned Night-heron			G5	S3B,S3N	H			•						
Dendroica striata	Blackpoll Warbler			G5	S4B,SZN		•								
Dendroica caerulescens	Black-throated Blue Warbler			G5	S5B	H					•				

		Status					Source								
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Dillon[7]	NRSI[8]	NHIC[9]	North South[13]	EBIRD[14]	GBBC[15]	OBBA2PC[16]	City of Hamilton	
														Fifty Creek Valley ESA[10]	Devil's PunchBowl Escarpment ESA - Rare Species[12]
Dendroica virens	Black-throated Green Warbler			G5	S5B	H					•				
Cyanocitta cristata	Blue Jay			G5	S5		•	•		•	•	•	•	•	
Polioptila caerulea	Blue-gray Gnatcatcher			G5	S4B,SZN	h	•			•					
Dolichonyx oryzivorus	Bobolink	THR	THR	G5	S4B,SZN		•			•					•
Chroicocephalus philadelphia	Bonaparte's Gull			G5	S4B,S4N						•				
Branta bernicla	Brant			G5	S4N						•				
Certhia americana	Brown Creeper			G5	S5N	h					•				
Molothrus ater	Brown-headed Cowbird			G5	S5B,SZN		•			•	•		•	•	
Bucephala albeola	Bufflehead			G5	S4						•				
Branta canadensis	Canada Goose			G5	S5B,SZN		•	•		•	•		•		
Wilsonia canadensis	Canada Warbler	THR	SC	G5	S4B	h					•				•
Aythya valisineria	Canvasback			G5	S1B,S4N						•				
Hydroprogne caspia	Caspian Tern	NAR	NAR	G5	S3B	h					•				
Petrochelidon fulva	Cave Swallow			G5	SNA						•				
Bombycilla cedrorum	Cedar Waxwing			G5	S5B,SZN		•	•		•	•		•	•	
Dendroica pensylvanica	Chestnut-sided Warbler			G5	S5B	h				•					
Chaetura pelagica	Chimney Swift	THR	THR	G5	S5B,SZN,S4B,S4N	h	•							•	•
Spizella passerina	Chipping Sparrow			G5	S5B,SZN		•			•	•				
Spizella pallida	Clay-coloured Sparrow			G5	S4B,SZN	H	•								
Bucephala clangula	Common Goldeneye			G5	S5						•				
Quiscalus quiscula	Common Grackle			G5	S5B,SZN		•			•	•		•	•	
Gavia immer	Common Loon			G5	S4B,SZN		•				•				
Mergus merganser	Common Merganser			G5	S5B,S5N						•				
Sterna hirundo	Common Tern	NAR	NAR	G5	S4B	h					•				

		Status					Source								
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Dillon[7]	NRSI[8]	NHIC[9]	North South[13]	EBIRD[14]	GBBC[15]	OBBA2PC[16]	City of Hamilton	
														Fifty Creek Valley ESA[10]	Devil's PunchBowl Escarpment ESA - Rare Species[12]
Bucephala clangula x islandica	Common x Barrow's Goldeneye (hybrid)										•				
Geothlypis trichas	Common Yellowthroat			G5	S5B,SZN		•			•			•	•	
Accipiter cooperii	Cooper's Hawk	NAR	NAR	G5	S4	H					•				
Junco hyemalis	Dark-eyed Junco			G5	S5B						•	•			
Phalacrocorax auritus	Double-crested Cormorant	NAR	NAR	G5	S5B						•				
Picoides pubescens	Downy Woodpecker			G5	S5		•			•	•		•		
Calidris alpina	Dunlin			G5	S4B,S5N						•				
Sialia sialis	Eastern Bluebird	NAR	NAR	G5	S4S5B	h				•			•		•
Tyrannus tyrannus	Eastern Kingbird			G5	S5B,SZN		•			•			•	•	
Sturnella magna	Eastern Meadowlark			G5	S5B,SZN		•	•	•						
Sayornis phoebe	Eastern Phoebe			G5	S5B	h					•				
Contopus virens	Eastern Wood-pewee			G5	S4B					•			•		
Sturnus vulgaris	European Starling			G5	SE,SNA		•	•		•	•		•	•	
Spizella pusilla	Field Sparrow			G5	S5B,SZN		•			•					
Passerella iliaca	Fox Sparrow			G5	S4B						•				
Anas strepera	Gadwall			G5	S4	H					•				
Larus hyperboreus	Glaucous Gull			G5	S4N						•				
Regulus satrapa	Golden-crowned Kinglet			G5	S5B	H					•				
Ammodramus savannarum	Grasshopper Sparrow			G5	S4B,SZN	h		•							
Dumetella carolinensis	Gray Catbird			G5	S5B,SZN		•	•		•	•		•	•	
Catharus minimus	Gray-cheeked Thrush			G5	S4B						•				
Larus marinus	Great Black-backed Gull			G5	S2B	H					•				
Ardea herodias	Great Blue Heron			G5	S4	h					•				
Myiarchus crinitus	Great Crested Flycatcher			G5	S4B					•			•		
Aythya marila	Greater Scaup			G5	S4						•				

		Status					Source								
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Dillon[7]	NRSI[8]	NHIC[9]	North South[13]	EBIRD[14]	GBBC[15]	OBBA2PC[16]	City of Hamilton	
														Fifty Creek Valley ESA[10]	Devil's PunchBowl Escarpment ESA - Rare Species[12]
Aythya marila/affinis	Greater/Lesser Scaup			G5	S4						•				
Anas crecca	Green-winged Teal			G5	S4	H					•				
Picoides villosus	Hairy Woodpecker			G5	S5	h					•			•	
Catharus guttatus	Hermit Thrush			G5	S5B						•				
Larus argentatus	Herring Gull			G5	S5B,SZN	h	•				•				
Lophodytes cucullatus	Hooded Merganser			G5	S5B,SN	H					•				
Podiceps auritus	Horned Grebe		SC	G5	S1B,S4N						•				
Eremophila alpestris	Horned Lark			G5	S5B,SZN		•			•	•				
Carpodacus mexicanus	House Finch			G5	SE, SNA		•				•	•	•	•	
Passer domesticus	House Sparrow			G5	SE,SNA		•			•	•		•	•	
Troglodytes aedon	House Wren			G5	S5B,SZN		•			•	•		•	•	
Larus glaucoides	Iceland Gull			G5	S4N						•				
Passerina cyanea	Indigo Bunting			G5	S5B,SZN		•								
Charadrius vociferus	Killdeer			G5	S5B,SZN		•	•		•	•		•		
Somateria spectabilis	King Eider			G5	SHB						•				
Larus fuscus	Lesser Black-backed Gull			G5	SNA						•				
Aythya affinis	Lesser Scaup			G5	S4						•				
Asio otus	Long-eared Owl			G5	S4	H					•				
Clangula hyemalis	Long-tailed Duck			G5	S3B						•				
Anas platyrhynchos	Mallard			G5	S5					•	•				
Falco columbarius	Merlin	NAR	NAR	G5	S5B						•				
Zenaida macroura	Mourning Dove			G5	S5B,SZN		•	•		•	•	•	•	•	
Oporornis philadelphia	Mourning Warbler			G5	S5B,SZN	h	•								
Cygnus olor	Mute Swan			G5	SNA						•				
Vermivora ruficapilla	Nashville Warbler			G5	S5B	h					•				

		Status					Source								
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Dillon[7]	NRSI[8]	NHIC[9]	North South[13]	EBIRD[14]	GBBC[15]	OBBA2PC[16]	City of Hamilton	
														Fifty Creek Valley ESA[10]	Devil's PunchBowl Escarpment ESA - Rare Species[12]
Cardinalis cardinalis	Northern Cardinal			G5	S5		•	•		•	•	•	•	•	
Colaptes auratus	Northern Flicker			G5	S5B,SZN		•				•		•		
Morus bassanus	Northern Gannet			G5	SNA						•				
Accipiter gentilis	Northern Goshawk	NAR	NAR	G5	S4	H					•				
Circus cyaneus	Northern Harrier	NAR	NAR	G5	S4B	H					•				
Mimus polyglottos	Northern Mockingbird			G5	S4B,SZN	h	•	•		•	•	•	•		
Anas acuta	Northern Pintail			G5	S5	H					•				
Stelgidopteryx serripennis	Northern Roughwinged Swallow			G5	S5B,SZN		•			•			•		
Aegolius acadicus	Northern Saw-whet Owl			G5	S4	H					•				
Lanius excubitor	Northern Shrike			G5	SNA						•				
Seiurus noveboracensis	Northern Waterthrush			G5	S5B,SZN		•				•				
Vermivora celata	Orange-crowned Warbler			G5	S4B						•				
Icterus spurius	Orchard Oriole			G5	SZB,SZN	h	•			•	•				
Pandion haliaetus	Osprey			G5	S5B	H					•				
Seiurus aurocapillus	Ovenbird			G5	S5B,SZN		•								
Dendroica palmarum	Palm Warbler			G5T5	S5B						•				
Falco peregrinus	Peregrine Falcon	SC	THR	G4	S3B	H					•				
Carpodacus purpureus	Purple Finch			G5	S4B	H						•			
Progne subis	Purple Martin			G5	S4B	h				•	•		•	•	
Melanerpes carolinus	Red-bellied Woodpecker			G5	S4	h				•	•				
Mergus serrator	Red-breasted Merganser			G5	S4B,S5N						•				
Sitta canadensis	Red-breasted Nuthatch			G5	S5	h					•				
Vireo olivaceus	Red-eyed Vireo			G5	S5B,SZN		•								
Aythya americana	Redhead			G5	S2B,S4N	H					•				
Podiceps grisegena	Red-necked Grebe	NAR	NAR	G5	S3B,S4N						•				

		Status					Source								
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Dillon[7]	NRSI[8]	NHIC[9]	North South[13]	EBIRD[14]	GBBC[15]	OBBA2PC[16]	City of Hamilton	
														Fifty Creek Valley ESA[10]	Devil's PunchBowl Escarpment ESA - Rare Species[12]
Buteo jamaicensis	Red-tailed Hawk	NAR	NAR	G5	S5B,SZN		•	•		•	•			•	
Gavia stellata	Red-throated Loon			G5	S1N,S3B						•				
Agelaius phoeniceus	Red-winged Blackbird			G5	S5B,SZN		•	•		•	•		•	•	
Larus delawarensis	Ring-billed Gull			G5	S5B,SZN		•	•			•		•		
Aythya collaris	Ring-necked Duck			G5	S5						•				
Phasianus colchicus	Ring-necked Pheasant			G5	SNA					•					
Columba livia	Rock Dove			G5	SE		•				•				
Columba livia	Rock Pigeon			G5	SNA					•			•		
Buteo lagopus	Rough-legged Hawk			G5	S1B,S4N						•				
Regulus calendula	Ruby-crowned Kinglet			G5	S4B						•				
Passerculus sandwichensis	Savannah Sparrow			G5	S5B,SZN		•	•		•	•				
Piranga olivacea	Scarlet Tanager			G5	S5B,SZN	h	•								
Accipiter striatus	Sharp-shinned Hawk		NAR	G5	S5	H					•				
Asio flammeus	Short-eared Owl	SC	SC	G5	S2N,S4B	H					•				
Plectrophenax nivalis	Snow Bunting			G5	SNA						•				
Melospiza melodia	Song Sparrow			G5	S5B,SZN		•			•	•		•	•	
Actitis macularia	Spotted Sandpiper			G5	S5					•	•				
Melanitta perspicillata	Surf Scoter			G5	S4B,S4N						•				
Melospiza georgiana	Swamp Sparrow			G5	S5B,SZN		•								
Tachycineta bicolor	Tree Swallow			G5	S5B,SZN		•			•	•		•		
Cygnus buccinator	Trumpeter Swan	NAR	NAR	G4	S4						•				
Cygnus columbianus	Tundra Swan			G4	S4						•				
Cathartes aura	Turkey Vulture			G5	S4B,SZN	h		•			•				
	Unknown Rail sp						•								
Vireo gilvus	Warbling Vireo			G5	S5B,SZN		•			•	•		•	•	

		Status					Source								
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Dillon[7]	NRSI[8]	NHIC[9]	North South[13]	EBIRD[14]	GBBC[15]	OBBA2PC[16]	City of Hamilton	
														Fifty Creek Valley ESA[10]	Devil's PunchBowl Escarpment ESA - Rare Species[12]
Aechmophorus occidentalis	Western Grebe			G5	SNA						•				
Sitta carolinensis	White-breasted Nuthatch			G5	S5B,SZN	h					•				
Zonotrichia leucophrys	White-crowned Sparrow			G5	S4B						•				
Zonotrichia albicollis	White-throated Sparrow			G5	S5B,SZN	h	•				•				
Loxia leucoptera	White-winged Crossbill			G5	S5B						•				
Melanitta fusca	White-winged Scoter			G5	S4B,S4N						•				
Meleagris gallopavo	Wild Turkey			G5	S5						•				
Empidonax traillii	Willow Flycatcher			G5	S5B,SZN		•			•			•		
Gallinago delicata	Wilson's Snipe			G5	S5B	H					•				
Troglodytes troglodytes	Winter Wren			G5	S5B	h					•				
Hylocichla mustelina	Wood Thrush			G5	S4B					•					
Dendroica petechia	Yellow Warbler			G5	S5B,SZN		•			•	•		•	•	
Dendroica coronata	Yellow-rumped Warbler			G5	S5B,SZN	H	•				•				

Table 4: Reptiles and amphibians recorded from the study area of the SCUBE Subwatershed Study. See Table 5 for footnotes.

		Status					Source					
											City of Hamilton	
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Dillon[7]	NHIC[9]	North South[13]	Hamilton Herp Atlas[17]	Fifty Creek Valley ESA[10]	Devil's Punch Bowl Escarpment ESA - Rare Species[12]
Bufo americanus americanus	American Toad	NAR	NAR	G5	S5		•			•	•	
Storeria dekayi	Brown Snake	NAR	NAR	G5	S5		•			•		•
Chelydra serpentina	Common Snapping Turtle	SC	SC	G5	S3,S5?		•			•		•
Thamnophis sirtalis sirtalis	Eastern Garter Snake	NAR	NAR	G5T?	S5		•			•	•	
Lampropeltis triangulum	Eastern Milk Snake	SC	SC	G5	S3		•	•		•		•
Pantherophis spiloides pop. 2	Gray Ratsnake	END	END	G5T1	S1			•				
Hyla versicolor	Gray Treefrog	NAR	NAR	G5	S5		•			•		
Rana clamitans	Green Frog	NAR	NAR	G5	S5		•		•	•	•	
Ambystoma jeffersonianum	Jefferson Salamander	END	END	G4	S2	H		•				•
Ambystoma laterale-jeffersonianum	Jefferson Salamander Complex			GNA	S2					•		
Chrysemys picta marginata	Midland Painted Turtle			G5T5	S5					•		
Rana pipiens	Northern Leopard Frog	NAR	NAR	G5	S5		•			•	•	•
Plethodon cinereus	Redback Salamander			G5	S5					•		
Notophthalmus viridescens viridescens	Red-spotted newt			G5T5	S5	h				•		
Crotalus horridus	Timber Rattlesnake	EXP	EXP	G4	SX	ex		•				
Pseudacris triseriata	Western Chorus Frog	NAR	NAR	G5	S4		•			•		•

Table 5: Insects recorded from the study area of the SCUBE Subwatershed Study.

		Status					Source			
									City of Hamilton	
Scientific Name	Common Name	COSEWIC[1]	COSSARO[2]	G Rank[3]	S Rank[4]	Regional[5]	Dillon[7]	NHIC[9]	Fifty Creek Valley ESA[10]	Devil's PunchBowl Escarpment ESA - Rare Species[12]
Stylurus spiniceps	Arrow Clubtail			G5	S2			•		
Tramea lacerata	Black saddlebags			G5	S4		•			
Pachydiplax longipennis	Blue Dasher			G5	S5				•	
Pieris rapae	Cabbage White			G5	SE		•		•	
Anax junius	Common Green Darner			G5	S5		•		•	
Lestes disjunctus	Common Spreadwing			G5	S5				•	
Libellula lydia	Common Whitetail			G5	S5				•	
Ischnura verticalis	Eastern Forktail			G5	S5				•	
Erythemis simplicicollis	Eastern Pondhawk			G5	S5				•	
Everes comyntas	Eastern tailed blue			G5	S5		•			
Thymelicus lineola	European Skipper			G5	SE				•	
Enallagma civile	Familiar Bluet			G5	S5				•	
Ancyloxypha numitor	Least Skipper			G5	S5				•	
Megisto cymela	Little Wood Satyr			G5	S5				•	
Polites mystic	Long Dash			G5	S5				•	
Danaus plexippus	Monarch	SC	SC	G5	S2N,S4B		•			•
Nymphalis antiopa	Mourning Cloak			G5	S5				•	
Phyciodes cocyta	Northern crescent			G5	S5		•			
Polites peckius	Peck's Skipper			G5	S5				•	
Polygonia interrogationis	Question mark			G5	S5		•			
Colias sp.	Sulphur sp.						•			
Libellula pulchella	Twelve-spotted Skimmer			G5	S5				•	
Spilosoma virginica	Virginian tiger moth caterpillar			G5	S5		•			

1. COSEWIC Status. COSEWIC (Committee on the Status of Endangered Wildlife in Canada) assigns a federal status ranking for all species that it assesses. Ranking definitions are as follows:

Endangered (E) - A wildlife species facing imminent extirpation or extinction.

Threatened (T) - A wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.

Special Concern (SC) - A wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats.

Not at Risk (NAR) - A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.

2. COSSARO Status. COSSARO (Committee on the Status of Species at Risk in Ontario) assigns a provincial status ranking for all species that it assesses. Ranking definitions are as follows:

Extinct – the species no longer lives anywhere in the world.

Extirpated – the species lives somewhere in the world, and at one time it lived in the wild in Ontario, but it no longer lives in the wild in Ontario.

Endangered – the species lives in the wild in Ontario but is facing imminent extinction or extirpation.

Threatened – the species lives in the wild in Ontario, is not endangered, but is likely to become endangered if steps are not taken to address factors threatening it.

Special Concern – the species lives in the wild in Ontario, is not endangered or threatened, but may become threatened or endangered due to a combination of biological characteristics and identified threats.

3. G-rank: Global ranks are assigned by a consensus of the network of Conservation Data Centres, scientific experts and The Nature Conservancy to designate a rarity rank based on the range-wide status of a species, subspecies or variety.

G1 - Extremely rare; usually 5 or fewer occurrences in the overall range or very few remaining individuals; or because of some factor(s) making it especially vulnerable to extinction.

G2 - Very rare; usually between 5 and 20 occurrences in the overall range or with many individuals in fewer occurrences; or because of some factor(s) making it vulnerable to extinction.

G3 - Rare to uncommon; usually between 20 and 100 occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances.

G4 - Common; usually more than 100 occurrences; usually not susceptible to immediate threats.

G5 - Very common; demonstrably secure under present conditions.

4. S-rank: Provincial (or Subnational) rank by the MNR Natural Heritage Information Centre (NHIC) to set protection priorities for rare species and natural communities.

S1 - Critically Imperiled - Critically imperiled in the state/province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province.

S2 - Imperiled - Imperiled in the province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the province.

S3 - Vulnerable - Vulnerable in the province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation

S4 - Apparently Secure - Uncommon but not rare; some cause for long-term concern due to declines or other factors.

S5 - Secure - Common, widespread, and abundant in the province.

5. Status in the City of Hamilton as defined by the Hamilton Natural Areas Inventory (Dwyer 2003)

H - Rare in the City of Hamilton (see Dwyer 2003 for complete definition).

h - Uncommon in the City of Hamilton (see Dwyer 2003 for complete definition).

ex – Considered extirpated from the City of Hamilton.

I - Considered introduced in the City of Hamilton.

6. Coefficient of Conservation: Numeric value between 0 and 10 which indicates the degree of faithfulness a plant displays to a specific habitat or set of environmental conditions. Conservative plant species, such as those which are only found in relatively pristine natural habitats such as bogs or prairies, are assigned a high coefficient of conservatism; other plant species which grow in a wide variety of habitats and can tolerate high levels of cultural disturbance are assigned low values.

7. Observed during fieldwork by Dillon Consulting Limited (2010).

8. Observed during fieldwork by Natural Resources Solutions Incorporated.

9. Observation records obtained on April 13, 2011 from the Natural Heritage Information Centre database for squares 17PH08_74, 17PH08_84, 17PH08_86, 17PH08_94, 17PH08_96, 17PH18_04, 17PH18_05, 17PH18_14, 17PH18_15, 17PH18_24 and 17PH18_25.

10. Fifty Creek Valley ESA species observation records from the City of Hamilton Natural Heritage Database obtained from Hamilton Conservation Authority on February 28, 2011.

11. Devil's PunchBowl Escarpment ESA species observation records from the City of Hamilton Natural Heritage Database obtained from Hamilton Conservation Authority on February 28, 2011.

12. Rare species observation records from Devil's PunchBowl Escarpment ESA from the City of Hamilton Natural Heritage Database obtained from Hamilton Conservation Authority on February 28, 2011.

13. Observed during fieldwork by North South Environmental Incorporated.

14. Records obtained from Bird Studies Canada's EBIRD database for the study area of the SCUBE Subwatershed Study and immediately surrounding area.

15. Records obtained from Bird Studies Canada's Great Backyard Bird Count database for the study area of the SCUBE Subwatershed Study and immediately surrounding area.

16. Records obtained from Bird Studies Canada's Ontario Breeding Bird Atlas database for the study area of the SCUBE Subwatershed Study and immediately surrounding area.

APPENDIX F:

MNR List of COSSARO-designated Species at Risk Known or Suspected to Occur in the City of Hamilton

HAMILTON

Species At Risk Designations	
ENDANGERED	
THREATENED	
SPECIAL CONCERN	
EXTIRPATED	

AMPHIBIANS		ESA Protection	Key Habitats Used By Species	Timing Of Life History Events	How to Conduct a Proper Survey
Jefferson Salamander (*Ambystoma jeffersonianum*)	**Known to Occur**	*Habitat Regulations*	inhabit deciduous and mixed deciduous forests with suitable breeding areas which generally consist of ephemeral (temporary) bodies of water that are fed by spring runoff, groundwater, or springs.	Active: March – October Hibernates: October – March Breeding: Late March - Mid April	Contact local MNR office for a copy

BIRDS		ESA Protection	Key Habitats Used By Species	Timing Of Life History Events	How to Conduct a Proper Survey
Acadian Flycatcher (*Empidonax virescens*)	**Known to Occur**	*Species Protection Only*	generally requires large areas of mature, undisturbed forest; avoids the forest edge; often found in well wooded swamps and ravines	Migrate South before Winter	**When to survey:** - good weather: winds <19km/hr (<3 on the Beaufort scale); no thick fog or precipitation - peak breeding season (May 24-July 10) - between dawn and 5 hours after dawn **How to survey:** -stand still & listen for a given period of time (5 minutes for the breeding bird atlas) and record any SAR birds seen or heard during this time. The following behaviours may tell you whether it is a breeding bird rather than a migrant visitor:
Bald Eagle (*Haliaeetus leucocephalus*)	**Known to Occur**	*N/A*	prefers deciduous and mixed-deciduous forest; and habitat close to water bodies such as lakes and rivers; They roost in super canopy trees such as Pine	Breed and Nest - April or May Some Migrate South when water bodies freeze over	• Nests are easy to spot from water or air • Adults may travel long distances from nest to hunt • Nesting may begin as early as February/March
Barn Owl (*Tyto alba*)	**Known to Occur**	*Habitat Regulations*	generally prefer low-elevation, open country; often associated with agricultural lands, especially pasture. Nests are located in buildings, hollow trees and cavities in cliffs.	Active Year Round Some leave for the Winter	• Buildings can be surveyed for clues such as pellets and droppings or presense of individuals • Night surveys may be helpful as they are very vocal
Black Tern (*Childonias niger*)	**Known to Occur**	*N/A*	generally prefer freshwater marshes and wetlands; nest either on floating material in a marsh or on the ground very close to water	Migrate South for the Winter	Watch for them conspicuously hunting throughout the day in their suitable habitat.
Bobolink (*Dolichonyx oryzivorus*)	**Known to Occur**	*Habitat Protection*	generally prefers open grasslands and hay fields. In migration and in winter uses freshwater marshes and grasslands	Migrate South for the Winter	• Follow Breeding Bird Survey Protocol

Cerulean Warbler (*Dendoica cerulea*)	**Known to Occur**	*Species Protection Only*	generally found in mature deciduous forests with an open understorey; also nests in older, second-growth deciduous forests.	Migrate South for the Winter	• Follow Breeding Bird Survey Protocol
Chimney Swift (*Chaetura pelagica*)	**Known to Occur**	*Habitat Protection*	historically found in deciduous and coniferous, usually wet forest types, all with a welldeveloped, dense shrub layer; now most are found in urban areas in large uncapped chimneys	Nesting - Late April to Mid- May Migrate South in September or Early October	• Watch for them foraging high in the sky, usually in groups • Most likely encountered in oldest sections of towns, with old buildings (churches, etc) that still have large brick/masonry chimneys • Surveys can be conducted at any time in the breeding season • A minimum of 2 visits at least 7 days apart • Best time for surveying is a dusk before and as they enter the roost
Common Nighthawk (*Chordeiles minor*)	**Suspected to Occur**	*N/A*	generally prefer open, vegetation-free habitats, including dunes, beaches, recently harvested forests, burnt-over areas, logged areas, rocky outcrops, rocky barrens, grasslands, pastures, peat bogs, marshes, lakeshores, and river banks. This species also inhabits mixed and coniferous forests. Can also be found in urban areas (nest on flat roof-tops)	Migrate South for the Winter	**When to Look/Listen:** • Time of day: dusk and the few hours following. • Flashlight surveys for nesting adults are done in the dark. **How to Look/Listen:** • set up survey routes with counts at regular intervals in desired habitat • Look and Listen for them flying above open areas just before dusk, making a nasal “peent” call. • Males perform an aerial display over nest site which consists of deep dives resulting in a “sonic boom” • Incubating females or silent males on the ground at night can be spotted using a powerful flashlight to scan open areas or their conspicuous eye shine.
Henslow's Sparrow *(Ammodramus henslowii)*	**Historically Known to Occur**	*Species Protection Only*	generally found in old fields, pastures and wet meadows. They prefer areas with dense, tall grasses, and thatch, or decaying plant material	Migrate South for the Winter	• Follow Breeding Bird Survey Protocol
Hooded Warbler *(Wilsonia citrina)*	**Known to Occur**	*N/A*	generally found in the Carolinian Zone, in the interiors of large upland tracts of mature deciduous and mixed forest, and in ravines; can breed in low shrubbery such as raspberry canes	Breed from Late May to Early July	• Follow Breeding Bird Survey Protocol
King Rail *(Rallus elegans)*	**Known to Occur**	*Species Protection Only*	generally this species requires large marshes with open shallow water that merges with shrubby areas	Breed from Late April to mid-May Migrate South for the Winter	• Follow MMP protocol; Very difficult to detect.
Least Bittern *(Ixobrychus exilis)*	**Known to Occur**	*Species Protection Only*	generally located near pools of open water in relatively large marshes and swamps that are dominated by cattail and other robust emergent plants	Migrate South for the Winter	• Follow MMP protocol; 10 day window of male calling (variable timing). Does not respond well to playback. Very difficult to detect.

Louisiana Waterthrush ***(Seiurus motacilla)***	**Known to Occur**	*N/A*	generally inhabits mature forests along steeply sloped ravines adjacent to running water. It prefers clear, cold streams and densely wooded swamps	Migrate South for the Winter	• Follow Breeding Bird Survey Protocol
Peregrine Falcon ***(Falco peregrinus)***	**Known to Occur**	*Habitat Regulations*	generally nest on tall, steep cliff ledges adjacent to large waterbodies; some birds adapt to urban environments and nest on ledges of tall buildings, even in densely populated downtown areas.	Active Year Round Lay Eggs around Easter Hatching occurs around Mother's Day Young fledge around Father's Day	• Visit ideal habitat locations and listen/look for individuals in the vicinity.
Prothonotary Warbler ***(Protonotaria citrea)***	**Known to Occur**	*Species Protection Only*	generally found in the dead trees of flooded woodlands or deciduous swamp forests; Carolinian zone	Migrate South for the Winter Eggs are layed from Late May - Early July	• Follow Breeding Bird Survey Protocol or look for nesting birds
Red-Headed Woodpecker ***(Melanerpes erythrocephalus)***	**Known to Occur**	*N/A*	generally prefer open oak and beech forests, grasslands, forest edges, orchards, pastures, riparian forests, roadsides, urban parks, golf courses, cemeteries, as well as along beaver ponds and brooks	Active from May to September	• Follow Breeding Bird Survey Protocol
Short-eared Owl ***(Asio flammeus)***	**Known to Occur**	*N/A*	generally prefers a wide variety of open habitats, including grasslands, peat bogs, marshes, sand-sage concentrations, old pastures and agricultural fields	Active Year Round	• Follow breeding bird survey protocol • Look and Listen at Dusk in appropriate habitat
Yellow-breasted Chat ***(Icteria virens)***	**Known to Occur**	*N/A*	generally prefer dense thickets around wood edges, riparian areas, and in overgrown clearings	Migrate South for the Winter Arrive in Ontario Early May	• Follow Breeding Bird Survey Protocol

FISH			**Key Habitats Used By Species**	**Timing Of Life History Events**	**How to Conduct a Proper Survey**
American Eel ***(Anguilla rostrata)***	**Known to Occur**	*Species Protection Only*	all fresh water, estuaries and coastal marine waters that are accessible to the Atlantic Ocean; 12-mile creek watershed and Lake Ontario	Active Year Round	• Electrofishing For information please contact your local MNR office, DFO, and Lakes and Rivers
Grass Pickerel ***(Esox americanus vermiculatus)***	**Known to Occur**	*N/A*	generally occur in wetlands with warm, shallow water and an abundance of aquatic plants; occur in the St. Lawrence River, Lake Ontario, Lake Erie, and Lake Huron	spawn in Ontario from late March to early May	For information please contact your local MNR office, DFO, and Lakes and Rivers
Redside Dace ***(Clinostomus elongatus)***	**Known to Occur**	*Habitat Protection*	generally found in pools and slow-moving areas of small headwater streams with a moderate to high gradien	Spawning occurs in May	• Minnow Trapping For information please contact your local MNR office, DFO, and Lakes and Rivers

INSECTS		ESA Protection	**Key Habitats Used By Species**	**Timing Of Life History Events**	**How to Conduct a Proper Survey**

Monarch Butterfly ***(Danaus plexippus)***	**Known to Occur**	*N/A*	exist primarily wherever milkweed and wildflowers exist; abandoned farmland, along roadsides, and other open spaces	Migrate South for the Winter Usually in Late September and October	• Watch for adults along roadsides and in open fields • Caterpillars feed on milkweeds: Common milkweed grows in open disturbed habitats (fields, roadsides, etc) and swamp milkweed grows in wet habitats (along streams, lakes, marshes) • Adults can be spotted from a distance; caterpillars must be looked for carefully on the host plant.

MAMMALS		ESA Protection	**Key Habitats Used By Species**	**Timing Of Life History Events**	**How to Conduct a Proper Survey**
American Badger ***(Taxidea taxus jacksoni)***	**Known to Occur**	*Habitat Regulations*	generally prefer open habitats, whether natural (grasslands) or man-made (agricultural fields, road right-of-ways, golf courses)	Breed: Late Summer Semi-dormant over Winter	• Determine if soils are suitable (sandy or loamy) • Dens and Woodchuck burrows should be surveyed for use
Woodland Vole ***(Microtus pinetorum)***	**Known to Occur**	*N/A*	generally associated with deciduous forests in areas of soft, friable, often sandy soil beneath deep humus, where it can burrow easily.	Active Year Round	The best way to document its presence is with traps. Abundances typically are highest during late summer and fall and it is during this time period that trapping efforts should be most successful. Evidence of its tunnels may be apparent in leaf litter as well as its angular chew marks on vegetation near or in passageways

MOLLUSCS	ESA Protection	**Key Habitats Used By Species**	**Timing Of Life History Events**	**How to Conduct a Proper Survey**

MOSSES	ESA Protection	**Key Habitats Used By Species**	**Timing Of Life History Events**	**How to Conduct a Proper Survey**

PLANTS		ESA Protection	**Key Habitats Used By Species**	**Timing Of Life History Events**	**How to Conduct a Proper Survey**
American Chestnut ***(Castanea dentata)***	**Known to Occur**	*Species Protection Only*	found in deciduous forest communities; this tree prefers arid forests with acid and sandy soils.	Flowers occur in Late Spring and Early Summer	• Walk slowly and systematically in grid fashion, pausing to scan for plants every 5 meters • Use a plant field guide to distinguish from similar species • Perform detailed floristic inventory • Look for distinictive fruits on the ground
American Columbo ***(Frasera caroliniensis)***	**Known to Occur**	*Species Protection Only*	most commonly associated with open deciduous forested slopes, thickets and clearings; grows in a variety of relatively stable habitats as well as on a wide variety of soils	Germination and development of the rosette begin in early spring; Flowers open in May; Fruit production continues until October or November	• Walk slowly and systematically in grid fashion, pausing to scan for plants every 5 meters • Use a plant field guide to distinguish from similar species • Look for spikes from last years flowers
American Ginseng ***(Panax quinquefolius)***	**Known to Occur**	*Species Protection Only*	grows in rich, moist, undisturbed and relatively mature deciduous woods in areas of neutral soil (such as over limestone or marble bedrock).	Flowering begins in June and continues until August; The fruit develop from July to August and ripen in August and September	• Walk slowly and systematically in grid fashion, pausing to scan for plants every 5 meters • Use a plant field guide to distinguish from similar species

Broad Beech Fern ***(Phegopteris hexagonoptera)***	**Known to Occur**	*N/A*	generally inhabits shady areas of beech and maple forests where the soil is moist or wet	The frond of the Broad Beech Fern appears towards the end of May	• Walk slowly and systematically in grid fashion, pausing to scan for plants every 5 meters • Use a plant field guide to distinguish from similar species
Eastern Flowering Dogwood ***(Cornus florida)***	**Known to Occur**	*Habitat Protection*	generally grows in deciduous and mixed forests, in the drier areas of its habitat, although it is occasionally found in slightly moist environments; Also grows around edges and hedgerows	flowering occurs in mid-spring, just as the leaves begin to develop. Fruit turns red at the end of summer.	• Walk slowly and systematically in grid fashion, pausing to scan for plants every 5 meters • Use a plant field guide to distinguish from similar species • Easiest to detect during Spring when in flower • Also look for distinctive bark
Few-flowered Club-rush ***(Trichophorum planifolium)***	**Known to Occur**	*Habitat Regulations*	generally found in Dry Fresh Oak deciduous forests and Dry Fresh Oak-Maple-Hickory deciduous forests (only found on RBG property)	Plants flower early before the forest canopy leafs in	• Walk slowly and systematically in grid fashion, pausing to scan for plants every 5 meters • Use a plant field guide to distinguish from similar species
Green Dragon ***(Arisaema dracontium)***	**Known to Occur**	*N/A*	generally grows in damp deciduous forests and along streams.	Flowering occurs in May and June	• Walk slowly and systematically in grid fashion, pausing to scan for plants every 5 meters • Use a plant field guide to distinguish from similar species
Red Mulberry ***(Morus rubra)***	**Known to Occur**	*Species Protection Only*	generally grows in moist forest habitats. In Ontario, these include slopes and ravines of the Niagara Escarpment, and sand spits and bottom lands; Can grow in open areas such as hydro corridors	Flowering occurs when leaves emerge in late spring. Fruit emerges in Mid-July.	• Walk slowly and systematically in grid fashion, pausing to scan for plants every 5 meters • Use a plant field guide to distinguish from similar species
Spotted Wintergreen ***(Chimaphila maculata)***	**Historically Known to Occur**	*Species Protection Only*	generally grow in sandy habitats in dry-mesic oak-pine woods. In Canada, they grow very close to the Great Lakes	Flowering occurs in late July to early August	• Watch for the distinct evergreen leaves in suitable habitat • May be easiest to search in fall and spring
White Wood Aster ***(Eurybia divaricata)***	**Known to Occur**	*Species Protection Only*	generally grows in open, dry, deciduous forests. It has been suggested that it may benefit from some disturbance, as it often grows along trails.	Flowering occurs in early September, and sets fruit later in the month	• Walk slowly and systematically in grid fashion, pausing to scan for plants every 5 meters • Use a plant field guide to distinguish from similar species

REPTILES	ESA Protection	**Key Habitats Used By Species**	**Timing Of Life History Events**	**How to Conduct a Proper Survey**

Blanding's Turtle ***(Emydonidea blandingii)***	**Known to Occur**	*Species Protection Only*	generally occur in freshwater lakes, permanent or temporary pools, slow-flowing streams, marshes and swamps. They prefer shallow water that is rich in nutrients, organic soil and dense vegetation. Adults are generally found in open or partially vegetated sites, and juveniles prefer areas that contain thick aquatic vegetation including sphagnum, water lilies and algae. They dig their nest in a variety of loose substrates, including sand, organic soil, gravel and cobblestone. Overwintering occurs in permanent pools that average about one metre in depth, or in slow-flowing streams.	Eggs are laid in June, with hatchlings emerging in late September and early October.	Contact your local MNR office for more information
Eastern Hog-nosed Snake ***(Heterodon platirhinos)***	**Historically Known to Occur**	*Species Protection Only*	generally prefer habitats with sandy, well-drained soil and open vegetative cover, such as open woods, brushland, fields, forest edges and disturbed sites. The species is often found near water.	Mating occurs in spring and in August and early September. Hatching occurs in late August or early September	Contact your local MNR office for more information
Eastern Ribbonsnake ***(Thamnophis sauritus)***	**Known to Occur**	*N/A*	generally occur along the edges of shallow ponds, streams, marshes, swamps, or bogs bordered by dense vegetation that provides cover. Abundant exposure to sunlight is also required, and adjacent upland areas may be used for nesting.	Hibernate: October - April Mating: Early Spring Hatching: Early Fall (September)	• In April, look for individuals near wetlands • After April, look for individuals in the wetland vegetation, occasionally basking on boardwalks/rocks/tussocks.
Milksnake ***(Lampropeltis triangulum)***	**Known to Occur**	*N/A*	generally occur in rural areas, where it is most frequently reported in and around buildings, especially old structures. It is also found in a wide variety of habitats, from prairies, pastures, and hayfields, to rocky hillsides and a wide variety of forest types. They must also be in proximity of water, and suitable locations for basking and egg-laying.	Active at dawn and dusk in the spring and fall, and at night in the summer. Hibernate: Late October to Early May	• In areas exposed to sunlight, search under warm surfaces for basking snakes • Surveys using cover boards should be used in appropriate habitats • These surveys should continue for the length of at least one active season • Surveys for potential hibernation sites should be conducted
Northern Map Turtle ***(Graptemys geographica)***	**Known to Occur**	*N/A*	generally inhabits both lakes and rivers, showing a preference for slow moving currents, muddy bottoms, and abundant aquatic vegetation. These turtles need suitable basking sites (such as rocks and logs) and exposure to the sun for at least part of the day.	Active: At night Hibernate: October - April Hatching: Late August - Early September	• scan shoreline in spring and partially submerged logs/rocks in summer for basking turtles • Be aware that map turtles do not allow as close of approach as other turtles before leaving a basking site • Snorkel in desired aquatic habitat! • Nesting season: search suitable habitat for nests

Snapping Turtle ***(Chelydra serpentina)***	**Known to Occur**	*N/A*	generally inhabit shallow waters where they can hide under the soft mud and leaf litter. Nesting sites usually occur on gravely or sandy areas along streams. Snapping Turtles often take advantage of man-made structures for nest sites, including roads (especially gravel shoulders), dams and aggregate pits.	Nesting: Late May and June Hibernate: October - April	• Scan offshore rocks and logs for basking turtles (10am-2pm) • Snorkel in desired aquatic habitat! • Nesting Season: Search known or preferred nesting habitat areas for females
Spiny Softshell ***(Apalone spinifera)***	**Known to Occur**	*Species Protection Only*	generally prefer marshy creeks, swift-flowing rivers, lakes, impoundments, bays, marshy lagoons, ditches and ponds near rivers	Lay eggs in June or July Hibernate over winter	• Best time to survey is during nesting season when females are active laying eggs • Visual searches should be conducted in appropriate habitat

Species at Risk info is not available in LIO – you can get some of it from NHIC. It should be noted that because the province has not been surveyed comprehensively for the presence of species at risk, the absence of an element occurrence does not indicate the absence of the species. Consequently, the presence of element occurrences is useful to flag the presence of a species at risk in an area, but is not an appropriate tool to determine whether a species is present at the local (property-scale) level.

Given the above, the District is of the opinion that field surveys are necessary to determine whether species at risk occur on a property. The District provides the following advice with respect to determining the presence of species at risk on a property for which a land-use change is being proposed.

I. Botanical Inventory

The District recommends undertaking a comprehensive botanical inventory of the entire area within the property's boundaries, in order to map all vegetation communities within the property's boundaries. The vegetation communities should be classified as per the "Ecological Land Classification for Southern Ontario" system, to either the "Ecosite" or "Vegetation Type" level, depending on the habitat specificity of potential SAR on the property.

II. Potential SAR on the property

A list of species at risk that have the potential to occur on the property can be produced by cross- referencing the Vegetation Types described during the botanical inventory with the habitat descriptions of species at risk known to occur in the county or regional municipality within which the property is located. A list of species at risk known and suspected to occur in the single tier municipality of Hamilton is attached. The species-specific COSEWIC status reports (www.cosewic.gc.ca) are a good source of information on species at risk habitat needs and will be helpful in determining the suitability of the property's Vegetation Types for a given species.

III. SAR surveys

The District is of the opinion that each species at risk identified under Step II should be surveyed for, regardless of whether or not the species has been previously recorded on the property. The survey report should describe how each species at risk was surveyed, and provide a rationale for why, if any, certain species appearing on the county/ regional municipal list were not the subject of the survey (e.g. No surveys for Wavy-rayed Lampmussel were conducted because there are no flowing watercourses within the property boundaries).

APPENDIX G:

North-South Environmental Incorporated Review of Bobolink Habitat

Introduction

In 2003 the City of Hamilton proposed Official Plan Amendments to incorporate additional lands within the Urban Area of Stoney Creek. The lands subject to these Official Plan Amendments became known as the Stoney Creek Urban Boundary Expansion (SCUBE) lands. The establishment of the Greenbelt Plan and several subsequent OMB hearings reduced the extent of the urban boundary expansion as originally proposed – in the end four disjunct blocks of land were incorporated in the Stoney Creek Urban Area. These blocks of land are referred to as SCUBE West, SCUBE Central, SCUBE East (Parcel A) and SCUBE East (Parcel B).

The City of Hamilton is currently undergoing a planning process to prepare the Fruitland-Winona Secondary Plan to cover these four blocks of land. The SCUBE East Subwatershed Study, being completed by Aquafor Beech Limited, addresses the SCUBE Central, SCUBE East (Parcel A) and SCUBE East (Parcel B) blocks as well as lands upstream and downstream.

North-South Environmental was retained by Aquafor Beech Limited in spring of 2010 to conduct breeding bird surveys within the study area of the SCUBE East Subwatershed Study, with a particular focus on the lands of SCUBE Central, SCUBE East (Parcel A) and SCUBE East (Parcel B). During these surveys, Bobolink was observed. This species is considered Threatened in Canada by the Committee on the Status of Species at Risk in Ontario (COSEWIC) and in Ontario by the Committee on the Status of Species at Risk in Ontario (COSSARO). Bobolink was noted in two areas: three singing males were noted in SCUBE Central and four singing males were noted in Zone C. These should be considered "possible" breeding records, as there was no other breeding evidence noted, but the birds were exhibiting behaviour consistent with nesting so there is no reason to assume they were not nesting. It should be noted that there may be other locations for Bobolink within the study area of the SCUBE East Subwatershed Study as most of the focus of breeding bird surveys was on SCUBE Central, SCUBE East (Parcel A) and SCUBE East (Parcel B); surveys within the broader study area were conducted by sampling representative habitats only.

In March, 2011 North-South Environmental Incorporated was requested by Aquafor Beech Limited to provide guidance for habitat conservation for Bobolink within the study area of the SCUBE East Subwatershed Study. This guidance is intended to address the requirements of the Endangered Species Act (2007). Several approaches are explored here, including the potential to build upon the Natural Heritage System (NHS) developed through the SCUBE East Subwatershed Study to include habitat for Bobolink.

MNR is currently drafting habitat specific regulations for protection of Bobolink habitat under the Endangered Species Act (2007). The habitat protection recommended in this study is predicated on the requirement to protect Bobolink habitat under the generic regulations. Once specific habitat regulations are provided they should be reviewed and the recommendations presented here revised as required to reflect the specific requirements.

Methods

North-South Environmental Incorporated reviewed a variety of literature sources, particularly the COSEWIC report for Bobolink (COSEWIC 2010 to determine the habitat requirements, as well as primary limiting factors and threats for Bobolink. Literature consulted is listed in the References section.

North-South Environmental Incorporated also consulted various agency staff including Joe Nocera, a research scientist in Species at Risk and Conservation Biology and grassland bird species specialist with the MNR, Karine Beriault, the Biodiversity and Species at Risk Biologist for the MNR Niagara Area office, Donald Sutherland, Zoologist with the Natural Heritage Information Centre, Chris Risley, Bird and Mammal Species at Risk Specialist, MNR Peterborough and Mike Cadman, songbird biologist with Environment Canada's Canadian Wildlife Service. The author's personal experience through 22 years of breeding bird surveys in a variety of urban and wilderness habitats was also used throughout the study.

Bobolink Habitat Requirements

Grassland Requirements

In southern Ontario, Bobolink nest primarily within areas of forage crops for livestock, such as hayfields and lightly-grazed pastures (COSEWIC 2010) dominated by a variety of tall grass and herb species, such as clover (*Trifolium* spp.), Timothy (*Phleum pratense*), smooth brome (*Bromus inermis*) and orchard grass (*Dactylis glomerata*), and broadleaved plants such as goldenrods (*Solidago* spp.) (COSEWIC 2010; personal observation). Hayfields and lightly-grazed pastures are this species' preferred habitat due to the plant cover present at the start of the nesting season (Nocera et al., 2007); such cover is generally absent from grain fields. Bobolink prefer habitat with moderate to tall vegetation, moderate to dense vegetation and moderately deep litter (Dechant *et al.* 1999). Bobolink also occur in wet prairie, graminoid peatlands and abandoned fields dominated by tall grasses, remnants of uncultivated tall-grass prairie, no-till cropland, small-grain fields, reed beds and irrigated fields in arid regions (COSEWIC 2010). However, in Ontario, lower densities are present in tallgrass prairie than in non-native grasslands (Sutherland 2011, pers. comm.). In Ontario, this species is also found in alvar habitat (personal observation).

The Bobolink is also known to use sites that have been restored to grassland habitat (COSEWIC 2010). Throughout its range alfalfa (*Medicago sativa*) monocultures are variably occupied (COSEWIC 2010). In Ontario, alfalfa fields support much lower abundance of Bobolink than grass-dominated hayfields (Nocera 2011, pers. comm.; Cadman 2011 pers. comm.; personal observation). Bobolinks do not generally occupy fields of row crops, such as corn, soybean and wheat (COSEWIC 2010, Cadman, Nocera pers. comm., 2010; personal observation), pastures in valleys with high shrub density or intensively grazed pastures (COSEWIC 2010). In Ontario they can be found in fields

with a light shrub cover, for example, Cadman (2011, pers. comm.) has noted them in fields where there is a shrub density of approximately 1 shrub/100 m^2 of grassland habitat. However, Nocera (2011, pers. comm.) noted that they are often not found in fields with even small numbers of shrubs.

Nocera (2011, pers. comm.) noted that Bobolink habitat in hayfields in Ontario tends to rotate between different crop systems. Over time, hayfields cannot continue to produce high yields if hay is removed year after year as the soils become depleted of nutrients and so these areas have a crop rotation pattern that includes tilled crops. Therefore, Bobolinks may not nest in the same field every year depending on the rotation, but will nest in nearby fields with suitable habitat in the area. In addition, Bobolink prefer grasslands with moderate thatch (Dechant *et al*. 1999), so grasses must be removed or the thatch will become too thick. Therefore, fields that provide preferred habitat are generally tilled from time to time reducing thatch build up. Cover crops such as alfalfa and clover are planted with grass species to return nitrogen to the soil. Hayfields are also sometimes rotated with other crops, such as pure alfalfa and even row crops such as soybeans and corn (Nocera 2011 pers. comm., personal observation).

Area-Sensitivity

Bobolink is generally noted to be area-sensitive throughout its range, occurring mainly in large fields (over 50 ha in size; Herkert et al. 1994), but also nesting in smaller (e.g. as small as 5 ha) fields (Nocera 2011, pers. comm.) in open agricultural settings (Cadman, Nocera, 2011 pers. comm.; personal observation, COSEWIC 2010). As noted by O'Leary and Nyberg (2000): "Birds' view of the vegetation structure of the landscape at many scales probably determines where they choose to settle". Estimates of area-sensitivity for Bobolink are thus somewhat variable, as they depend on factors that include the size of individual fields, the management of fields over time and the regional setting where fields are located. In a study in Illinois, Bobolink rarely occurred in grassland fields of less than 20 ha (Herkert 1991 in Vickery et al. 1994) and this author considered 10-30 ha to be the species' minimum requirement. Herkert (1994) observed that the probability of observing this species reached 50% only in fields over 50 ha. Reproductive success is reportedly lower in small (16-32 ha) habitat fragments (Johnson and Temple 1990). Forman et al. (2002), in a study within an urbanizing agricultural landscape near Boston, noted that all regular breeding (breeding observed in three or more years) of Bobolink only occurred on grasslands greater than 7.2 ha.

Area-sensitivity is at least partly related to the fact that Bobolink avoid edges of woodlands, hedgerows, etc. Nesting success of Bobolinks and other grassland birds decreases near woodland edges (Bollinger and Gavin 2004). Bobolink do not utilize the edge as frequently as the interior area (O'Leary and Nyberg 2000). Fencerows that grassland birds avoid may be dispersal corridors for small mammals as well as foraging runways for nocturnal predators, such as raccoons, skunks and coyotes (O'Leary and Nyberg 2000). However, Renfrew et al. (2005) noted that high predation rates occurred on nests regardless of distance from edge in fragmented landscapes, probably because predators were abundant and could penetrate easily into grassland habitats.

Threats

Agricultural landscapes may become ecological sinks for Bobolink, especially in actively managed hayfields, if haying occurs early in the season.(Perlut et al. 2008). Bobolink eggs and post-fledging juveniles are particularly susceptible to early haying, with nest success declining drastically if haying occurs when eggs or post-fledging juveniles are present (COSEWIC 2010). In Ontario, Gahbauer (2007) has reported that nesting success is considerably higher in undisturbed fields and those mown in mid- to late summer, as early haying results in a high rate of juvenile mortality or nest failure. Bobolink tend to have high fidelity to nest sites: they return to the same nest site every year and so will continue to use the same habitat as long as nesting success is high (Gavin and Bollinger 1988).

Nests and newly-fledged young of grassland species are also highly susceptible to predation, particularly near woodland edges (Renfrew et al. 2005, Suedkamp Wells et al. 2007), but also at considerable distance from edges in fragmented landscapes (Renfrew et al. 2005). It is likely that newly-fledged juveniles are susceptible to vehicle collisions, like most juvenile birds (personal observation), where nests are located in close proximity to roads. Grassland bird nests are also somewhat susceptible to cowbird parasitism (Dechant *et al.* 1999).

Breeding habitat of Bobolink is generally threatened because of habitat loss, due to intensification of agriculture and succession of cultural meadows to shrubland. Suitable habitat used during migration and wintering habitat is also likely being lost, though less is known about this species' migration and wintering requirements. Bobolink has one of the longest migrations of any songbird species (approximately 20,000 km), which places this species at greater risk of encountering hazards on migration and/or on wintering grounds such as human harvest, poisoning (because they are considered pests) and habitat destruction (COSEWIC 2010).

Presence in Urban Habitat

Bobolink are not generally found in habitat surrounded by urban development (personal observation; Cadman, Nocera, and Sutherland, 2011 pers. comm.); for example, this species is not found in larger grasslands that occur in some urban settings such as hydro rights-of-way and roadside verges (personal observation; Sutherland and Cadman 2011, pers. comm.). However, as in the study area of the SCUBE East Subwatershed Study, this species is occasionally found in suitable grasslands in settings where there is a mix of agricultural fields and areas recently converted to urban and residential development (personal observation: for example in the City of Mississauga and Towns of Aurora and Stony Creek). However, it is not known where the threshold exists regarding sensitivity to development, i.e. how much development Bobolink will tolerate.

Almost no studies have investigated Bobolink habitat preferences in urban settings: almost all studies are in habitat in agricultural settings where the surrounding landscape is

characterised by small woodlands, riparian areas and croplands. Jones and Bock (2002) studied Bobolink and other grassland species in municipal open space in Boulder, Colorado and concluded that municipal open spaces can support populations of many Great Plains grassland birds, including Bobolink, if habitat areas are of sufficient size. However, in this study Bobolink distribution was clumped, as the only suitable tall grass habitat for Bobolink was to the south-east of the City, and it is not clear whether Bobolink were found near urban development. In a study evaluating farmland habitat use by breeding birds in southern Quebec, Jobin et al. (1998) encountered no bobolinks in urban habitat – the highest incidence was in dairy farming areas, followed by cash crops, then old fields. This study concluded that Bobolink may avoid houses, based on the fact that only one bobolink was observed out of 86 stops in or near farm houses in this study.

Haire et al. (2000) concluded that urbanization imposed limits on the abundance of all grassland bird species in a Colorado study, (including bobolink), suggesting that urbanization operates at time scales too fast for evolutionary adjustment, and the effects of urbanization continue after the landscape has changed through pollution of air and water. These authors also suggested that interactions between species may also be affected by urbanization; urban cover-types provide opportunities for interspecific competition between grassland nesters and suburban nesting species that would not exist otherwise. In addition, ground-nesting songbirds are easy targets for domestic predators (cats and dogs) whose populations are not limited by availability of prey. As noted above, predators can penetrate a considerable distance into grasslands in fragmented landscapes. However, as in the study by Jones and Bock (2002), the limited extent of tallgrass cover type corresponded with the limited extent of species that depend on this cover type (Bobolink among them), and they were unable to draw conclusions strictly regarding effects of urbanization.

Bobolink appear to avoid busy roads. Breeding of Bobolink and other grassland birds decreases within 700 m of the edges of busy (i.e. more than 15,000 to 30,000 cars/day) roads (Forman et al, 2002). Bobolink are also likely highly susceptible to urban threats. They are ground nesters, and as noted above, nests and young are highly vulnerable to predation. They are low flyers and likely susceptible to vehicle collisions. In addition, they are susceptible to trampling; for example, they are not found in heavily used pastures.

Bobolink Conservation in the SCUBE East Subwatershed

Lands Subject to Fruitland-Winona Secondary Plan

North-South Environmental Incorporated assessed SCUBE Central, SCUBE East (Parcel A) and SCUBE East (Parcel B) for potential Bobolink habitat. Within these lands, the area of most suitable Bobolink habitat consists of the portion of SCUBE Central east of Lewis Road, as it is the only area that includes a large block of grassland – all other large open areas are fragmented by fencerows, old orchards, patches of cultural woodland, etc... It is likely that this entire area would have to be protected to maintain Bobolink.

This area supported three Bobolinks in 2010 (with the caveat that these are records of possible breeding only). The habitat for this species appeared suitable in 2010, with the area occupied mainly by hayfields, though with small areas of abandoned orchard, hedgerow and a small strip of ploughed cropland. The approximate area of optimal habitat within SCUBE Central east of Lewis Road is currently 10 ha. However, if the entire area (which is approximately 16 ha) were converted to grassland habitat, the area is within the lower end of the size range reported to provide preferred habitat for Bobolink. In addition, the area is currently in a regional landscape setting most often associated with the presence of Bobolink: the SCUBE Central lands are still in a largely open, agricultural setting, with localized areas of development.

However, there are many uncertainties associated with conservation of Bobolink habitat in this setting. The portion of the SCUBE Central lands east of Lewis Road is surrounded on two sides and partially on a third side with residential development along the road frontage. Since Bobolink are not generally found in urban settings, it is not certain whether this species would persist, if the remaining frontage areas along Highway 8 and Lewis Road develop in a similar fashion and/or if the SCUBE Central lands west of Lewis Road were developed, as this species appears to be sensitive to surrounding development. It is likely that the croplands located to the north and/or south of the area of optimal habitat would need to be preserved as agricultural or open space (Nocera 2011, pers. comm.). This would provide a more extensive grassland corridor north and south of the SCUBE Central lands that would encourage the persistence of grassland species (Nocera 2011, pers. comm.). However, lands north of Barton Street east of Lewis Road are currently being developed into an industrial park or are subject to planning applications to develop residential housing. Moreover, since the size of the habitat provided by the SCUBE Central lands east of Lewis Road may be near the threshold of Bobolink area requirements and may be degraded as urbanization proceeds, it could not be guaranteed that Bobolink would persist in the area all years, or at all (Nocera 2011, pers. comm., Cadman 2011, pers. comm., Sutherland 2011, pers. comm.).

In addition to protecting adjacent lands from urban development the conservation of Bobolink habitat in the SCUBE Central lands east of Lewis Road would also entail a considerable commitment to management to maintain suitable grassland habitat. For example, as trees and shrubs naturally develop in old fields or meadows they would have to be rigorously removed to ensure successional processes did not degrade Bobolink habitat. The habitat could be planted as permanent grassland, with sowing of warm season grasses, and managed as tallgrass prairie by annual mowing and prescribed burning. However, this may result in sub-optimal habitat, as in Ontario, abundance of Bobolink in tallgrass prairie is much lower than in forage crops (Sutherland 2011, pers. comm.). The preferred alternative would be to manage the area for hay with no early season cutting and with occasional crop rotation. In this case, there would be years when alfalfa or soybeans (for example) would be planted to replenish soil nutrients. The habitat would not be suitable for Bobolink during years when crops other than forage grasses were planted. In all cases, grasses would need to be removed from time to time to avoid build-up of too deep a thatch, as Bobolink prefer a moderate thatch cover.

In addition, development would have to be managed in the area surrounding the SCUBE Central lands east of Lewis Road such that this Bobolink habitat does not become completely surrounded by urban development. In particular, adjacent agricultural habitat to the north and/or south would need to be maintained. This is likely not possible for the lands north of Barton Street east of Lewis Road as they are currently being developed into an industrial park or are subject to planning applications to develop residential housing. Further, busy arterial roads (i.e. over 15,000 to 30,000 cars/day) should not be built within approximately 700 m of this species' habitat. Again, this would be difficult as Highway 8 is already an arterial road and traffic will likely increase as proposed urbanization of the lands subject to the Fruitland-Winona Secondary Plan proceeds. Control of urban predators such as cats and raccoons should be implemented, possibly with the use of a fence around the habitat. The habitat could be used as an area for passive recreation, as long as trails were routed away from nest sites (this species is not particularly sensitive to the presence of people) but dogs would have to be kept on a leash during the breeding season for these birds.

Zones A and C

North-South Environmental Incorporated also noted Bobolink in fields south of Highway 8, in the area east of Fifty Road north of the Niagara Escarpment. Bobolink may be more widespread than this study suggests as breeding bird surveys focused on SCUBE Central, SCUBE East (Parcel A) and SCUBE East (Parcel B); elsewhere within the study area of the SCUBE East Subwatershed Study only representative habitat was sampled. The habitat between the Escarpment and Highway 8 is generally very open, and any suitable grassland area is likely to provide suitable habitat for Bobolink. Bobolink will likely persist as long as the farming practices in this area continue to provide grassland habitat. However, in this part of Ontario hayfields are generally cut prior to the fledging of young (some hayfields had already been cut by the time of the second field visit, on June 12th 2010, in this study). It is likely that mortality of eggs and post-fledging young due to the practice of early cutting of hay is similar to that reported in other areas of Ontario. Thus, it is unknown whether the hayfields in this area would be source or sink habitats for Bobolink. In addition, farming practices in this area may change in the future, with potential loss of hay fields to other types of agriculture, reducing the available habitat for Bobolink. However, these areas of potential habitat are not likely to be subject to intensive urban development as the area south of Highway 8 is subject to the Niagara Escarpment Plan.

Conclusions and Recommendations

Bobolink was noted in two areas within the study area of the SCUBE East Subwatershed Study; within the portion of the SCUBE Central lands east of Lewis Road and within the agricultural lands south of Highway 8. The presence of Bobolink is related to hayfields that provide suitable grassland habitat but within the study area of the SCUBE East Subwatershed Study areas of suitable habitat may be near the threshold of the size preferred by Bobolink, a species which is highly area-sensitive. The presence of

Bobolink is likely related to the open agricultural setting in which hayfields are located.

It is recommended that two management strategies be employed to protect habitat for this species:

1. Designate the entire portion of the SCUBE Central lands east of Lewis Road as an Area Specific Policy Area pending MNR development of Endangered Species Act (2007) regulations for the protection of Bobolink habitat; and

2. Promote agricultural practices that support Bobolink habitat in Zone C.

Should the hayfields in the SCUBE Central lands east of Lewis Road be included in the specific habitat regulations (as seems likely), the entire area east of Lewis Road would be protected. At such time when the specific regulation is drafted for Bobolink habitat, and when the Recovery Strategy is provided, policies for management of this area should be developed.

This two-pronged strategy would provide the most certainty that habitat can be maintained and enhanced. However, the habitat within the SCUBE Central lands may be near the threshold of this area-sensitive species' size range in urban settings, and the habitat will become less suitable as the surrounding landscape becomes developed, such that the species may not persist even if the habitat is maintained and appropriately managed. Fields must be managed to control shrubs and trees, to reduce thatch build-up and also to ensure that the soil nutrients are not depleted by continuous removal of hay. This will likely entail occasional use of the area for other crops such as soybeans or alfalfa which are not suitable habitat for Bobolink. Management of the surrounding lands would also have to include control of development so that the grassland does not become surrounded by urban uses, as well as control of road development as Bobolink abundance decreases within 700 m of a busy highway. Such control may be difficult to accomplish as the lands north of SCUBE Central east of Lewis Road are currently being developed into an industrial park or are subject to planning applications to develop residential housing. Moreover, Highway 8 is already an arterial road. In addition, a fence should be erected around the area to protect it from urban predators. The preserve could be used as recreational open space, and during parts of the year even as an off-leash dog park, but dogs would have to be on-leash during the breeding season.

In order to increase the certainty that Bobolinks persist in the SCUBE East Subwatershed, it is recommended that continued management of the agricultural area south of Highway 8 and east of Fifty Road for hay be promoted through stewardship initiatives. However, late haying practices should be promoted.

References

Bollinger, E. K., and T. A. Gavin. 2004. Responses of nesting Bobolinks (Dolichonyx oryzivorous) to habitat edges. Auk 121:767-776.

COSEWIC. 2010. COSEWIC assessment and status report on the Bobolink (*Dolichonyx oryzivorus*) in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. vi + 42 pp.

Dechant, J.A., M.L. Sondreal, D.H. Johnson, L.D. Igl, C.M. Goldade, A.L. Zimmerman and B.R. Euliss. 1999 (revised 2001). Effects of management practices on grassland birds: Bobolink. Northern Prairie Wildlife Research Centre, Jamestown, ND. 24 pp.

Forman, R.T.T., B. Reineking and A.M. Hersperger. 2002. Road traffic and nearby grassland bird patterns in a suburbanizing landscape.

Gahbauer, M.A. 2007. Bobolink. In Cadman, M.D., D.A. Sutherland, G.G. Beck, D. Lepage, and A.R. Couturier. (eds). 2007. Atlas of the breeding birds of Ontario, 2001-2005. Bird Studies Canada, Environment Canada, Ontario Field Ornithologists, Ontario Ministry of Natural Resources and Ontario Nature, Toronto. xxii + 706 pp.

Gavin, TA., and E.K. Bollinger. 1988. Reproductive correlates of breeding-site fidelity in Bobolinks. Ecology 69:96-103.

Haire, S.L., C.E. Bock, B.S. Cade and B.C. Bennett. 2000. The role of landscape and habitat characteristics in limiting abundance of grassland nesting songbirds in an urban open space. Landscape and Urban Planning 48: 65-82

Herkert, J.R. 1994. The effects of habitat fragmentation on Midwestern grassland bird communities. Ecological Applications 4: 461-471.

Jobin, B., J-L Desgranges, and C. Boutin. 1998. Farmland habitat use by breeding birds in southern Quebec. Can. Field-Nat. 112 (4): 611-618.

Johnson, R.G. and S.A. Temple. 1990. Nest predation and brood parasitism of tallgrass prairie birds. J. Wildl. Manage. 54: 106-111.

Jones, Z.F. and C.E. Bock. 2002. Conservation of grassland birds in an urbanizing landscape: a historical perspective. The Condor 104: 643-651.

O'Leary, C.H. and D.W. Nyberg. 2000. Treelines between fields reduce the density of grassland birds. Natural Areas Journal 20: 243-249.

Perlut, N.G., A.M. Strong, T.M. Donovan, and N.J. Buckley. 2008. Grassland songbird

survival and recruitment in agricultural landscapes: implications for source-sink demography. Ecology 89: 1941-1952.

Rosalind B. Renfrew, Christine A. Ribic, Jamie L. Nack and E. K. Bollinger. 2005. Edge avoidance by nesting grassland birds: a futile strategy in a fragmented landscape. Auk 122 (2): 618-636.

Suedkamp Wells, K.M., M.R. Ryan, J.J. Millspaugh, F.R. Thompson III and M.W. Hubbard. 2007. Survival of Postfledging Grassland Birds in Missouri. Condor 109 (4): 781-794.

APPENDIX H:

Preliminary Meander Belt Assessment

Aquafor Beech Limited determined a preliminary meander belt width for each watercourse within Zone B of the SCUBE Subwatershed Study. Quantification of the meander belt was intended to be a first approximation and thus did not consist of a thorough and detailed assessment. Instead, the empirical relation provided by TRCA (2001) was used to quantify the meander belt. This equation was developed for watercourses within the TRCA jurisdiction and is based on sound physical predictors of meander belt widths, which include slope, discharge, and drainage area. The equation is based on a data set of rural watercourses which had not been previously altered, had no recent change in hydrologic regime, had drainage areas < 25 km^2 and were not situated on bedrock.

Data used to calculate the meander belts for Zone B (e.g. drainage area and estimates of future flows) were obtained from elsewhere in the Stage 1 and Stage 2 Report. Data pertaining to channel slope were derived from City of Hamilton digital mapping. The empirical equation presented in TRCA (2001) provides approaches for taking into account changes in hydrologic regime and thus this was used for the current study since not only peak flows would change, but also flow duration and frequencies. Results of the preliminary meander belt assessment are provided below.

Site	Preliminary meander belt width (m)
WC 5.0 Future	42
WC 5.2 Future	16
WC 6 - Future	44
WC 7 West - Future	41
WC 7 East - Future	42
WC 7 Center - Future	55
WC 7.2 - Future	17

Typically, when undertaking meander belt assessments, multiple approaches are used to converge upon a single meander belt value. Thus, caution should be used when applying the above value for future land planning decisions and a thorough meander belt assessment should be undertaken for each watercourse.

Reference:

Toronto and Region Conservation Authority. 2001. Belt Width Delineation Procedures. Prepared by PARISH Geomorphic Limited for Toronto and Region Conservation Authority, 64 pp. In Ministry of Natural Resources, Natural Hazards Technical Guides: River and Stream Systems Erosion Hazard Limit Technical Guide.

APPENDIX I:

2012 Breeding Bird Report

REPORT ON FOUR AVIAN SPECIES AT RISK AND OTHER BREEDING BIRD SPECIES Within Fruitland-Winona Secondary Plan Area, Scube Central, Scube East 'A' and Scube East 'B' Parcels

DRAFT COPY

Prepared for:
City of Hamilton.
Planning and Economic Development Department
Community Planning and Design Section
71 Main Street West, 6th Floor,
Hamilton ON L8P 4Y5

Prepared by:
Stantec Consulting Ltd.
Suite 1 – 70 Southgate Drive
Guelph, Ontario N1G 4P5

Stantec File 160950433
August 2012

Table of Contents

LIST OF APPENDICES

LIST OF FIGURES

Appendix A

REPORT ON FOUR AVIAN SPECIES AT RISK AND OTHER BREEDING BIRD SPECIES WITHIN FRUITLAND-WINONA SECONDARY PLAN AREA, SCUBE CENTRAL, SCUBE EAST 'A' AND SCUBE EAST 'B' PARCELS

1.0 Introduction

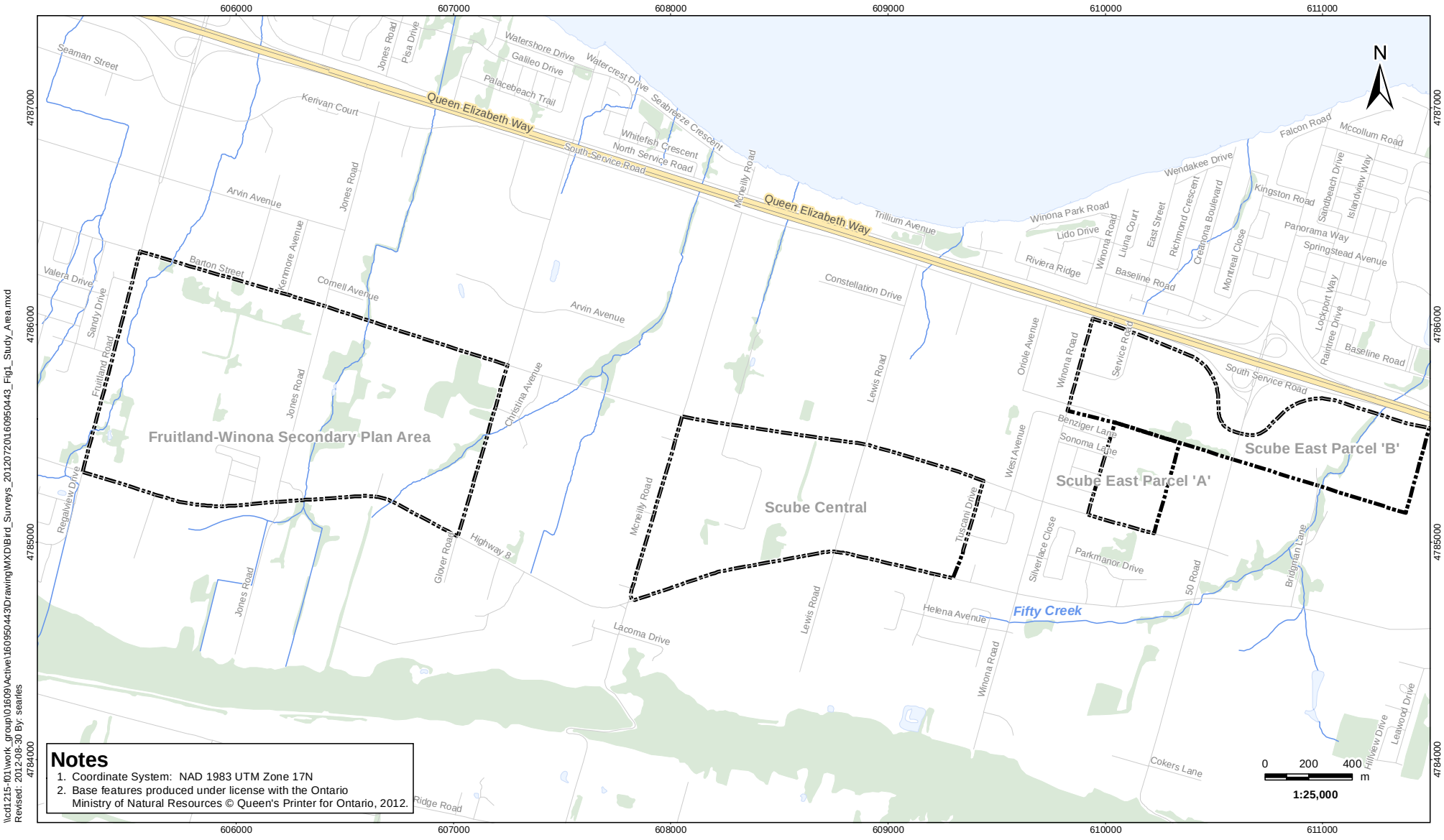
Stantec was retained by the City of Hamilton in 2012 to conduct avian Species at Risk (SAR) surveys and Breeding Bird Surveys within the Fruitland-Winona Secondary Plan Area (hereafter SPA) and the Scube Central, Scube East 'A' and Scube East 'B' parcels (hereafter Scube Parcels). The SPA and Scube Parcels are located in the east portion of the City of Hamilton and are generally bounded to the north by the Queen Elizabeth Way, to the west by Fruitland Road, to the south by Highway 8 and to the east by Fifty Road. A portion of the Scube East Parcel B extends easterly from Fifty Road approximately 1 kilometre so as to contain the channel of 50 Creek and additional lands east of the channel. The location of these parcels is shown in Figure 1.

SAR surveys were conducted for Bobolink (*Dolichonyx oryzivorus*), Eastern Meadowlark (*Sturnella magna*), Barn Swallow (*Hirundo rustica*) and Chimney Swift (*Chaetura pelagica*) as these species were considered to potentially occur and breed in the SPA and Scube Parcels (Karine Beriault, MNR Guelph District SAR Biologist). Each of these provincially threatened species typically nest and forage in human-altered habitats throughout much of eastern North America, including areas with a mix of rural and urban land use such as occur within the SPA and Scube Parcels. The Bobolink, Eastern Meadowlark and Barn Swallow typically nest and forage in agricultural habitats while Chimney Swift nests and forages over urban areas.

The purpose of these surveys was to determine whether particular avian SAR occur within the SPA and Scube Parcels and, to identify locations where avian SAR occur. Based on our findings, we were to make recommendations regarding areas, if any, which should be preserved for these avian SAR. General Breeding Bird Surveys were also conducted to identify breeding bird species within the SPA and Scube Parcels, whether SAR or non-SAR species. Findings of these surveys will be used to guide land use planning as part of the Fruitland-Winona Secondary Plan. Work performed was based on the Scope of Work provided by the City of Hamilton on April 3rd, 2012 and June 25th, 2012.

This report includes:

- Findings of avian SAR Surveys
- Maps of avian SAR Locations
- An evaluation of the habitat types in the study area in terms of their potential use by the following SAR: Bobolink, Eastern Meadowlark, Barn Swallow, and Chimney Swift;
- Recommendations regarding any potential areas for preservation of avian SAR habitat;
- Findings of Breeding Bird Surveys; and
- Field data sheets.



\\cd1215-f01\work_group\01609\Active\160950443\Drawing\MXD\Bird_Surveys_20120720\160950443_Fig1_Study_Area.mxd
Revised: 2012-08-30 By: seatles

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2012.

August 2012
160950443

Stantec

Legend

- Study Area
- Road
- Highway
- Watercourse
- Waterbody
- Woodlot

Client/Project

City of Hamilton
SAR Surveys

Figure No.
1

DRAFT

Title

Study Area

2.0 Current Land Use

The SPA and Scube Parcels have historically been rural areas where farming was the dominant land use. In the SPA, wheat is still farmed to the west of Jones Road and remnant fruit trees and vineyards are occasionally present throughout the remainder of the SPA. In the Scube Parcels, farming still occurs on the east side of Lewis Road.

An examination of aerial imagery reveals that buildings within the SPA and Scube Central Parcel are common and highly concentrated along roadways; fallow land and limited active agricultural land lies in the interiors of parcels. The majority of buildings present are residences, but business and municipal buildings also occur. In the Scube East 'A' and Scube East 'B' parcels, fallow land occupies almost all of the parcels and buildings are only rarely present along roadways.

In addition to widespread fallow land, the SPA and Scube Parcels include small woodlands, shrub thickets and wetlands. All forms of natural habitat within the SPA and Scube Parcels are small in area, fragmented and in pioneering or early stages of vegetation succession.

3.0 Methods

SAR Surveys for Chimney Swift, Barn Swallow, Eastern Meadowlark and Bobolink were carried out in the SPA and Scube Parcels using protocols recommended by the MNR and Bird Studies Canada when these had been developed; and, protocols of the Ontario Breeding Bird Atlas (OBBA) when specialized protocols do not exist.

Surveys for non-SAR birds were carried out in the SPA and Scube Parcels using protocols of the OBBA.

Survey methods for both SAR and non-SAR birds are described below.

3.1 CHIMNEY SWIFT

Chimney Swift is known to depend almost entirely on chimneys for nesting and roosting within southern Ontario. Therefore, assessment for this species focused on examining the suitability of chimneys for nesting and roosting using the Chimney Swift Monitoring Protocol (Bird Studies Canada, 2009) as well as making Chimney Swift observations.

The Chimney Swift Monitoring Protocol assesses the suitability of chimneys for Chimney Swift roosting/nesting based on their physical dimensions and the presence/absence of features which prevent Chimney Swifts from entering and leaving chimneys such as animal guards, spark protectors, terra cotta liners and metal liners. As buildings with potentially suitable

chimneys were found within the Study Area only along the existing roadways, surveys consisted of stopping at 200 m intervals along all roadways where buildings occurred and determining the suitability of chimneys at these locations for Chimney Swift nesting and roosting. At each survey location, chimneys were observed for 15 minutes to allow opportunity to detect any Chimney Swifts using the chimney. Surveys for Chimney Swift were conducted throughout daylight hours as this species remains active throughout the day.

Using the 200 m intervals, and given the length of roadways present, 27 locations were surveyed within the SPA and 13 locations were surveyed within the Scube parcels. The lower number of locations within the Scube parcels is due to the lack of buildings in Scube East 'A' and Scube East 'B' parcels. Locations where chimneys were assessed for their suitability for Chimney Swift nesting are shown In Figure 2.

Chimney Swift surveys were conducted within the SPA on May 17th and 31st, 2012. Additional observations within the SPA were made June 25th, 2012 at two locations where Chimney Swift were encountered on May 31st. Surveys within the Scube Parcels occurred on June 26th, July 4th and July 12th, 2012.

In addition to the dedicated Chimney Swift survey, any Chimney Swifts encountered in all other surveys conducted including SAR Surveys for Barn Swallow, Bobolink and Eastern Meadowlark and surveys for non-SAR birds were also recorded.

3.2 BARN SWALLOW

No MNR-sanctioned survey method for Barn Swallows exists. Recognizing that it is standard practice in avian surveys to identify and record all species of birds heard or seen, it was decided to assess Barn Swallows simultaneously with other species during standard OBBA point counts. These point counts are of five minute duration and are conducted during early morning hours (5 AM to 10 AM) when bird activity is at a maximum.

Point count locations were chosen before fieldwork commenced through consideration of habitat as characterized by Aquafor Beech (2012). Locations were chosen to provide the best possible access to all habitats found within the study area. Selection of point count locations had to accommodate limited property access within the SPA and restriction to road ROWs within the Scube Parcels. The survey locations selected for Barn Swallows were considered to adequately cover available habitat since Barn Swallows are aerial foragers and are highly mobile and easily detectable. To increase the probability of detection, monitoring occurred 3 times spaced through the nesting season.

Seventeen point count locations were chosen within both the SPA and Scube Parcels (Figure 3). Point counts within the SPA included locations both on and off roadways. Point counts within the Scube Parcels were limited to road ROWs. Surveys at the point count locations took place on June 11th/12th, June 25th and July 10th 2012 within the SPA and on June 26th, July 4th and July 12th, 2012 within the Scube Parcels.

Barn Swallow nests were searched for under bridges spanning watercourses within the SPA and Scube Parcels because Barn Swallows often nest on the exposed beams of older bridges (Cadman et al. 2007). Aerial imagery and background documents identify that small watercourses cross under several roadways within the SPA and Scube Parcels including Barton, Highway 8, Fruitland Road and Glover Road in the SPA and the South Service Road in the Scube Parcels. Searches for Barn Swallow nests occurred at all locations where roads crossed watercourses.

Surveys for Barn Swallow nests took place at 7 watercourse locations within the SPA (Figure 3). These surveys took place on June 11th/12th, June 25th and July 10th 2012 within the SPA. Surveys for Barn Swallow nests took place at 2 watercourse locations within the Scube Parcels (Figure 3). Surveys within the Scube Parcels occurred on June 26th, July 4th and July 12th, 2012. Surveys for Barn Swallow nests took place throughout the day as any nests present would be visible at any time of the day.

Any incidental observations of Barn Swallows made during Chimney Swift, Bobolink and Eastern Meadowlark surveys were also recorded.

3.3 EASTERN MEADOWLARK

Surveys for Eastern Meadowlark used 10 minute point counts in areas of apparently suitable habitat as identified through prior studies (Aquafor Beech, 2012) and aerial imagery. The 10 minute period is suggested by the MNR and is probably sufficient given the species frequent and distinctive vocalizations and conspicuousness in the open habitats it frequents.

Areas of apparently suitable habitat for Eastern Meadowlark consist of forb meadow, fresh – moist mixed meadow habitats and other open habitats. Point count locations were selected within the SPA and Scube Parcels before fieldwork commenced, in areas where access had been granted and habitat appeared suitable. To improve probability of detection, monitoring occurred 3 times spaced through the nesting season.

Surveys within the SPA took place at 10 locations on June 11th/12th, June 25th and July 10th, 2012. An initial reconnaissance of the Scube Parcels for Eastern Meadowlark habitat found habitat to be limited such that only 1 location of apparently suitable habitat was selected for surveys. Surveys within the Scube Parcels occurred on June 26th, July 4th and July 12th, 2012. Because access to properties was not obtained for the Scube Parcels, this survey took place along the roadway adjacent to suitable habitat. Eastern Meadowlark survey locations are shown on Figure 4.

During general Breeding Bird Surveys and all other surveys, any additional Eastern Meadowlark sightings were recorded.

3.4 BOBOLINK

Bobolink was searched for simultaneously with Eastern Meadowlark at the same locations and dates. Therefore, surveys within the SPA took place at 10 locations on June 11th/12th, June 25th and July 10th, 2012 and within the Scube Parcels at 1 location on June 26th, July 4th and July 12th, 2012. Bobolink survey locations are shown on Figure 4.

During general Breeding Bird Surveys and all other surveys, any additional Bobolink sightings were recorded.

3.5 COMMON SPECIES

Surveys of non-SAR birds were conducted within the SPA and Scube Parcels using 5 minute point counts during which all species of birds heard or seen are identified and recorded. This 5 minute period is the standard recommended in the OBBA (Cadman et al. 2007). Surveys were conducted during early morning hours (5 AM to 10 AM) when bird activity is at a maximum.

Point count locations were chosen before fieldwork commenced through consideration of habitat as characterized by Aquafor Beech (2012). Locations were selected to to provide the best possible access to all habitats found within the study area. Selection of point count locations had to accommodate limited property access within the SPA and restriction to road ROWs within the Scube Parcels. This restriction on point count locations likely affected detection of some species within the Scube Parcels.

To improve probability of detection, monitoring occurred 3 times spaced through the nesting season. Seventeen point count locations were chosen within both the SPA and Scube Parcels (Figure 5). Point counts within the SPA included locations both on and off roadways. Point counts within the Scube Parcels were limited to road ROWs. Surveys at the point count locations took place on June 11th/12th, June 25th and July 10th 2012 within the SPA and on June 26th, July 4th and July 12th, 2012 within the Scube Parcels.

Any avian SAR observed during these surveys were recorded and are mapped and considered in this report.

4.0 Considerations for Species at Risk

This section presents relevant information on the biology of Chimney Swift, Barn Swallow, Eastern Meadowlark and Bobolink, evidence that declines have occurred in Ontario's populations and factors thought to be involved in their declines.

Evidence of declines is based primarily on the Ontario Breeding Bird Atlas (OBBA) and Breeding Bird Survey (BBS) as these two projects provide the most comprehensive information on Ontario's bird populations. The OBBA was conducted from 1981 to 1985 (Cadman et al.

1987) and again from 2001 to 2005 (Cadman et al. 2007), with over 121,000 hours and 152,000 hours of observations conducted in the first and second atlases respectively. The BBS has been conducted annually since 1966 across North America and Ontario and over 300 surveys have been conducted within Ontario (Sauer et al. 2011).

Factors thought to be involved in declines are those discussed in relevant COSEWIC and COSSARO reports.

4.1 CHIMNEY SWIFT

Chimney Swift can be thought of as having two components to its habitat: chimneys within which nesting, roosting and reproduction occur and air masses within which foraging takes place. Chimney Swift nest sites have been afforded general habitat protection through the ESA (MNR 2008).

Chimney Swift is an aerial forager of flying insects; a group or guild of bird species that includes swallows, martins, flycatchers, goatsuckers and others . Aerial foragers have experienced widespread population declines since about the 1980's and these declines are suspected to be due, in part, to declining populations of flying insects (McCracken 2008). According to the BBS, the Canadian Chimney Swift population declined 7.8% annually between 1968 and 2005, resulting in a cumulative decline of 95% over that 37-year period (COSEWIC 2007). Similarly, data from the OBBA estimates that the probability of Chimney Swift detection declined by 46% in Ontario between 1981-1985 and 2001-2005. Data from the United States indicates that the species is declining there as well (COSEWIC 2007).

Chimney Swifts are believed to have declined only in part due to drops in flying insect populations. Major losses of nest and roost sites may be a more significant problem. Chimney Swifts are almost entirely dependent upon chimneys for nesting and roosting. Suitable chimneys are larger than 28.5 cm in diameter, offer protection against cold weather and include a rough inner surface of brick, cement, or tile permitting the attachment of nests. . Suitable chimneys also must be freely accessible to Chimney Swifts (Bird Studies Canada, 2009). In recent decades, older chimneys have been modified to improve safety by the addition of spark protectors, animal guards, metal liners and caps. These modifications inadvertently made chimneys inaccessible to Chimney Swifts (COSSARO, 2009; COSEWIC 2007). As well, since about 1960, homes have generally been built with chimneys too small for use by Chimney Swift.

As the dramatic reduction in suitable nesting and roosting sites appears to be a principal cause for declining populations of Chimney Swift, any effort to protect the species would need to focus on protecting remaining nest and roost sites.

4.2 BARN SWALLOW

Like the Chimney Swift, Barn Swallow habitat can be considered to consist of a nest site and foraging habitat. Nests are almost always built on human structures that provide a horizontal nesting surface such as barns, sheds, garages, bridges with exposed beams and road culverts.

Barns have historically been important breeding sites for Barn Swallow and unlike garages, shed and other structures where nest sites are more limited, barns typically support larger colonies of Barn Swallow (COSEWIC 2011a). Barn Swallows forage for flying insects over a variety of relatively open areas such as pastures, fallow land, and farmland of various descriptions, wetlands, road rights-of-way, large forest clearings, cottage areas, islands, sand dunes and lakeshores (COSEWIC 2011a).

Like Chimney Swift, Barn Swallows are aerial foragers and have experienced widespread population declines both within Ontario and across much of North America (COSSARO 2011a). The declines in Barn Swallow populations are likely due in part to reductions in flying insect populations (McCracken 2008). In Canada, long-term BBS data show a statistically significant decline of 3.6% per year between 1970 and 2009, which corresponds to an overall population decline of about 76% over the last 40 years (COSEWIC 2011a). In Ontario, the probability of detection for Barn Swallow declined by 35% between the first and second OBBA (Cadman et al. 2007).

Despite these declines, Barn Swallows remain quite widespread and common in southern Ontario (Cadman *et al.* 2007; COSEWIC 2011a). While it may seem contradictory that a species can be both "at risk" and relatively common and widespread, SAR classification within Ontario considers population trends and threats to a species as well as its current abundance and distribution. For Barn Swallow, classification as a provincially threatened species was made because the population decline is over the threshold level of 30% over the most recent 10-year period (COSSARO 2011a).

While declining populations of flying insects are likely partly responsible for declines in Barn Swallow populations, declines in the number of nest sites may also be involved as older-style wooden farm structures with easy access to nest sites are gradually replaced by modern buildings that lack easy access to suitable nesting sites (COSEWIC 2011a, COSSARO 2011a). Other factors responsible for declining populations are the replacement of grassland and pastures with row crops and urban land uses, use of pesticides, reduction in the fecundity of Barn Swallows and other factors (COSEWIC, 2011a).

4.3 EASTERN MEADOWLARK

The Eastern Meadowlark is most common in native grasslands, pastures and savannahs. It also uses other anthropogenic grassland habitats including hayfields, weedy meadows and grassy airfields. Eastern Meadowlarks occasionally nest in row crop fields such as corn and soybean, but these crops are considered low-quality habitat. Large tracts of grasslands are preferred over smaller fragments: the *Significant Wildlife Habitat Technical Guide* (MNR, 2000) states that 10 ha of suitable habitat are necessary for Eastern Meadowlark breeding. Vegetation structure is also important. Generally, optimal habitat contains moderately tall (25 to 50 cm) grass with abundant litter cover, a high proportion of grass, moderate to high forb density and low shrub and tree cover.

The Eastern Meadowlark is one of a number of grassland species which have shown widespread population declines (McCracken 2005). The Eastern Meadowlark has shown significant declines in Ontario and Canada. Long-term BBS data show a statistically significant population decline of 3.1% per year in Canada between 1970 and 2009, which corresponds to an overall decline of 71% over 40 years (Sauer et al. 2011). The OBBA shows a similar decline with Eastern Meadowlark detected 13% less frequently in Ontario and 16% less frequently in the Carolinian zone in the second Atlas compared to the first 20 years earlier.

Several factors appear to be involved in the species' declining populations. Habitat loss appears to be a primary factor as grasslands and pastures at the edges of urban areas or in marginal farming areas are abandoned and succeed to forest or shrub-dominated areas. Habitat is also lost when grasslands and pastures are converted to row crops or urban land uses. Other factors that may be involved in declining populations include: changes in farming practices, particularly earlier and more frequent haying that appears to significantly reduce nestling and adult survival; pesticide use; predation; Brown-headed Cowbird parasitism; climate change; and overgrazing by livestock (COSEWIC 2011b; COSSARO 2011b).

4.4 BOBOLINK

The Bobolink nests primarily in forage crops (e.g., hayfields and pastures), abandoned fields dominated by tall grasses and small-grain fields (COSEWIC 2010). In Ontario it was probably originally rare, but its range expanded with the arrival of Europeans and the conversion of forests to forage crops. The Bobolink is sensitive to habitat size; the MNR (2000) suggests that habitat should be at least 50 ha in size to support breeding.

Like Eastern Meadowlark, Bobolink is a grassland species. The Bobolink has significantly declined in Canada and Ontario. In Canada, long-term BBS data show a significant decline of 5.2% per year between 1968 and 2008, which corresponds to a population loss of 88% over the last 40 years (COSEWIC 2010). In Ontario, the OBBA showed a statistically significant decline in the probability of detection of 28% in Ontario and of 10% within the Carolinian zone between 1981-1985 and 2001-2005.

Changing farming practices and habitat loss appear to be the major factors involved in population declines. Haying is occurring earlier in the summer and frequently occurs before Bobolinks fledge. When fields with active nests are cut, mortality of young is 94% (COSEWIC 2010). The conversion of hayfields and pastures to row crops has also played a part in population declines as row crops are rarely used for nesting. Pastures have declined by 35% to 70% between 1981 and 2001 in different regions of Ontario (Cadman et al. 2007). Bobolink breeding habitat has also been lost as farmland near cities have been converted to urban land uses, and abandoned farmland has succeeded to forested or shrub-dominated habitat. Pesticide use on both breeding and wintering grounds, habitat fragmentation, overgrazing by livestock and climate change are also considered potential contributors to population declines (COSEWIC 2010; COSSARO 2010).

5.0 Results

The following reports findings of 2012 surveys for SAR based on all survey types and for non-SAR based on general Breeding Bird Surveys. All data sheets used to record observations are provided in Appendix C.

5.1 CHIMNEY SWIFT

Fruitland-Winona SPA

A significant effort was made to detect Chimney Swift and Chimney Swift accessible chimneys in the SPA. Surveys of chimneys took place at 27 locations on May 17th and 31st, 2012. Additional opportunity to detect Chimney Swifts occurred while conducting non-SAR bird surveys. Such surveys took place at 17 locations throughout the SPA on June 11th/12th, June 25th and July 10th, 2012. The total time spent searching for Chimney Swift within the SPA was approximately 30 hours.

Despite this considerable search effort, Chimney Swift was recorded at only 3 locations within the SPA. Birds observed appeared to be foraging only, flying well above chimneys present, making no effort to enter chimneys and flying over an extensive area. As Chimney Swifts are aerial foragers which fly for much of the day and wander widely from nest and roost sites, the limited observations suggest that the observed swifts nest and roost outside of the SPA but occasionally forage in the air mass above the SPA. Locations where Chimney Swift was encountered were in the vicinity of Highway 8 and are shown in Figure 6.

During surveys of chimneys, chimneys at 27 properties were assessed for suitability based on their dimensions and the presence or absence of safety features such as animal guards, spark protectors, metal liners, and terra cotta liners. At all chimneys examined, it was observed that chimneys were unsuitable for nesting or roosting due to various types of modifications to chimneys which prevent swifts from entering.

Based on the unsuitability of chimneys, the limited number of Chimney Swift sightings and the behaviour of those swifts observed, Chimney Swifts do not appear to nest or roost within the SPA.

Scube Parcels

A significant effort was also made to detect Chimney Swift and Chimney Swift accessible chimneys in the Scube parcels. Surveys of chimneys took place on June 26th, July 4th and 12th, 2012 using the Chimney Swift Monitoring Protocol at 13 locations. As with the SPA, additional opportunity to detect Chimney Swifts occurred while conducting non-SAR bird surveys which took place on June 26th, July 4th and July 12th, 2012 at 17 locations. Despite a search effort of approximately 10 hours during dedicated Chimney Swift surveys and an additional time of

approximately 15 hours during general breeding bird surveys, Chimney Swift was not recorded within any of the Scube parcels during any component of fieldwork (Figure 6).

Chimneys were assessed for suitability for Chimney Swift nesting and roosting on June 26th, July 4th and 12th, 2012 using the Chimney Swift Monitoring Protocol at 13 locations. No chimneys were found which appeared suitable for use by Chimney Swift. Only Scube Central had a significant number of buildings with chimneys, but these chimneys all had modifications such as animal guards and metal liners which prevent Chimney Swift from entering the chimney. Chimneys were found to be almost entirely lacking in the Scube East 'A' and Scube East 'B' parcels due to buildings being only rarely present.

Based on the lack of Chimney Swift sightings and the unsuitability of chimneys, Chimney Swifts do not appear to nest or roost within the Scube Parcels.

5.2 BARN SWALLOW

Fruitland-Winona SPA

Barn Swallows are common and widespread within the SPA. They were observed at 17 locations and were encountered on surveys conducted May 17th and 31st, June 11th, 12th and 25th and July 10th, 2012. Birds were encountered on general Breeding Bird Surveys, Bobolink and Eastern Meadowlark surveys and Chimney Swift surveys. Surprisingly, no Barn Swallows or Barn Swallow nests were encountered at the seven watercourse crossing locations. Overall, the species was encountered with such frequency that it was one of the most widespread species in the SPA (Table 1). The locations of observed birds are shown in Figure 7. The abundance of Barn Swallow within the SPA may seem at odds with its status as a provincially threatened SAR but its provincial status is based on declining numbers (COSSARO 2011a) rather than rarity and our results are in accord with results of the second OBBA which showed it to be present in almost all parts of southern Ontario (Cadman et al. 2007).

Birds were observed to preferentially forage over cultural meadows, abandoned farmland, agricultural fields and mown lawns. These habitats are all herbaceous-dominated and consistent with descriptions of foraging habitat provided in COSEWIC (2011a). Field investigations and aerial photography show such herbaceous-dominated areas to dominate the majority of the SPA and the ubiquity of this type of habitat likely accounts for the abundance of the species within the SPA. When observed, Barn Swallows were found in small numbers (<10) rather than large concentrations.

During fieldwork it was observed that apparently suitable nest sites for Barn Swallow such as sheds and garages were common within the SPA. While these structures were not counted they may number several hundred. These apparently suitable structures are for the most part associated with private residences which are common along all roadways and not within the interior of land parcels. Field investigations also determined that barns which could support larger Barn Swallow colonies were not present within the SPA. Therefore it is expected that sheds, garages and other structures associated with private residences are the most frequently

used and important structures for Barn Swallow nesting. Observations which would suggest nesting in these structures such as birds entering/leaving buildings were limited but did occur. Unlike barns which can support larger colonies (COSEWIC 2011a), individual sheds and garages within the SPA likely typically support only one or two pairs due to their relatively limited space.

Barn Swallow nests were specifically searched for at 7 locations where roadways within the SPA crossed watercourses (Figure 2). This specific effort was made because Barn Swallows frequently nest on the exposed horizontal beams that support many bridges. Barn Swallow nests were not observed at any of the 7 watercourse crossings and watercourses were found to be spanned by box culverts or corrugated steel pipes rather than bridges. The box culverts and corrugated steel pipes which span watercourses within the SPA do not provide Barn Swallow nesting opportunities due to the lack of horizontal structures upon which swallows could build nests, their relatively small height and width (1 to 2 metres) and the presence of vegetation at the ends of culverts which appears likely to obstruct Barn Swallows from entering.

Scube Parcels

Barn Swallows are common and widespread within the Scube parcels. They were observed at 14 locations within the Scube parcels distributed across all Scube Parcels. Barn Swallows were observed on surveys conducted June 26th, July 4th and July 12th, 2012 both during general Breeding Bird and dedicated Chimney Swift surveys. The locations of observed birds are shown in Figure 7 and the relevant data sheets are provided in Appendix B.

Birds observed were foraging over cultural meadows, abandoned farmland and mown lawns. Field investigations and aerial photography show such areas to dominate the majority of the Scube Parcels and the ubiquity of this type of habitat likely accounts for the abundance of the species within the Scube Parcels. When observed, Barn Swallows were found in small numbers (<10) rather than large concentrations.

Field investigations determined that apparently suitable nest sites such as sheds and garages were common within the Scube Central parcel and concentrated along existing roadways and not within the interior of land parcels. Scube East Parcel 'A' and Scube East Parcel 'B' had very limited number of garages, sheds and other potential nest sites within them. Field investigations also determined that barns which often support larger colonies in Ontario were not present within the Scube parcels.

Watercourse crossings which have the potential to allow Barn Swallow nesting under bridges were limited to a crossing of a creek along the South Service Road to the east of Fifty Road. No Barn Swallows or their nests were observed at this watercourse (Appendix B). Field investigations determined that this watercourse is spanned by a relatively large box culvert which does not provide nesting opportunities due to the lack of ledges upon which swallows could build nests, and the presence of vegetation at the ends of culverts which appeared to obstruct entrance to the culverts.

5.3 EASTERN MEADOWLARK

Fruitland-Winona SPA

A significant effort was made to detect Eastern Meadowlark in the SPA. Dedicated Eastern Meadowlark surveys took place at 10 locations with suitable habitat located throughout the SPA on June 11th/12th, June 25th and July 10th, 2012. General breeding bird surveys which can also detect Eastern Meadowlark took place at an additional 7 locations on June 11th/12th, June 25th and July 10th, 2012. The total time spent searching for Eastern Meadowlark within the SPA was approximately 15 hours.

Despite this significant search effort, Eastern Meadowlarks were not observed within the SPA during surveys dedicated to this species or during other fieldwork (Figure 8). The lack of observations occurred despite the conspicuous nature of the species and the observers' prior experience with the species. When present, the Eastern Meadowlark is easily detected as its breeding songs and calls are distinctive and its frequent flights above grasslands are conspicuous. The absence of sightings during our 2012 investigations provides good evidence that no Eastern Meadowlark breeding occurred this year within the SPA.

Habitat within the SPA appears unsuitable for Eastern Meadowlarks for two reasons. First, grassland habitats within the SPA are relatively small compared to the 10 ha value cited in the *Significant Wildlife Habitat Technical Guide* (MNR, 2000). Second, herbaceous vegetation appears to be denser, higher and composed of a high frequency of forbs relative to grasses compared to optimal habitat preferred by Eastern Meadowlarks (Zimmerman 1992; Bollinger 1995). Optimal habitat for Eastern Meadowlark is considered to consist of sparse, short, patchily-distributed, grass-dominated vegetation. Third, shrubs and tree saplings appear to be too frequent within abandoned farmland for Eastern Meadowlark. Shrub and tree cover values of 5% are considered optimal for Eastern Meadowlark habitat (COSEWIC 2011b) but shrub and tree cover within the SPA appeared to significantly exceed this value. As the shrub and tree saplings already present will likely increase in density and height, the suitability of the land for breeding by Eastern Meadowlark will only decrease in the future.

Scube Parcels

Search effort for Eastern Meadowlark within the Scube Parcels was considerable with searches occurring at 17 locations on June 26th, July 4th and July 12th, 2012. Despite a search effort of approximately 15 hours within the Scube parcels, Eastern Meadowlarks were detected at only three locations within the Scube parcels, all in the vicinity of Lewis Road (Figure 8). Birds were encountered at these sites only on the initial survey (June 26th) and appeared to be absent on subsequent surveys (July 4th and 12th) at the same locations. Due to its frequent vocalizations, Eastern Meadowlark is a fairly conspicuous species and the lack of sightings on July 4th and 12th suggests the species may have abandoned the sites between the first and subsequent surveys.

Habitat within the Scube parcels was compared to optimal Eastern Meadowlark habitat as described in COSEWIC (2011b**)** and the *Significant Wildlife Habitat Technical Guide* (MNR,

2000). To be suitable for occupancy, grassland habitat must be 10 ha or larger (MNR 2000). However, within the Scube parcels, hedgerows, shrubs and treed areas are frequent and appear to fragment grassland habitat into areas less than 10 ha in size. Second, optimal shrub and tree cover is considered to be 5% for Eastern Meadowlark (COSEWIC 2011b) but shrub and tree cover within herbaceous-dominated areas appears to exceed this value. Due to insufficient sizes and excessive woody cover, habitat for Eastern Meadowlark appears to be marginal within the Scube parcels.

5.4 BOBOLINK

Fruitland-Winona SPA

Despite three surveys conducted specifically to detect Bobolink at 10 point count locations and an additional three surveys conducted for breeding birds in general at 17 point count locations, Bobolinks were observed in only one part of the SPA. These sightings occurred between Fruitland and Jones Roads where a mixed meadow several hectares in size exists (Figure 8). During the June 11th, 2012 survey, 4 male and 1 female Bobolink were observed in a mixed meadow. Two males appeared agitated by the observer's presence and the female appeared paired with one of the males. These observations suggest that at this date, Bobolinks were attempting to breed within the area. During the second and third surveys conducted June 25th and July 10th, 2012, no Bobolinks were observed in the same area. Their absence at these later dates suggests the birds had abandoned the mixed meadow as it is unlikely that birds would have successfully bred and then dispersed from the area by these dates.

The area Bobolinks were observed within had earlier been identified as a fresh-moist mixed meadow (Aquafor Beech, 2012). Habitat within this area was compared to optimal Bobolink habitat as described in COSEWIC (2010) and the *Significant Wildlife Habitat Technical Manual* (MNR 2000). Optimal Bobolink habitat has a low frequency of shrub and tree cover within the dominant herbaceous vegetation (COSEWIC 2010). While conducting fieldwork, it was observed that the mixed meadow had inclusions of old hedgerows and stands of trees and shrubs and that the number of new saplings and shrubs was high, making the area unsuitable as Bobolink habitat. Further evidence of the unsuitability of the area for Bobolink is based on the area occupied. The *Significant Wildlife Habitat Technical Manual* states that 50 ha or more of habitat is required for occupancy by Bobolink. Within the SPA, the area occupied by Bobolink was estimated by creating a polygon from observation locations and determining the enclosed area. This area was determined by be 7 ha, far below the 50 ha value cited in the *Technical Manual*.

During the July 10th, 2012 survey, 2 male and one female/juvenile Bobolinks overflew the area. Based on their behaviour, these birds appeared to be post-breeding individuals moving through the area. Fall migration of this species begins in mid-to-late July, with adults and immature birds forming loose flocks close to the breeding grounds (COSEWIC, 2010).

Scube Parcels

Despite a search effort of approximately 15 hours which included three surveys for breeding birds in general at 17 locations and three surveys specifically for Bobolink at one location, no evidence that Bobolink breed within the Scube parcels was obtained. During surveys conducted June 26th and July 4th, Bobolink was not observed at any locations despite the conspicuous nature of this species with its frequent singing and flights over open grasslands. The absence of sightings provides good evidence that Bobolinks do not breed within the Scube Parcels.

On the July 12th survey, Bobolink was observed at one location (Figure 8). At this location, three Bobolinks were observed to overfly the area, moving in an easterly direction without stopping. Fall migration of this species begins in mid-to-late July, with adults and immature birds forming loose flocks close to the breeding grounds (COSEWIC, 2010). The three individuals observed overflying the Scube parcels were judged to be post-breeding birds engaged in this behavior.

As with the SPA, habitat within the Scube parcels was compared to optimal Bobolink habitat as described in COSEWIC (2010) and the *Significant Wildlife Habitat Technical Manual* (MNR 2000). Optimal Bobolink habitat has a low frequency of shrub and tree cover within the dominant herbaceous vegetation (COSEWIC 2010). While conducting fieldwork, it was observed that no land was being farmed and that fallow land was a mix of herbaceous meadows, thickets and early succession forest. As with the SPA, herbaceous dominated areas appeared to include a frequency of shrubs and saplings sufficiently high that these areas would be unsuitable for Bobolink. As well, no area of herbaceous-dominated vegetation was near in size to the 50 ha value cited in The *Significant Wildlife Habitat Technical Manual* (MNR 2000). It was also noted during fieldwork that some portions of the Scube parcels are being developed for residences.

Our observations that much of the Scube parcels are succeeding to tree and shrub-dominated communities or are being developed for residences, coupled with the lack of breeding evidence, strongly suggests that the Scube parcels lack breeding Bobolink and that the species will continue to be absent from the area.

5.5 COMMON NIGHTHAWK

Common Nighthawk (*Chordeiles minor*) has been designated as a species of Special Concern on the SARO list and when observed is often within urban areas (Cadman et al. 2007). Surveys for this species were not included within the work plan but one individual was observed during the Chimney Swift chimney assessment carried out May 31st. The individual observed was flying about 100 m above the ground in an erratic manner and appeared to be foraging in the way characteristic of its species. No behavior was observed which would suggest nesting. As a species of special concern, the Common Nighthawk and its habitat are not protected through the ESA (2007).

5.6 COMMON SPECIES

The following section reports findings of 2012 general Breeding Bird Surveys with respect to all species of breeding birds including SAR. SAR results are discussed in more detail in Sections 5.1 through 5.5.

Fruitland-Winona SPA

A total of 44 species were encountered within the SPA. These species are listed in Table 1 (Appendix B) from the most frequently encountered to least frequently encountered species. Of the 44 species encountered, 26 are considered to be common and widespread within Ontario (S5 rank), 14 are considered uncommon but not rare within Ontario (S4 rank) and 2 species are not native to Ontario.

Species observed are adaptive to a wide variety of habitat and capable of using small, fragmented areas of suitable habitat. Examples of such species include American Robin (*Turdus migratorius*), Song Sparrow (*Melospiza melodia*), Northern Cardinal (*Cardinalis cardinalis*), American Goldfinch (*Carduelis tristis*) and Brown-headed Cowbird (*Molothrus ater*). Each of these species was encountered at 10 or more locations within the SPA. Due to their abundance and widespread distributions within Ontario, these species are not considered of conservation concern. The provincially threatened Barn Swallow was also widespread (10 locations) and is discussed in Section 5.2.

The least frequent species were 11 species encountered at only 1 location. These species were Red-tailed Hawk, (*Buteo jamaicensis*), American Kestrel (*Falco sparverius*), American Woodcock (*Scolopax minor*), Black-billed Cuckoo (*Coccyzus erythropthalmus*), Downy Woodpecker (*Picoides pubescens*), Northern Flicker (*Colaptes auratus*), Alder Flycatcher (*Empidonax alnorum*), Warbling Vireo (*Vireo gilvus*), White-breasted Nuthatch (*Sitta carolinensis*), Brown Thrasher (*Toxostoma rufum*) and Swamp Sparrow (*Melospiza georgiana*). Although these species were only infrequently found within the SPA, they are still relatively common species within Ontario with wide distributions (S4 and S5 species) and are not of conservation concern.

Within the SPA, most species encountered have relatively stable populations. Thirty of 44 species encountered did not show any statistically significant change in numbers between the two OBBAs in the Carolinian zone (Table 1). Relatively stable species include most of the more widespread species such as Northern Cardinal, Song Sparrow, Gray Catbird and Brown-headed Cowbird and the Barn Swallow, which was reported as stable in the Carolinian zone, even though this species was reported as showing statistically significant declines in the province as a whole based on the OBBA work.

Statistically significant declines over the OBBA periods were reported in 11 of the 44 species encountered (Table 1). Declining species included four aerial insectivores, five grassland/shrub species, one wetland and one forest species.

Declines in aerial insectivores are possibly due to declines in aerial insects, pesticides use both on breeding grounds and wintering areas, loss of habitat and for Chimney Swift, loss of nesting and roosting sites (North American Bird Conservation Initiative Canada. 2012; Nebel *et al.* 2010). Declining aerial insectivores encountered within the SPA were Chimney Swift, Northern Rough-winged Swallow, Common Nighthawk and Eastern Kingbird.

Grassland and shrub dwelling species have shown widespread declines in much of North America (North American Bird Conservation Initiative Canada. 2012). The decline in grassland/shrub species appears to be due to: the loss of habitat as grasslands/shrub habitat is replaced by urban development near urban areas or reforested on marginal farmland; as pastures are replaced by row crops and hedgerows are removed; and through increases in pesticide and herbicide use (North American Bird Conservation Initiative Canada. 2012). Declining grassland/shrub species detected consisted of Field Sparrow, Bobolink, American Kestrel, Brown Thrasher and Eastern Kingbird, which is also considered a member of the aerial insectivores.

The wetland species encountered within the SPA which has shown declines within the Carolinian zone is the American Woodcock while the forest-dwelling species is the Northern Flicker.

Three species encountered within the SPA have had statistically significant population increases within the Carolinian zone; these species are House Finch, Cooper's Hawk and Black-capped Chickadee. The House Finch has shown a large population increase between 1981/85 and 2001/05. During this time period the species colonized southern Ontario after being introduced in New York state (Cadman et al. 2007). Cooper's Hawk has also increased greatly after adapting to urban landscapes (BirdLife International (2012). The Black-capped Chickadee population increase is much smaller but still statistically significant. Population increases are possibly due to an increase in the amount of forest habitat (North American Bird Conservation Initiative Canada. 2012).

Scube Parcels

A total of 45 species were encountered within the Scube parcels and these are listed in Table 2 (Appendix B) from the most frequently encountered to least frequently encountered species. Of species encountered, 24 are considered to be common and widespread within Ontario (S5 rank), 18 species are considered uncommon but not rare within Ontario (S4 rank) and 3 species are not native to Ontario.

As with the SPA, species were adaptive to a wide variety of habitat and capable of using small, fragmented areas of suitable habitat. The most widespread species were largely the same as within the SPA: American Robin, Northern Cardinal, Red-winged Blackbird (*Agelaius phoeniceus*), American Goldfinch, Song Sparrow and Brown-headed Cowbird were all encountered at 15 or more locations. These species are not considered of conservation concern.

The least frequently encountered species were 7 species encountered at 1 location: American Kestrel, Downy Woodpecker, Eastern Phoebe (*Sayornis phoebe*), Purple Martin (Progne subis), White-breasted Nuthatch (*Sitta carolinensis*), Indigo Bunting (*Passerina cyanea*) and Purple Finch (*Carpodacus purpureus*).

Barn Swallow, Eastern Meadowlark and Bobolink, all of which are provincially threatened, were all encountered within the Scube parcels. The Barn Swallow was observed at 14 locations (Figure 4) while the Eastern Meadowlark and Bobolink were observed at 3 and 1 locations respectively. These SAR are discussed in Sections 5.2 through 5.5.

The comparison of birds encountered in the Scube parcels and the list of increasing, decreasing and relatively stable species, based on the two OBBAs, yielded results similar to the SPA area. Of the 45 species encountered, 27 have shown relatively stable populations within the larger Carolinian zone between 1981/85 and 2001/05 (Table 2). Relatively stable species again include most of the species which are widespread in the Scube Parcels such as American Robin, Red-winged Blackbird, Mourning Dove, Song Sparrow and the Barn Swallow although this species has shown statistically significant declines in the province as a whole.

Statistically significant (<0.1) declines have occurred in 12 of the 45 species encountered within the Scube parcels (Table 1). Declining species included three aerial insectivores, six grassland/shrub species and three forest species. Declining aerial insectivores encountered within the Scube parcels were Northern Rough-winged Swallow, Eastern Kingbird and Purple Martin. Declines in aerial insectivores are possibly due to declines in aerial insects, pesticides use both on breeding grounds and wintering areas and loss of habitat (North American Bird Conservation Initiative Canada. 2012; Nebel *et al.* 2010).

Grassland/shrub species encountered within the Scube parcels which have declined significantly in the Carolinian zone are Eastern Meadowlark, Field Sparrow, Bobolink, Brown Thrasher, American Kestrel and Eastern Kingbird which is a shrub-dwelling species as well as an aerial insectivore.

Forest-dwelling species encountered within the Scube parcels which have declined significantly in the Carolinian zone are Northern Flicker, Indigo Bunting and Purple Finch.

One additional declining species was encountered whose habitat is difficult to categorize. This species, the Killdeer, typically forages and nests on lawns and bare soil.

6.0 Discussion

The following section evaluates habitat in the SPA and Scube Parcels in terms of their potential use by Bobolink, Eastern Meadowlark, Barn Swallow, Chimney Swift and common species. No areas are recommended for preservation for these species due to small or non-existent populations, poor quality habitat which appears to be further declining in value as breeding habitat, and for Barn Swallows, the lack of concentrated breeding or foraging areas.

6.1 CHIMNEY SWIFT

Fruitland-Winona SPA

No areas within the SPA are recommended for preservation as a means of preserving the provincially threatened Chimney Swift..

The primary reason for not protecting any portion of the SPA for Chimney Swift populations is that the species appears to be limited to occasional foraging within the air mass above the SPA. Nesting appears to occur somewhere outside of the SPA.

Secondly, it was observed that chimneys in the SPA were unsuitable for nesting or roosting by this species due to modifications to chimneys which increase safety but prevented Chimney Swift from entering.

Scube Parcels

No areas within the Scube Parcels are recommended for preservation as a means of preserving the provincially threatened Chimney Swift. The rationale for this conclusion is as follows.

Based on our 2012 surveys, the Chimney Swift does not appear to occur within the Scube Parcels (Figure 6).

Secondly, it was observed that chimneys in the Scube Parcels were unsuitable for nesting or roosting by this species due to the absence of chimneys in the Scube East 'A' and Scube East 'B' parcels, and the modifications to chimneys which had occurred in the Scube Central parcel.

6.2 BARN SWALLOW

Fruitland-Winona SPA

No areas within the SPA are recommended for preservation as a means of preserving the provincially threatened Barn Swallow. This conclusion is based on the lack of concentrated foraging and nesting areas for Barn Swallows. The absence of areas where Barn Swallows nest or forage in large numbers means that protecting specific areas would be ineffective in protecting a large proportion of birds currently present. In addition, because Barn Swallow

populations appear to be falling in part due to declining numbers of flying insects, and because numbers of flying insects are expected to continue to fall (McCracken, 2008), retention of specific nest sites and/or foraging areas is not likely to prevent Barn Swallow numbers from falling within the SPA.

Scube Parcels

No areas within the Scube Parcels are recommended for preservation as a means of preserving the provincially threatened Barn Swallow. This conclusion is based on the lack of concentrated foraging and nesting areas for Barn Swallows. The absence of areas where Barn Swallows nest or forage in large numbers means that protecting specific areas would be ineffective in protecting a large proportion of birds currently present. In addition, because Barn Swallow populations appear to be falling in part due to declining numbers of flying insects, and because numbers of flying insects are expected to continue to fall (McCracken, 2008), retention of specific nest sites and/or foraging areas is not likely to prevent Barn Swallow numbers from falling within the Scube Parcels.

6.3 EASTERN MEADOWLARK

Fruitland-Winona SPA

No areas within the SPA are recommended for preservation as a means of preserving the provincially threatened Eastern Meadowlark.

The principal reason for not protecting land for Eastern Meadowlark within the SPA is that the species already appears to be absent. This conclusion is based on the findings of our 2012 surveys which did not detect Eastern Meadowlark within any part of the SPA (Figure 8).

A second reason for not protecting land for Eastern Meadowlark populations within the SPA is that habitat within the SPA appears to be unsuitable for Eastern Meadowlarks due to the insufficient size of grasslands present and excessive amounts of shrub and tree cover within grassland areas.

Succession of fallow land within the SPA from herbaceous-dominated to shrub and tree-dominated communities is widespread and has made the SPA unsuitable for Eastern Meadowlark breeding. This same process of succession is also occurring within marginal farmland across much of Ontario and North America and causing declining populations in these much larger areas (COSSARO 2011b).

Scube Parcels

No areas within the Scube Parcels are recommended for preservation as a means of preserving the provincially threatened Eastern Meadowlark.

The primary reason for not protecting land for Eastern Meadowlark populations within the Scube Parcels is that populations are small. This conclusion is based on our 2012 surveys which found only three individuals during approximately 15 hours of field investigations.

A second reason for not protecting land for Eastern Meadowlark populations within the Scube Parcels is that habitat within the Scube parcels appears to be unsuitable for Eastern Meadowlarks due to insufficient size and excessive woody cover.

The reforestation of fallow land within the Scube Parcels is reducing the suitability of habitat for Eastern Meadowlark. This same process is also occurring within marginal farmland across much of Ontario and North America and causing declining populations in these much larger areas (COSSARO 2011b).

6.4 BOBOLINK

Fruitland-Winona SPA

No areas within the SPA are recommended for preservation as a means of preserving the provincially threatened Bobolink.

The first reason for not protecting land for Bobolink populations within the SPA is that the Bobolink population is already small and likely declining.

The second reason for not protecting land for Bobolink populations within the SPA is that Bobolink habitat within the SPA is of marginal and decreasing value to Bobolinks due to insufficient area and the high frequency of shrub and sapling growth. Within several years, this growth in the amount of woody vegetation will likely result in the disappearance of Bobolink as a breeding species from the SPA.

The succession of abandoned farmland from herbaceous-dominated to shrub and tree-dominated communities which is occurring within the SPA is an example of the larger scale succession of abandoned farmland across Ontario and much of North America which is considered to be a major factor in the species' decline within Ontario and much of North America (COSSARO 2010).

Scube Parcels

No areas within the Scube Parcels are recommended for preservation as a means of preserving the provincially threatened Bobolink..

The first reason for not protecting land for Bobolink populations within the Scube Parcels is that a breeding population within these parcels already appears to be absent. This conclusion is based on the findings of our 2012 surveys

The second reason for not protecting land for Bobolink populations within the Scube Parcels is that habitat within the Scube parcels already appears to be unsuitable for Bobolinks due to the insufficient size of habitats and the high and increasing frequency of shrub and tree cover.

6.5 COMMON SPECIES

Fruitland-Winona SPA

Forty-four species of birds were encountered within the SPA and these included four Species at Risk (Chimney Swift, Barn Swallow, Common Nighthawk and Bobolink) (Table 1). Most species encountered likely breed within the SPA and are common, widespread species within Ontario (S5), are uncommon but not rare within Ontario (S4) or are non-native species to Ontario (SNA). The majority of species are widespread because they commonly nest and forage in small and fragmented areas of suitable habitat such as occurs within the studied areas.

No portions of the SPA are recommended for preservation to protect common bird species found within them. This is because most common species present have stable numbers, are widespread within Ontario and adaptive to human development to the extent that that they will continue to occur in developed areas, using planted trees and shrubs for nesting. Examples of such species include American Robin, Chipping Sparrow and American Goldfinch. Additional common species found within the SPA are declining in the larger Carolinian zone but preservation of habitat for these species within the SPA is not recommended due to the ineffectiveness of habitat protection in a small portion of these species' ranges to reverse declining populations at much larger scales. For example, Field Sparrow, Eastern Kingbird, Northern Rough-winged Swallow and American Woodcock are all declining in the Carolinian zone, but protecting the limited habitat for these species found within the SPA will not effectively reverse population declines throughout the Carolinian zone. Other species which currently occur such as Willow Flycatcher, Savannah Sparrow and Northern Flicker are expected to disappear from the SPA as a result of development, but their expected disappearance is not considered sufficient cause to preserve the area as they are widespread within Ontario and not considered to be of conservation concern. Area-sensitive species of forest, grassland and wetland are often of conservation concern in areas with extensive development such as occurs within the SPA and Scube Parcels because suitable large areas of forest, grassland and wetland are infrequent in such areas. Within the SPA, 3 of 44 species found (Bobolink, Cooper's Hawk and White-breasted Nuthatch) are considered to be area-sensitive species. Based on the fragmented nature of habitat within the SPA, it cannot be considered important habitat for area-sensitive species.

Scube Parcels

Forty-five species of birds were encountered within the Scube Parcels including three Species at Risk (Barn Swallow, Bobolink and Eastern Meadowlark) (Table 2). All species encountered likely breed within the Scube Parcels and are common, widespread species within Ontario (S5), are uncommon but not rare within Ontario (S4) or are non-native species to Ontario (SNA). The

majority of species are widespread because they commonly nest and forage in small and fragmented areas of suitable habitat such as occurs within the studied areas.

No portions of the Scube Parcels are recommended for preservation to protect common bird species found within them. This is because most species present are common and widespread within Ontario and are adaptive to human development such that many will continue to occur in developed areas, using planted trees and shrubs for nesting. As with the SPA, additional common species found within the Scube Parcels are declining in the larger Carolinian zone but preservation of habitat for these species within the Scube parcels is not recommended due to the ineffectiveness of habitat protection in a small portion of these species' ranges to reverse declining populations at much larger scales. For example, Field Sparrow, Eastern Kingbird, Northern Rough-winged Swallow and American Woodcock are all declining in the Carolinian zone, but protecting habitat for these species within the Scube parcels will not effectively reverse population declines throughout the Carolinian zone. With development, some species are expected to disappear such as Willow Flycatcher, Gray Catbird and Savannah Sparrow however these species are not considered to be of conservation concern. Area-sensitive species of forest, grassland and wetland were limited to 3 of 45 species (Bobolink, Eastern Meadowlark and White-breasted Nuthatch) detected within the Scube Parcels. Based on the fragmented nature of habitat within the Scube Parcels, it cannot be considered important habitat for area-sensitive species.

7.0 References

AquaforBeech. 2012.

BirdLife International (2012) Species factsheet: *Accipiter cooperii*. Downloaded from http://www.birdlife.org on 13/08/2012.

Bird Studies Canada. 2009. Chimney Swift (*Chaetura pelagica*) Monitoring Protocol.

Cadman, M.D., D.A. Sutherland, G.G. Beck, D. Lepage and A.R. Couturier (eds). 2007. Atlas of the Breeding Birds of Ontario 2001- 2005. Bird Studies Canada, Environment Canada, Ontario Field Ornithologists, Ontario Ministry of Natural Resources, and Ontario Nature, Toronto. 706 pp.

Cadman, M.D., P.F.J. Eagles and F.M. Helleiner, 1987. Atlas of the Breeding Birds of Ontario. University of Waterloo Press.

COSEWIC, 2007. COSEWIC assessment and status report on the Chimney Swift *Chaetura pelagica* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa vi + 49 pp.

COSEWIC, 2010. COSEWIC assessment and status report on the Bobolink *Dolichonyx oryzivorus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa vi + 42 pp.

COSEWIC, 2011a. COSEWIC assessment and status report on the Barn Swallow *Hirundo rustica* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa ix + 37 pp.

COSEWIC, 2011b. COSEWIC assessment and status report on the Eastern Meadowlark *Sturnella magna* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa vi + 40 pp.

COSSARO. 2009. COSSARO classifications from March 24-25 and May 27-29, 2009 assessments reported to the Minister on June 11, 2009.

COSSARO. 2010. COSSARO Candidate Species at Risk Evaluation Form for Bobolink (*Dolichonyx oryzivorus*). Committee on the Status of Species at Risk in Ontario.

COSSARO. 2011a. COSSARO Candidate Species at Risk Evaluation Form for Barn Swallow (*Hirundo rustica*). Committee on the Status of Species at Risk in Ontario (COSSARO). June, 2011. Final

COSSARO. 2011b. COSSARO Candidate Species at Risk Evaluation Form for Eastern Meadowlark (*Sturnella magna*). Committee on the Status of Species at Risk in Ontario (COSSARO). June, 2011. Final

McCracken, J. 2005. Where the Bobolinks Roam: The Plight of North America's Grassland Birds. Tropical Conservancy 6: 20-29.

McCracken, J. 2008. Are Aerial Insectivores Being 'Bugged Out'? Bird Watch Canada. 42:4-7.

Nebel, S., A. Mills, J. D. McCracken, and P. D. Taylor. 2010. Declines of aerial insectivores in North America follow a geographic gradient. *Avian Conservation and Ecology - Écologie et conservation des oiseaux* **5**(2): 1. [online] URL: http://www.ace-eco.org/vol5/iss2/art1/

North American Bird Conservation Initiative Canada. 2012. *The State of Canada's Birds, 2012.* Environment Canada, Ottawa, Canada. 36 pages.

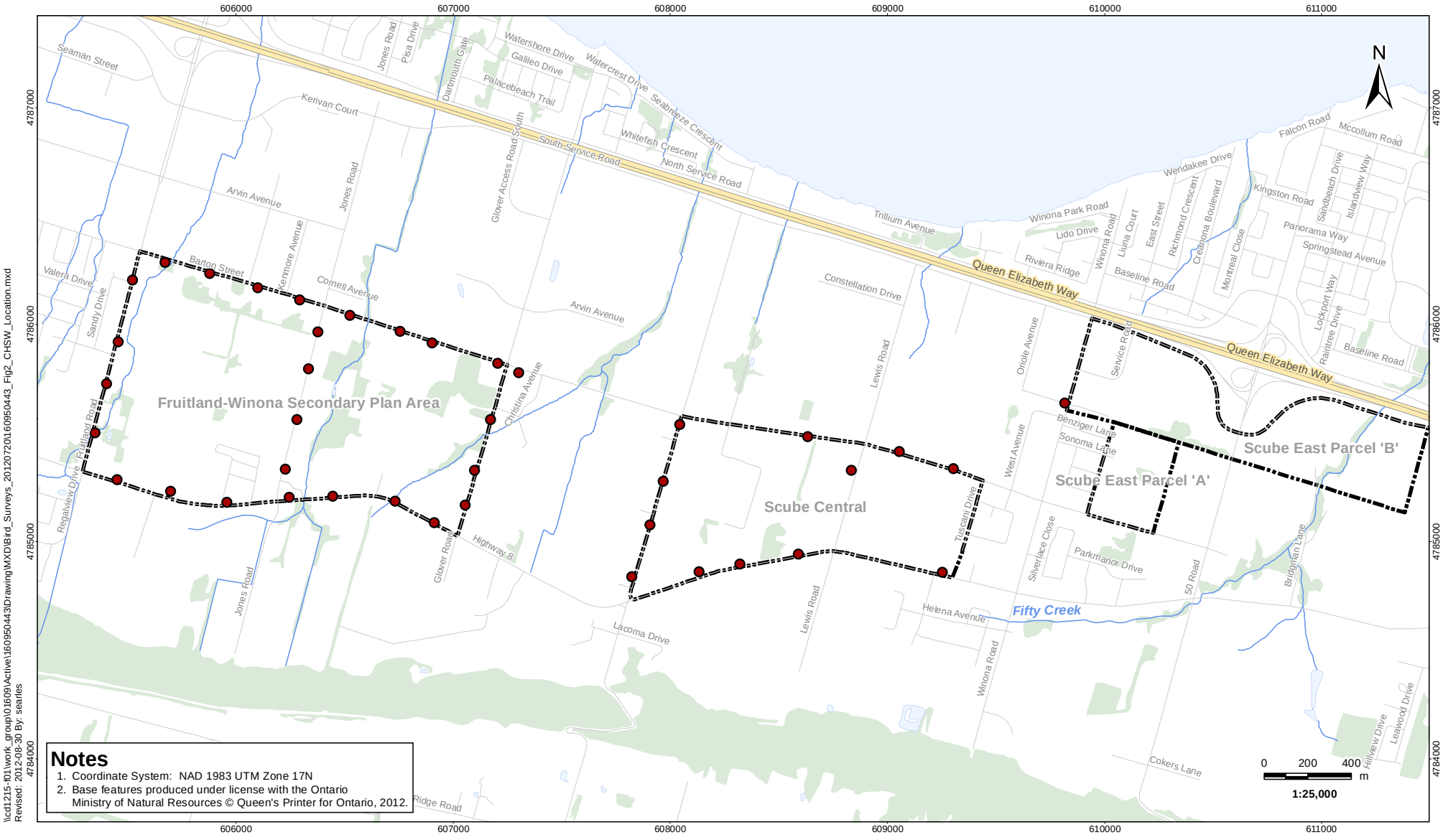
Ontario Ministry of Natural Resources (MNR). 2000. Significant Wildlife Habitat Technical Manual.

Ontario Ministry of Natural Resources (MNR). 2007. Endangered Species Act. Available online at: http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_07e06_e.htm#BK0.

Ontario Ministry of Natural Resources (MNR). 2008. Habitat protection for endangered, threatened and extirpated species under the Endangered Species Act, 2007.

Sauer, J. R., J. E. Hines, J. E. Fallon, K. L. Pardieck, D. J. Ziolkowski, Jr., and W. A. Link. 2011. *The North American Breeding Bird Survey, Results and Analysis 1966 - 2010. Version 12.07.2011 USGS Patuxent Wildlife Research Center, Laurel, MD*

APPENDIX A:
Figures



Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2012.

\\cd1215-f01\work_group\01609\Active\160950443\Drawing\MXD\Bird_Surveys_20120720160950443_Fig2_CHSW_Location.mxd
Revised: 2012-08-30 By: seatles

August 2012
160950443

Legend

- Chimney Swift Survey Location
- Study Area
- Road
- Highway
- Watercourse
- Waterbody
- Woodlot

Stantec

Client/Project

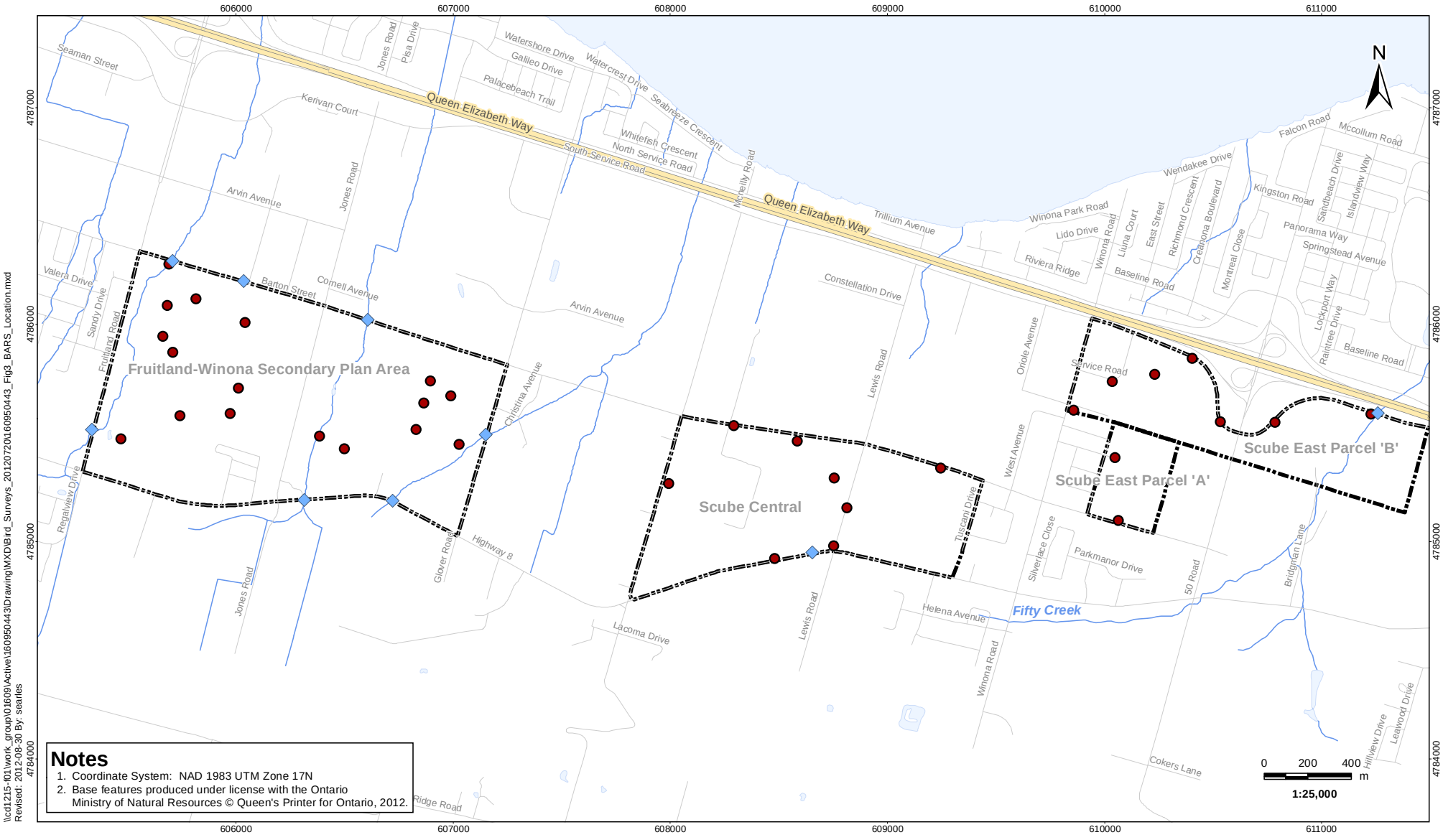
City of Hamilton
SAR Surveys

Figure No.
2

DRAFT

Title

Chimney Swift Survey Location



\\cd1215-f01\work_group\01609\Active\160950443\Drawing\MXD\Bird_Surveys_20120720\160950443_Fig3_BARS_Location.mxd
Revised: 2012-08-30 By: seatles

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2012.

August 2012
160950443

Stantec

Legend

- Barn Swallow Survey Location
- Barn Swallow Nest Search Location
- Study Area
- Road
- Highway
- Watercourse
- Waterbody

Client/Project

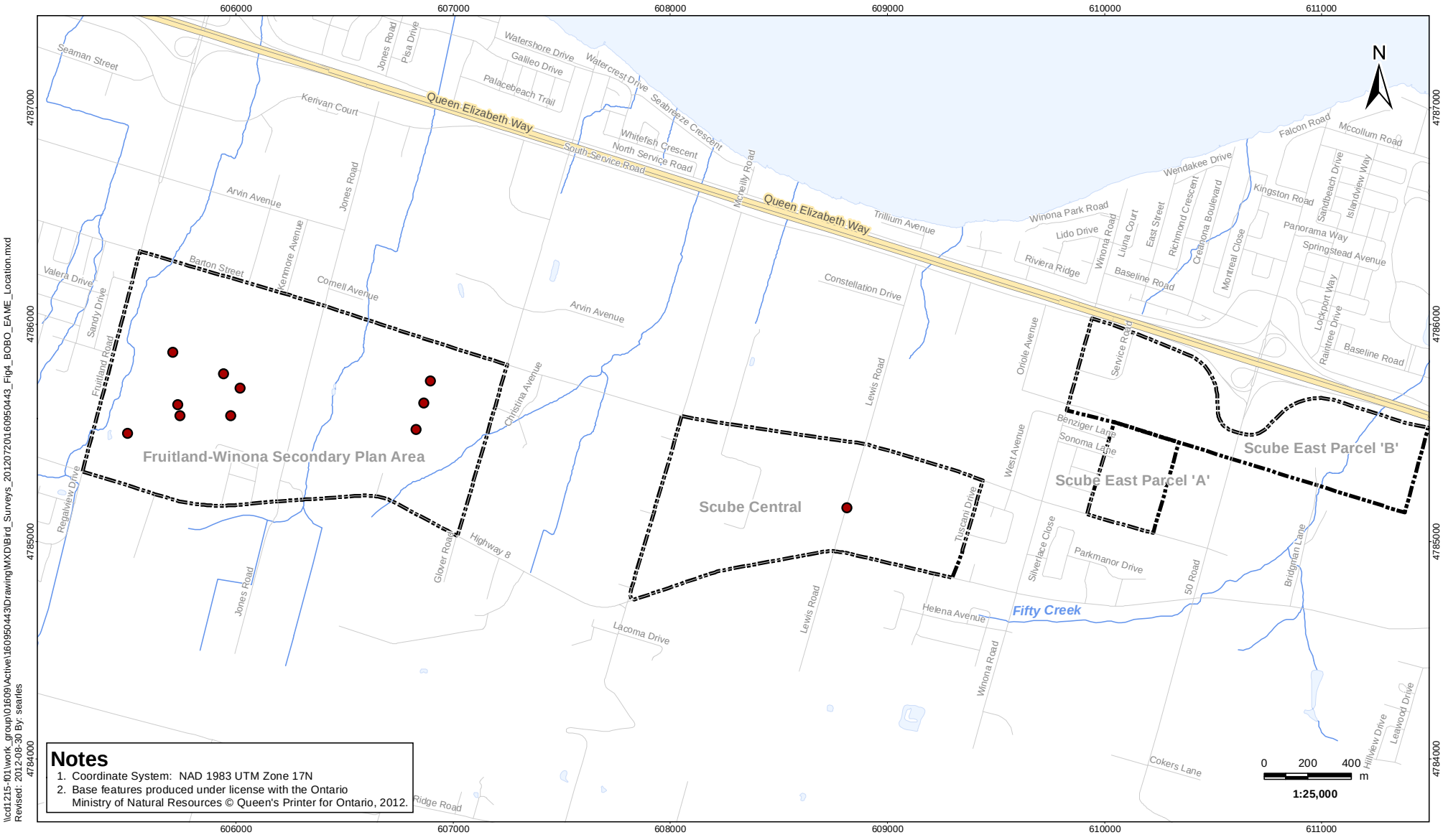
City of Hamilton
SAR Surveys

Figure No.
3

DRAFT

Title

Barn Swallow Survey Location



\\cd1215-f01\work_group\01609\Active\160950443\Drawing\MXD\Bird_Surveys_20120720\160950443_Fig4_BOBO_EAME_Location.mxd
Revised: 2012-08-30 By: seatles

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2012.

August 2012
160950443

Stantec

Legend

- Bobolink/Eastern Meadowlark Survey Location
- Study Area
- Road
- Highway
- Watercourse
- Waterbody

Client/Project

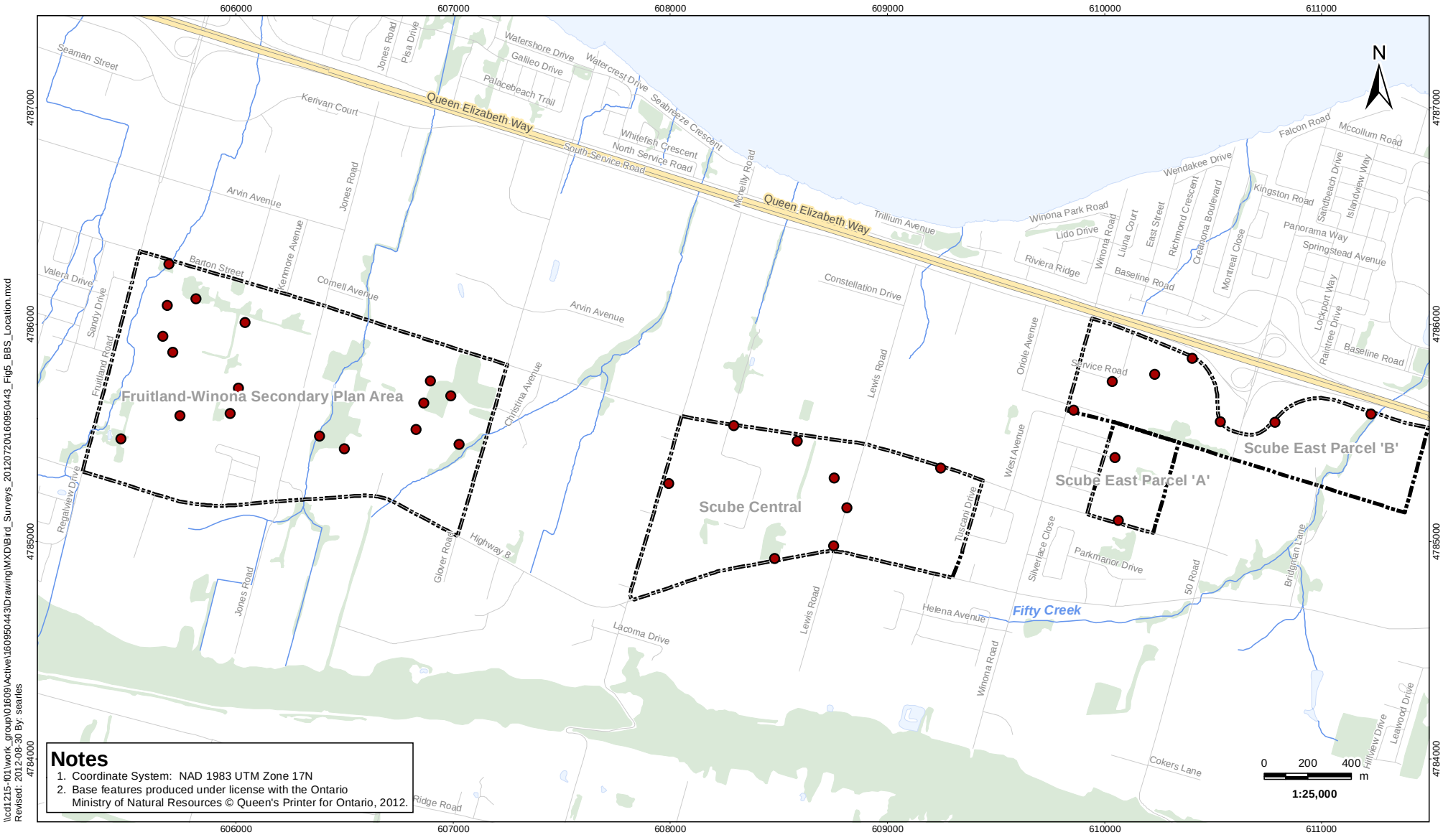
City of Hamilton
SAR Surveys

Figure No.
4

DRAFT

Title

Bobolink & Eastern Meadowlark Survey Location



\\cd1215-f01\work_group\01609\Active\160950443\Drawing\MXD\Bird_Surveys_20120720\160950443_Fig5_BBS_Location.mxd
Revised: 2012-08-30 By: seatles

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2012.

August 2012
160950443

Stantec

Legend

- Breeding Bird Survey Location
- Study Area
- Road
- Highway
- Watercourse
- Waterbody
- Woodlot

Client/Project

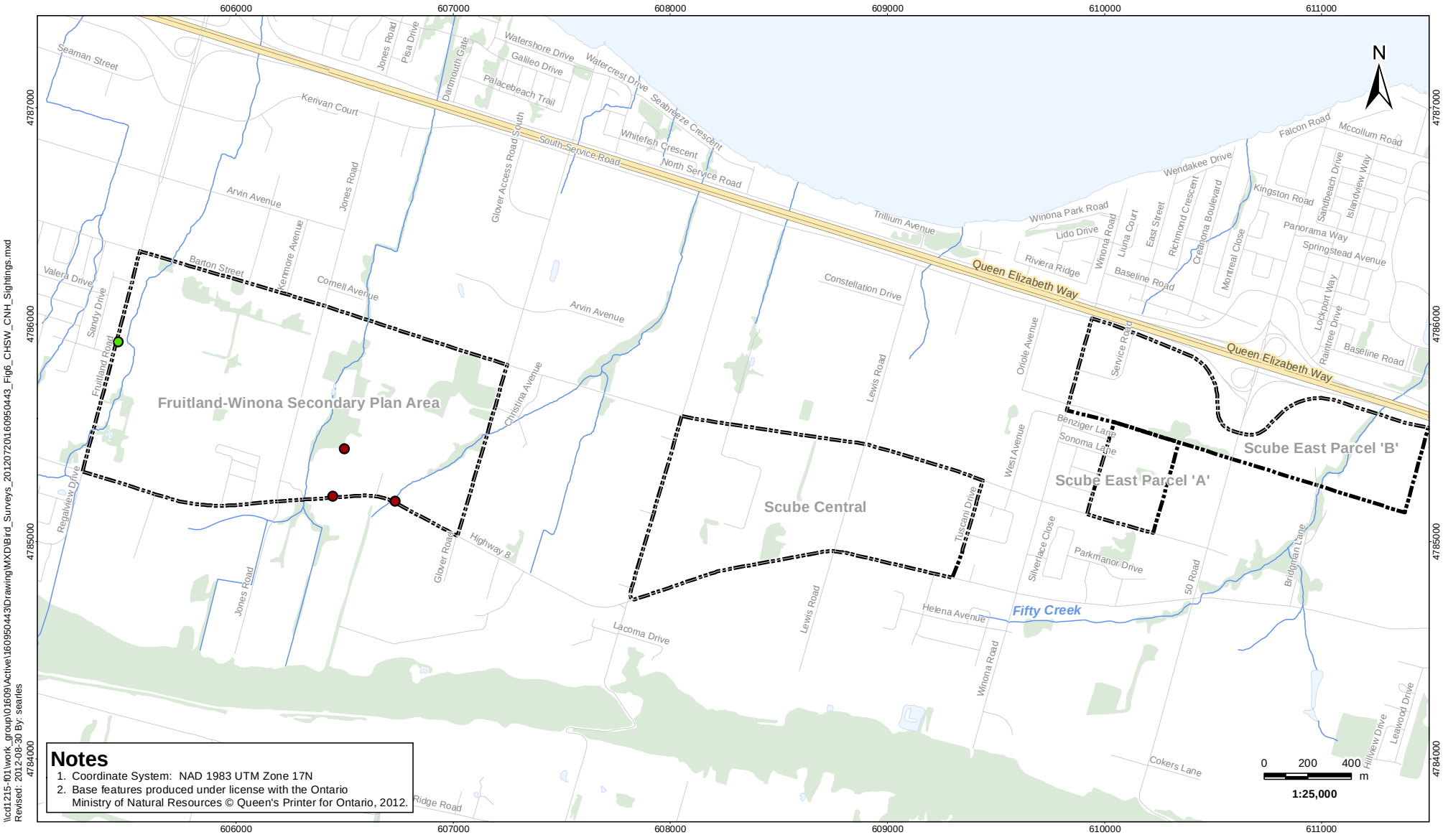
City of Hamilton
SAR Surveys

Figure No.
5

DRAFT

Title

Breeding Bird Survey Locations



Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2012.

\\cd1215-f01\work_group\01609\Active\160950443\Drawing\MXD\Bird_Surveys_20120720\160950443_Fig6_CHSW_CNH_Sightings.mxd
Revised: 2012-08-30 By: seatles

August 2012
160950443

Legend

- Common Nighthawk Sighting Location
- Chimney Swift Sighting Location
- Study Area
- Road
- Highway
- Watercourse
- Waterbody
- Woodlot

Stantec

Client/Project

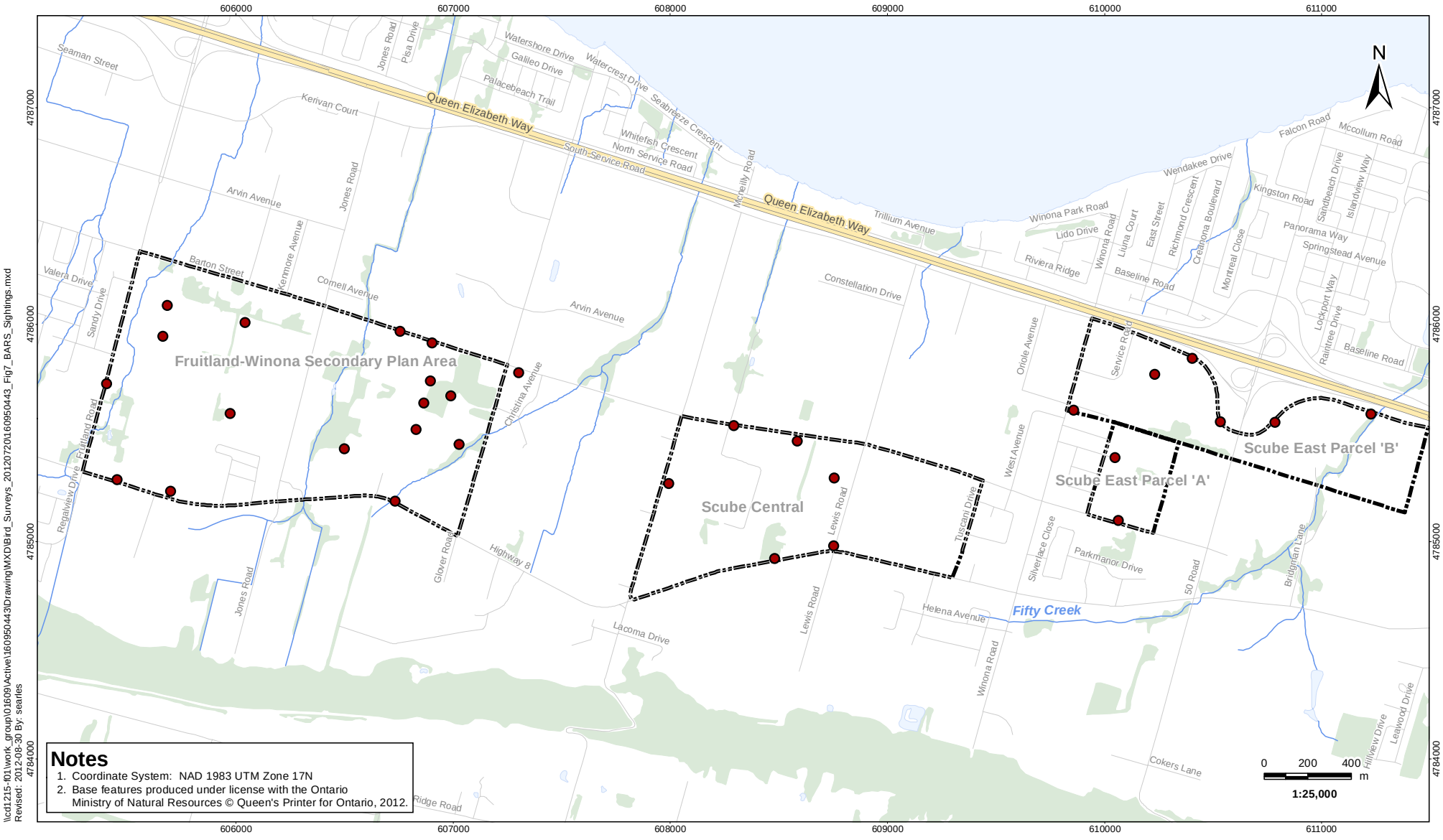
City of Hamilton
SAR Surveys

Figure No.
6

DRAFT

Title

Chimney Swift & Common Nighthawk Sighting Location



Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2012.

\\cd1215-f01\work_group\01609\Active\160950443\Drawing\MXD\Bird_Surveys_20120720\160950443_Fig7_BARS_Sightings.mxd
Revised: 2012-08-30 By: seatles

August 2012
160950443

Legend

- Barn Swallow Sighting Location
- Study Area
- Road
- Highway
- Watercourse
- Waterbody
- Woodlot

Stantec

Client/Project

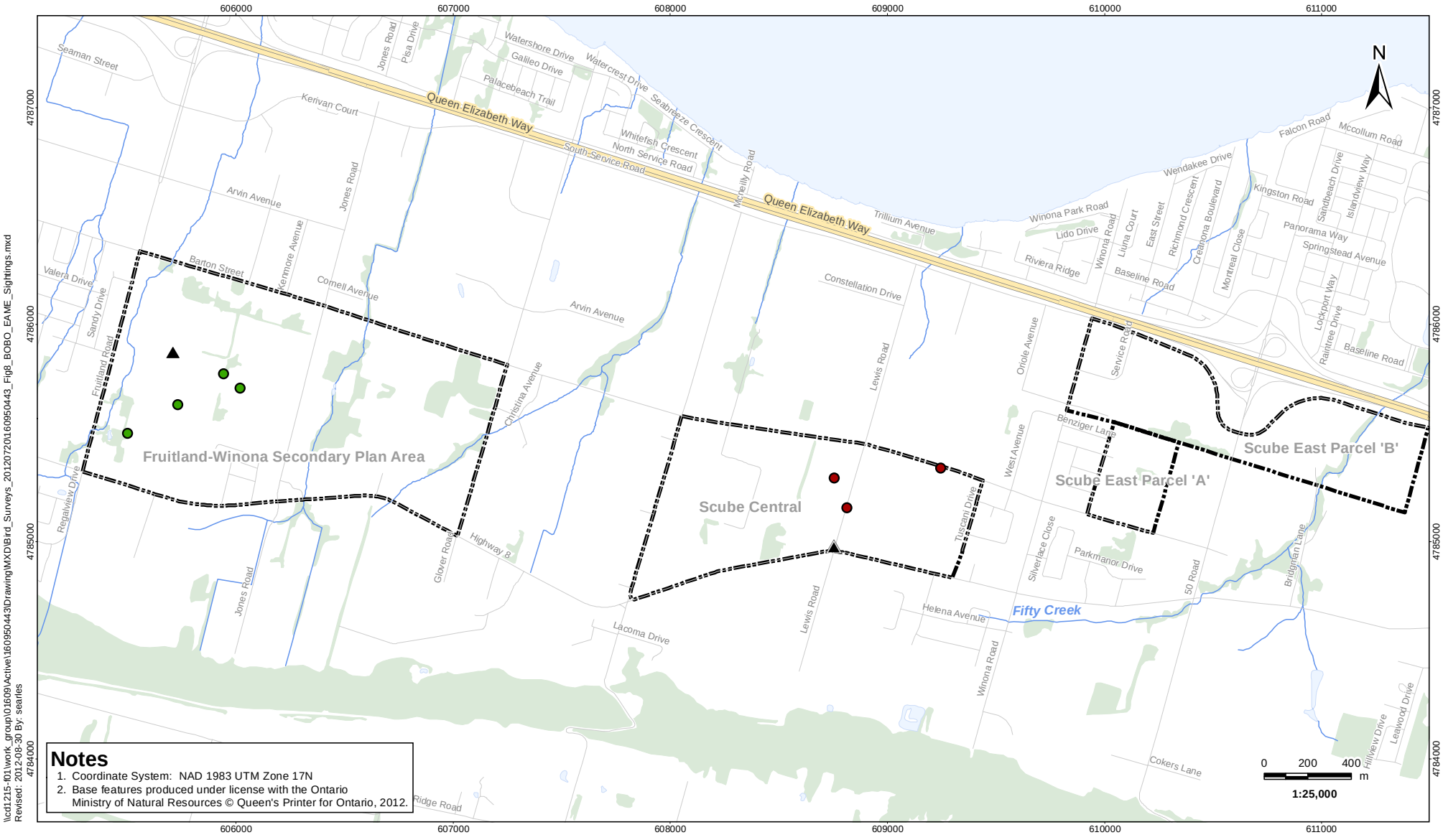
City of Hamilton
SAR Surveys

Figure No.
7

DRAFT

Title

Barn Swallow Sighting Location



\\cd1215-f01\work_group\01609\Active\160950443\Drawing\MXD\Bird_Surveys_20120720\160950443_Fig8_BOBO_EAME_Sightings.mxd
Revised: 2012-08-30 By: seatles

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2012.

August 2012
160950443

Stantec

Legend

- Bobolink Sighting Location
- Boblink Non-Breeding Sighting Location
- Eastern Meadowlark Sighting Location
- Study Area
- Road
- Highway
- Watercourse
- Waterbody
- Woodlot

Client/Project

City of Hamilton
SAR Surveys

Figure No.
8

DRAFT

Title

Bobolink & Eastern Meadowlark Sighting Location

APPENDIX B:

Tables

Table 1: Breeding Bird Species within the SPA.

Common Name	*Scientific Name*	*Habitat Preference*	*Total # of Stations per Species*	*Ontario Status*	COSSARO	COSEWIC	Population Changes Between Atlases[1]	Area Sensitivity (ha)	Local Status Hamilton
American Robin	*Turdus migratorius*	Isolated trees/Forest	*16*	S5B			NS		
Song Sparrow	*Melospiza melodia*	Shrubs	*15*	S5B			NS		
Northern Cardinal	*Cardinalis cardinalis*	Shrubs	*15*	S5			NS		
American Goldfinch	*Carduelis tristis*	Shrubs	*15*	S5B			NS		
Brown-headed Cowbird	*Molothrus ater*	Shrubs	*13*	S4B			NS		
Barn Swallow	*Hirundo rustica*	Grassland	*10*	S4B	THR	THR-NS	NS		
Gray Catbird	*Dumetella carolinensis*	Shrubs	*9*	S4B			NS		
Red-winged Blackbird	*Agelaius phoeniceus*	Grassland	*9*	S5			NS		
Mourning Dove	*Zenaida macroura*	Isolated trees/Forest	*8*	S5			NS		
European Starling	*Sturnus vulgaris*	Isolated trees/Forest	*8*	SNA			NS		
Field Sparrow	*Spizella pusilla*	Grassland/Shrubs	*7*	S4B			-17		
Common Grackle	*Quiscalus quiscula*	Isolated trees	*7*	S5B			NS		
Blue Jay	*Cyanocitta cristata*	Forest	*6*	S5			NS		
Cedar Waxwing	*Bombycilla cedrorum*	Shrubs	*6*	S5B			NS		
Willow Flycatcher	*Empidonax traillii*	Shrubs	*5*	S5B			NS		
Eastern Kingbird	*Tyrannus tyrannus*	Shrubs	*5*	S4B			-8		
American Crow	*Corvus brachyrhynchos*	Isolated trees/Forest	*5*	S5B			NS		
Tree Swallow	*Tachycineta bicolor*	Grassland	*5*	S4B			NS		
Black-capped Chickadee	*Poecile atricapillus*	Forest	*5*	S5			+11		
House Wren	*Troglodytes aedon*	Shrubs	*5*	S5B			NS		
Yellow Warbler	*Setophaga petechia*	Shrubs	*5*	S5B			NS		
Chipping Sparrow	*Spizella passerina*	Residential	*4*	S5B			NS		
Savannah Sparrow	*Passerculus sandwichensis*	Grassland	*4*	S4B			NS		

Table 1: Breeding Bird Species within the SPA.

Common Name	*Scientific Name*	*Habitat Preference*	*Total # of Stations per Species*	*Ontario Status*	COSSARO	COSEWIC	Population Changes Between Atlases[1]	Area Sensitivity (ha)	Local Status Hamilton
Killdeer	*Charadrius vociferus*	Grassland	*3*	S5B, S5N			-11		
Red-eyed Vireo	*Vireo olivaceus*	Forest	*3*	S5B			NS		
Common Yellowthroat	*Geothlypis trichas*	Wetland	*3*	S5B			NS		
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	Grassland	*2*	S4B			-11		
Bobolink	*Dolichonyx oryzivorus*	Grassland	*2*	S4B	THR	THR-NS	-10	50	
Baltimore Oriole	*Icterus galbula*	Forest	*2*	S4B			NS		
House Finch	*Carpodacus mexicanus*	Residential	*2*	SNA			>+200		
Cooper's Hawk	*Accipiter cooperii*	Residential/Forest	*1*	S4	NAR	NAR	>+200	4-50+	Rare
Red-tailed Hawk	*Buteo jamaicensis*	Grassland	*1*	S5	NAR	NAR	NS		
American Kestrel	*Falco sparverius*	Grassland	*1*	S5B			-21		Uncommon
American Woodcock	*Scolopax minor*	Wetland	*1*	S4B			-29		
Black-billed Cuckoo	*Coccyzus erythropthalmus*	Shrubs	*1*	S5B			NS		Uncommon
Common Nighthawk	*Chordeiles minor*	Residential	*1*	S4B	SC	THR	-59		Rare
Chimney Swift	*Chaetura pelagica*	Aerial forager	*1*	S4B, S4N	THR	THR	-32		Uncommon
Downy Woodpecker	*Picoides pubescens*	Forest	*1*	S5			NS		
Northern Flicker	*Colaptes auratus*	Forest	*1*	S4B			-7		
Alder Flycatcher	*Empidonax alnorum*	Shrubs	*1*	S5B			NS		Uncommon

Table 1: Breeding Bird Species within the SPA.

Common Name	*Scientific Name*	*Habitat Preference*	*Total # of Stations per Species*	*Ontario Status*	COSSARO	COSEWIC	Population Changes Between Atlases[1]	Area Sensitivity (ha)	Local Status Hamilton
Warbling Vireo	*Vireo gilvus*	Forest	*1*	S5B			NS		
White-breasted Nuthatch	*Sitta carolinensis*	Forest	*1*	S5			NS	10	
Brown Thrasher	*Toxostoma rufum*	Shrubs	*1*	S4B			-32		Uncommon
Swamp Sparrow	*Melospiza georgiana*	Wetland	*1*	S5B			NS		

[1] Proportional changes in species numbers between the 1st (1981-1985) and 2nd (2001-2005) OBBAs (Cadman et al. 2007).
COSSARO: Committee on the Status of Species at Risk in Ontario

COSEWIC: Committee on the Status of Endangered Wildlife in Canada

S4: Apparently Secure—Uncommon but not rare

S5: Secure—Common, widespread, and abundant in the province

SNA: Not applicable—A conservation status rank is not applicable because the species is not a suitable target for conservation activities.

END: Endangered

THR: Threatened

NS: Not Statistically Significant

Table 2: Breeding Bird Species within Scube Central, Scube East Parcel 'A' and Scube East Parcel 'B'.

Common Name	*Scientific Name*	*Habitat Preference*	*Total # of Stations per Species*	*Ontario Status*	COSSARO	COSEWIC	Population Changes Between Atlases	Area Sensitivity (ha)	Local Status Hamilton
American Robin	*Turdus migratorius*	Isolated trees/Forest	17	S5B			NS		
Northern Cardinal	*Cardinalis cardinalis*	Shrubs	17	S5			NS		
Red-winged Blackbird	*Agelaius phoeniceus*	Grassland	17	S5			NS		
American Goldfinch	*Carduelis tristis*	Shrubs	17	S5B			NS		
Song Sparrow	*Melospiza melodia*	Shrubs	15	S5B			NS		
Brown-headed Cowbird	*Molothrus ater*	Shrubs	15	S4B			NS		
Mourning Dove	*Zenaida macroura*	Isolated trees/Forest	14	S5			NS		
Barn Swallow	*Hirundo rustica*	Grassland	14	S4B	THR	THR-NS	NS		
European Starling	*Sturnus vulgaris*	Isolated trees/Forest	14	SNA			NS		
Common Grackle	*Quiscalus quiscula*	Isolated trees	12	S5B			NS		
Eastern Kingbird	*Tyrannus tyrannus*	Shrubs	11	S4B			-8		
Field Sparrow	*Spizella pusilla*	Grassland/Shrubs	10	S4B			-17		
Savannah Sparrow	*Passerculus sandwichensis*	Grassland	10	S4B			NS		
Gray Catbird	*Dumetella carolinensis*	Shrubs	9	S4B			NS		
Cedar Waxwing	*Bombycilla cedrorum*	Shrubs	9	S5B			NS		
House Sparrow	*Passer domesticus*	Residential	9	SNA			NS		
Blue Jay	*Cyanocitta cristata*	Forest	8	S5			NS		
Willow Flycatcher	*Empidonax traillii*	Shrubs	7	S5B			NS		
House Wren	*Troglodytes aedon*	Shrubs	7	S5B			NS		
Tree Swallow	*Tachycineta bicolor*	Grassland	6	S4B			+6		
Black-capped Chickadee	*Poecile atricapillus*	Forest	6	S5			+11		

Table 2: Breeding Bird Species within Scube Central, Scube East Parcel 'A' and Scube East Parcel 'B'.

Common Name	*Scientific Name*	*Habitat Preference*	*Total # of Stations per Species*	*Ontario Status*	COSSARO	COSEWIC	Population Changes Between Atlases	Area Sensitivity (ha)	Local Status Hamilton
Yellow Warbler	*Setophaga petechia*	Shrubs	6	S5B			NS		
Chipping Sparrow	*Spizella passerina*	Residential	6	S5B			NS		
Killdeer	*Charadrius vociferus*	Grassland	5	S5B, S5N			-11		
Northern Flicker	*Colaptes auratus*	Forest	4	S4B			-7		
Bobolink	*Dolichonyx oryzivorus*	Grassland	4	S4B	THR	THR-NS	-10	50	
Red-tailed Hawk	*Buteo jamaicensis*	Grassland	3	S5	NAR	NAR	NS		
Warbling Vireo	*Vireo gilvus*	Forest	3	S5B			NS		
American Crow	*Corvus brachyrhynchos*	Isolated trees/Forest	3	S5B			NS		
Northern Mockingbird	*Mimus polyglottos*	Shrubs	3	S4			>+200		Uncommon
Brown Thrasher	*Toxostoma rufum*	Shrubs	3	S4B			-32		Uncommon
Common Yellowthroat	*Geothlypis trichas*	Wetland	3	S5B			NS		
Eastern Meadowlark	*Sturnella magna*	Grassland	3	S4B	THR	THR-NS	-16	10	
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	Grassland	2	S4B			-11		
Carolina Wren	*Thryothorus ludovicianus*	Shrubs	2	S4			>+200		Rare
Swamp Sparrow	*Melospiza georgiana*	Wetland	2	S5B			NS		
Baltimore Oriole	*Icterus galbula*	Forest	2	S4B			NS		
House Finch	*Carpodacus mexicanus*	Residential	2	SNA			>+200		
American Kestrel	*Falco sparverius*	Grassland	1	S5B			-21		Uncommon
Downy Woodpecker	*Picoides pubescens*	Forest	1	S5			NS		
Eastern Phoebe	*Sayornis phoebe*	Forest	1	S5B			+44		Uncommon

Table 2: Breeding Bird Species within Scube Central, Scube East Parcel 'A' and Scube East Parcel 'B'.

Common Name	*Scientific Name*	*Habitat Preference*	*Total # of Stations per Species*	*Ontario Status*	COSSARO	COSEWIC	Population Changes Between Atlases	Area Sensitivity (ha)	Local Status Hamilton
Purple Martin	*Progne subis*	Aerial forager	1	S4B			-21		Uncommon
White-breasted Nuthatch	*Sitta carolinensis*	Forest	1	S5			NS	10	
Indigo Bunting	*Passerina cyanea*	Forest	1	S4B			-14		
Purple Finch	*Carpodacus purpureus*	Forest	1	S4B			-36		Uncommon

COSSARO: Committee on the Status of Species at Risk in Ontario

COSEWIC: Committee on the Status of Endangered Wildlife in Canada

S4: Apparently Secure—Uncommon but not rare

S5: Secure—Common, widespread, and abundant in the province

SNA: Not applicable—A conservation status rank is not applicable because the species is not a suitable target for conservation activities.

END: Endangered

THR: Threatened

NS: Not Statistically Significant

APPENDIX C:
Data Sheets

Stantec Consulting Ltd.
70-1 Southgate Drive
Guelph, Ontario, Canada
N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Barn Swallow Observation Form

Project Number 160950443 Project Name: Fruitland - Winona

Date: June 25, 2012 Field Personnel: Nicole Kopysch.

Weather Conditions:	Temp:	Wind:	Cloud:	PPT:	PPT in last 24 hrs:
	16 - 20°C	2-3	10%	0	rain.

Survey Station	Time	GPS Coordinates	# BARS observed	Type of structure (e.g. barn, culvert)	Accessible nesting sites (Y or N)	Nests	
						Active	Inactive
4	6^19 - 6^24		2	N.A.	Foraging only		
10	8^11 - 8^16		2	N.A.	Foraging only		
9	8^30 - 8^35		1	N.A.	Foraging only		
14	937 - 942		8	N.A.	Foraging only		
15	945 - 950		8	N.A.	Foraging only		
13	930 - 935		8	N.A.	Foraging only		
17	10^04 - 10^09		2	N.A.	Foraging only		

Quality Control: This form is complete (__) & legible (__).

Signature: _____ (Field Personnel)

Signature: _____ (Project Manager)

Stantec Consulting Ltd.
70-1 Southgate Drive
Guelph, Ontario, Canada
N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Barn Swallow Observation Form

Project Number 60950443 Project Name: Hamilton

Date: June 12, 2012 Field Personnel: N. Kopysh

Weather Conditions:	Temp:	Wind:	Cloud:	PPT:	PPT in last 24 hrs:
	20°C.	3	100%		rain overnight

Station #13.

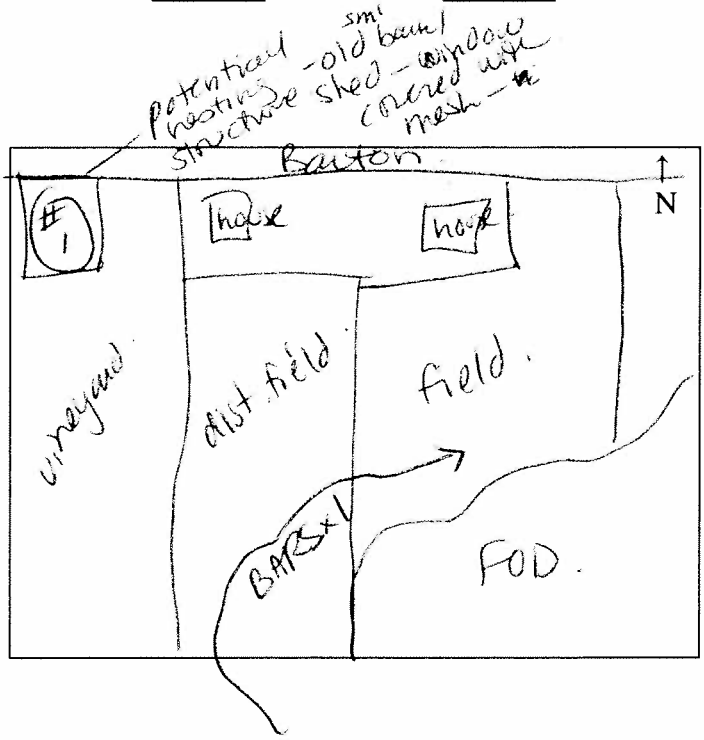
Location of BARS observation: ~~1~~

Start Time: 06:30 End Time: 06:45

Tally of BARS: ~~1~~ 1

Sketch of Habitat (include foraging habitat and location of potential nesting structures) or provide details on air photo

- Map crop types in vicinity of BARS observation and surrounding area (i.e. within 200m)
- Include location of water bodies (e.g. river, pond)
- Mark location of BARS foraging
- Mark location of potential nesting structures



Description of Potential Nesting Structures:

Structure # (indicate location on map)	Type of structure (e.g. barn, culvert)	Accessible nesting sites (Y or N)	Number of nests present			
			BARS		CLIS	
			Active	Inactive	Active	Inactive
#1	barn/shed.	(Y) - open windows = covered with mesh. front = open doorway.	unknown - no access to observe			
			0	BARS seen entering/exiting 1 seen in vicinity foraging		

Quality Control: This form is complete (✓) & legible (✓).

Signature: _____ (Field Personnel)

Signature: _____ (Project Manager)

Stantec Consulting Ltd.
70-1 Southgate Drive
Guelph, Ontario, Canada
N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Barn Swallow Observation Form

Project Number 160950443 Project Name: Fruitland - Winona

Date: June 11, 2012 Field Personnel: M. Oliveira

Weather Conditions:	Temp:	Wind:	Cloud:	PPT:	PPT in last 24 hrs:
	17°C	0	20%	0	0

Survey Station	Time	GPS Coordinates	# BARS observed	Type of structure (e.g. barn, culvert)	Accessible nesting sites (Y or N)	Nests	
						Active	Inactive
1	10^{10}-10^{15}	606318, 4785210	0	Concrete box culvert	No.		None.
	10^{23}-10^{28}	606729, 4785199	0	Concrete box culvert	No		None
	10^{35}-10^{40}	607153, 4785490	0	Concrete box culvert	No		None
	10^{43}-10^{48}	606688, 4786033	0	Pipe culvert	No		None
	10^{55}-11^{03}	606002, 4786211	0	No culvert present	No		None
	11^{09}-11^{14}	608693, 4786279	0	Pipe/concrete culvert	No		None
	11^{18}-11^{23}	608331, 4785484	0	Two small concrete pipes running parallel with Fruitland Rd. Not suitable for nesting	No		None

Quality Control: This form is complete (__) & legible (__).

Signature: _____ (Field Personnel) Signature: _____ (Project Manager)

Stantec Consulting Ltd.
70-1 Southgate Drive
Guelph, Ontario, Canada
N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Barn Swallow Observation Form

Project Number 160950443 Project Name: Fruitland - Winona

Date: June 11, 2012 Field Personnel: Michael Oliveira

Weather Conditions:	Temp:	Wind:	Cloud:	PPT:	PPT in last 24 hrs:
	17°C	0	20%	0	0

Survey Station	Time	GPS Coordinates	# BARS observed	Type of structure (e.g. barn, culvert)	Accessible nesting sites (Y or N)	Nests	
						Active	Inactive
10	913-918	606801 4785428	5	N.A.	Foraging only		

Quality Control: This form is complete (__) & legible (__).

Signature: _____ (Field Personnel)

Signature: _____ (Project Manager)

Stantec Consulting Ltd.
70-1 Southgate Drive
Guelph, Ontario, Canada
N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Barn Swallow Observation Form

Project Number 160950443 Project Name: Fruitland - Winona

Date: July 10, 2012 Field Personnel: D. Graham

Weather Conditions:	Temp:	Wind:	Cloud:	PPT:	PPT in last 24 hrs:
	17-24°C	1	10%	None	Light rain

Survey Station	Time	GPS Coordinates	# BARS observed	Type of structure (e.g. barn, culvert)	Accessible nesting sites (Y or N)	Nests	
						Active	Inactive
1	5^{30}-5^{35}	605665, 4785945	1	N.A.	Foraging only		
2	5^{40}-5^{45}	605685, 4786087	1	N.A.	Foraging only		
4	6^{15}-6^{20}	606042, 4786009	1	N.A.	Foraging only		
10	8^{34}-8^{39}	606501, 4785428	6	N.A.	Foraging only		
13	9^{25}-9^{30}	606896, 4785741	1	N.A.	Foraging only		
14	9^{35}-9^{40}	606866, 4785638	1	N.A.	Foraging only		
15	9^{45}-9^{50}	606832, 4785515	1	N.A.	Foraging only		
16	10^{05}-10^{10}	606982, 4785871	1	N.A.	Foraging only		
17	10^{15}-10^{20}	607028, 4785948	1	N.A.	Foraging only		

Quality Control: This form is complete (__) & legible (__).

Signature: _____ (Field Personnel)

Signature: _____ (Project Manager)

Stantec Consulting Ltd.
70-1 Southgate Drive
Guelph, Ontario, Canada
N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Barn Swallow Observation Form

Project Number 160950443 Project Name: Fruitland - Winona

Date: July 12, 2012 Field Personnel: D. Graham

Weather Conditions:	Temp: 26 °C	Wind: 1	Cloud: 0%	PPT: None	PPT in last 24 hrs: None

Survey Station	Time	GPS Coordinates	# BARS observed	Type of structure (e.g. barn, culvert)	Accessible nesting sites (Y or N)	Nests	
						Active	Inactive
Hwy 8 1	1235	606323 4785209	0	Box culvert	N - no ledges for nesting, roof of culvert too low, vegetation obstruct entrance		
Hwy 8 2	1245	606972 4785072	0	Corrugated steel culvert	N - too small in dia, no ledges, veg obstructs		
Glover 3	1300	607163 4785495	0	Box culvert	N - no ledges, veg. obstructs		
Barton 4	1310	606607 4786030	0	Corrugated steel culvert	N - too small in dia, no ledges, veg. obstructs		
Barton 5	1325	605990 4786219	0	unable to find any structure or watercourse			
Barton 6	1335	605688 4786313	0	Box culvert	N - no ledges, veg. obstructs		
Fruitland 7	1345	605353 4785531	0	Box culvert	N - "		"

Quality Control: This form is complete (__) & legible (__).

Signature: _____ (Field Personnel) Signature: _____ (Project Manager)

Stantec Consulting Ltd.
70-1 Southgate Drive
Guelph, Ontario, Canada
N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Barn Swallow Observation Form

Project Number 60950443 Project Name: Hamilton – Fruitland

Date: June 25, 2012 05:30 – 1040 Field Personnel: N. KOPYSH

Weather Conditions:	Temp:	Wind:	Cloud:	PPT:	PPT in last 24 hrs:
	20°C.	2-3	10%	Ø	

Survey Station BARS#	Time	GPS Coordinates	# BARS observed adt/ in culvert	Type of structure (e.g. barn, culvert)	Accessible nesting sites (Y or N)	Nests	
						Active	Inactive
6	05:30	0605692/	Ø	sml. round culvert	N	Ø	
		4786278					
		Glover Rd.					
3	10:11	See map	Ø	sml. md. culvert	N	Ø	
2	10:32	Hwy 8	Ø		N	Ø	
1	10:34	Hwy 8	Ø		N	Ø	
4	10:37	Barton	Ø	see rd 1	N	Ø	
5	10:40	Barton	Ø		N	Ø	

Quality Control: This form is complete (✓) & legible (✓).

Signature: _____ (Field Personnel) Signature: _____ (Project Manager)

REV: June-09 FORM 034

BBS

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, ON
Canada N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Stantec

Birding Point Counts Survey Observation Form

Project Number: 60950443 Project Name: Hamilton

Date: June 12, 2012 Field Personnel: N. Kopysh

Weather Conditions:	TEMP (°C):	WIND:	CLOUD:	PPT:	PPT (in last 24 hrs):
	20°C	1-2	100%	Ø	rain overnight

GPS #: T

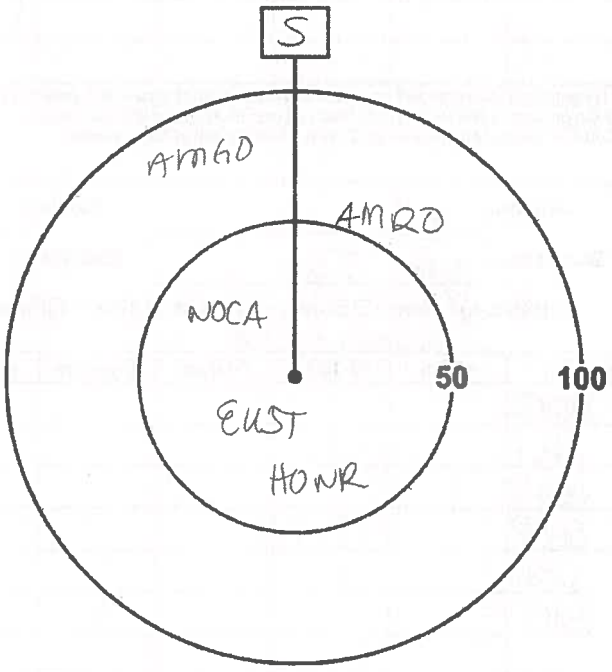
BBS - 5min pc

Station: 12 Feature: riparian corridor UTM:

Start Time: 06:00 End Time: 06:05

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
AMGO		1			
EUST	1				
HOWR	1				
AMRO		1			
NOCA	1				



Height of blade sweep varies from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Signature: MKopysh (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature: (Project Manager)

17T 0606896, 4785741

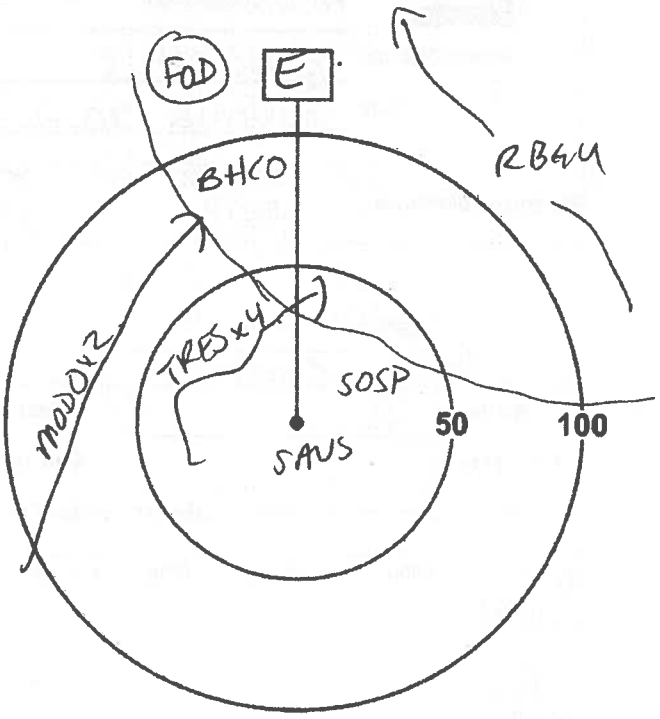
Station: 13 **Feature:** **UTM:**

Start Time: 06:30 **End Time:** 06:35

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
TRES				4	
MODO				2	
SOSP	1				
SAVS	1				

BAR SWAL



** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Station: 14 **Feature:** **UTM:** 17T 0606866 4785638

Start Time: 06:56 **End Time:** 07:01

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop
6 bn field

Species	<50m	50-100m	>100m	Flyovers	Height*
AMCR		1			
REVI		1			
AMGO	1				
SOSP		1			
SAVS		1			
BHCO				1	

(took RTHA present perched on woodland edge prior to point count)

** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Page ___ of ___

Quality Control: This form is complete ☐ & legible ☐.

Signature: _____ (Field Personnel)

Signature: _____ (Project Manager)

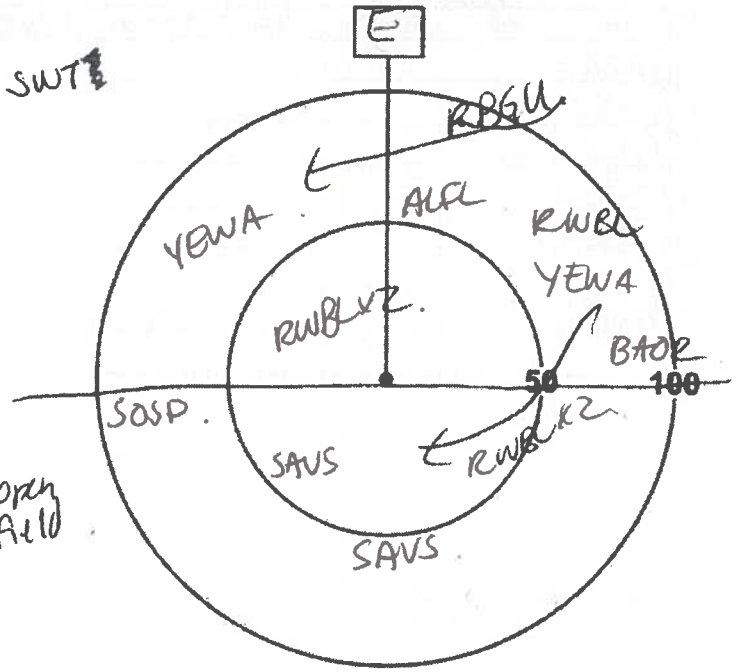
REV: 2011-05-04 / FORM 020

Station: 15 Feature: UTM: 17T 0606832 4785515

Start Time: 07:15 End Time: 07:20

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
YEWA		2			
RWBL	2	1		2	
ALFL		1			
BAOR		1			
RBGU				1	
SOSP		1			
SAVS	1	1			



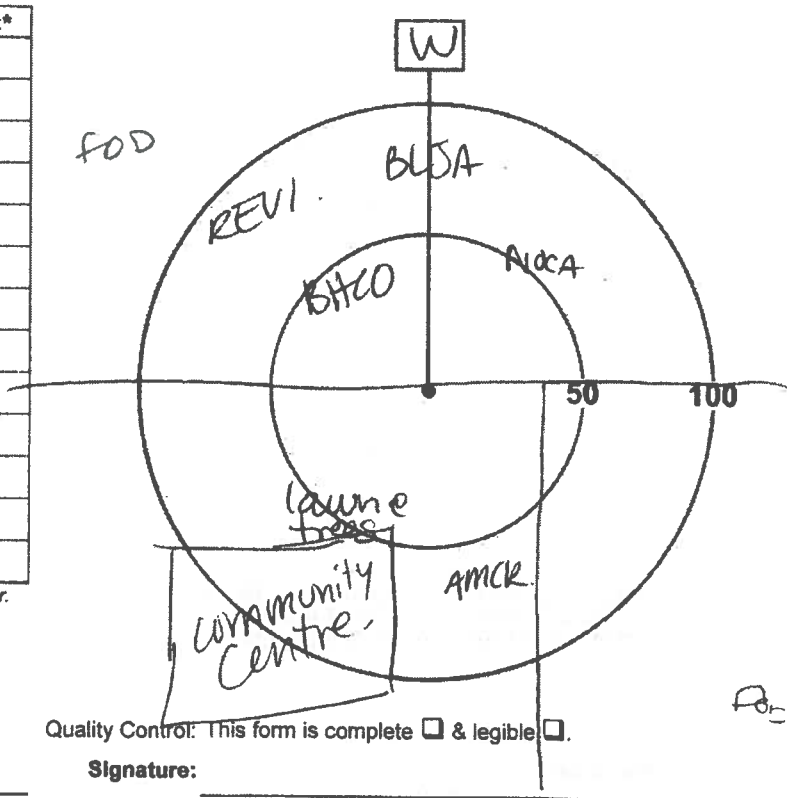
* Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Station: 16 - community centre Feature: UTM: 0606992 4785671

Start Time: 07:40 End Time: 07:45

Habitat: ☑Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop
lawn.

Species	<50m	50-100m	>100m	Flyovers	Height*
REVI		1			
BLJA		1			
BHCO	1				
NOCA		1			
AMCR		1			



* Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Page 2 of 2

Signature: (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature: (Project Manager)

REV: 2011-05-04 / FORM 020

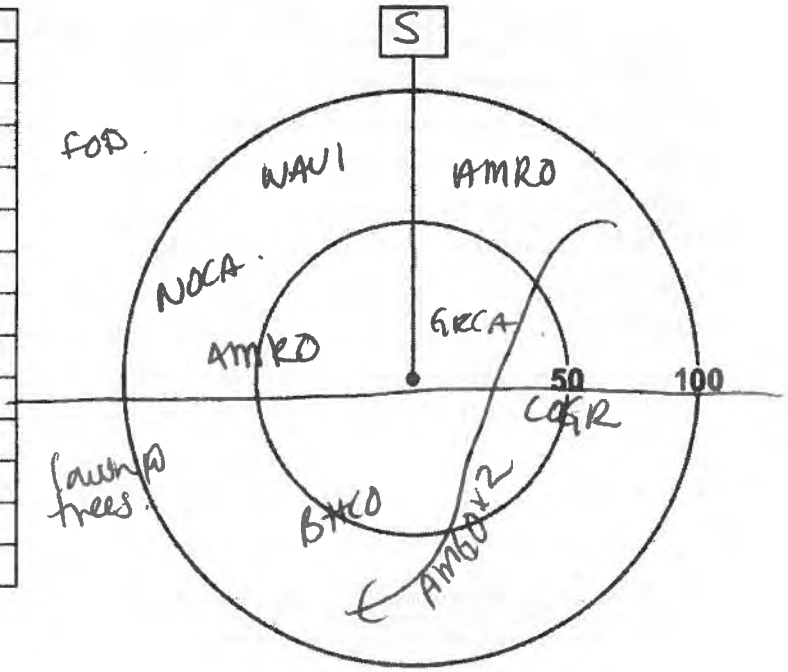
birascare guns

Station: 17 - Community Centre. Feature: ITT UTM: 0607028 4785448.

Start Time: 07:50 End Time: 07:55

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop
lawn.

Species	<50m	50-100m	>100m	Flyovers	Height*
NOCA.		1			
AMRO	1	1			
GRCA	1				
BHCO		1			
COGR	1				
WAVI		1			
AMGO				2.	



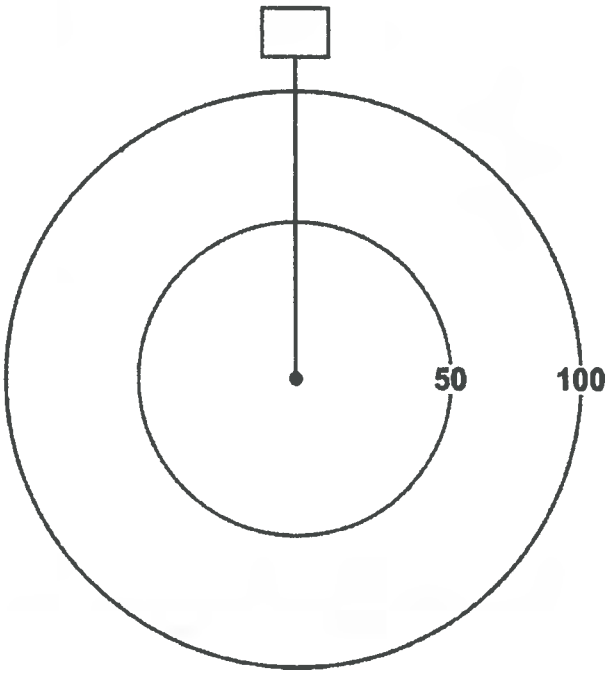
*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Station: Feature: UTM:

Start Time: End Time:

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*



*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Page ___ of ___

Quality Control: This form is complete ☐ & legible ☐.

Signature: _____ (Field Personnel)

Signature: _____ (Project Manager)

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, ON
Canada N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Stantec

Birding Point Counts Survey Observation Form

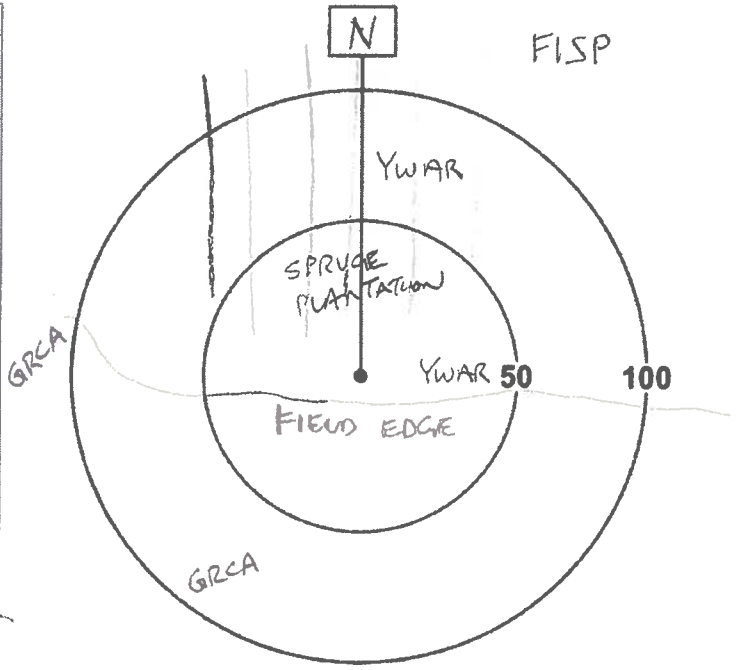
Project Number: 160950443
Project Name: Fruitland-Winona Secondary Plan Area
Date: JUNE 11 2012
Field Personnel: ~~D Graham~~, MICHAEL OLIVEIRA

Weather Conditions:	TEMP (°C):	WIND:	CLOUD:	PPT:	PPT (in last 24 hrs):
	17°C	0	20%	0	0

GPS #: T (PERSONAL GPS, MODEL: GARMIN 60CSX)

Station: 1
Feature: SPRUCE PLANTATION / FEARMAN SUCCESSION
UTM: 17T 0603665 4785945
Start Time: 5:26
End Time: 5:31
Habitat: ☑Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
YWAR	1	1			
GRCA		1	1		
FISP			1		



*Height of blade sweep varies from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Page ___ of ___

Signature: _____ (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

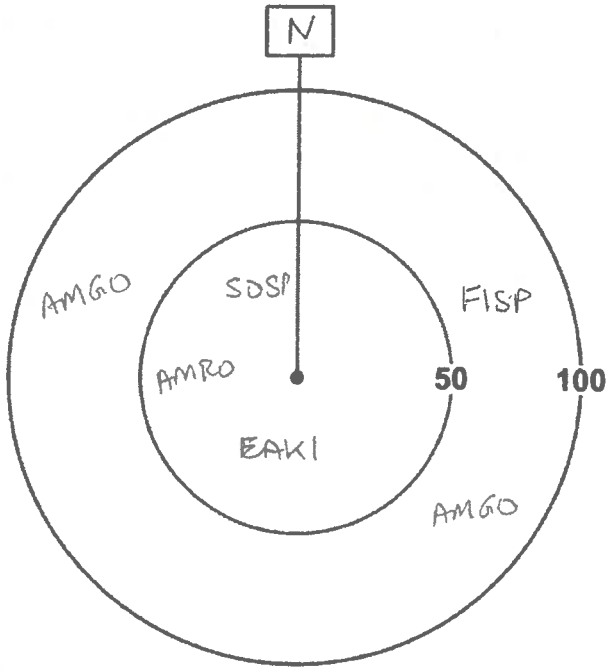
Signature: _____ (Project Manager)

Station: 2 **Feature:** SPRUCE PLANTATION / EARLY SUCCESSIONAL **UTM:** 17 T 0605685 4786087

Start Time: 0541 **End Time:** 05:46

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
EAKI	1				
AMRO	1				
AMGO		2			
SOSP	1				
FISP		1			



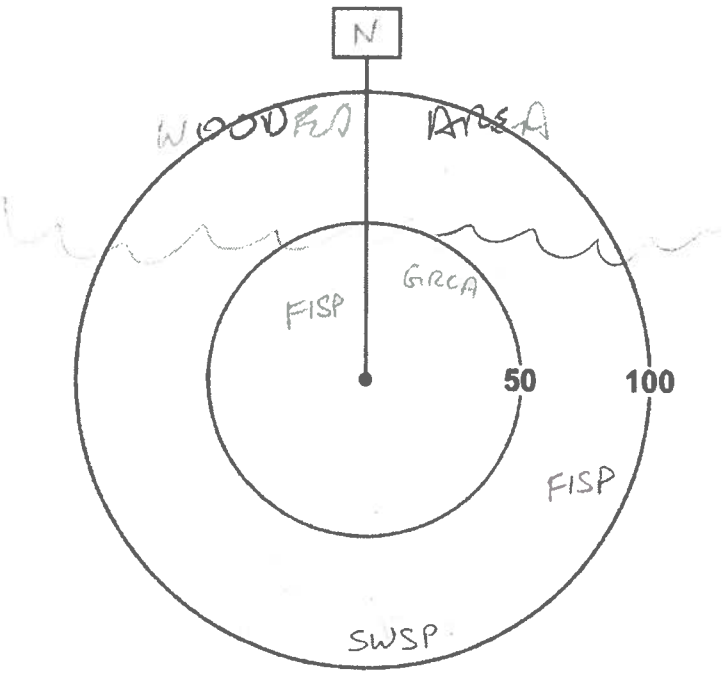
** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Station: 3 **Feature:** WOODED AREA / EARLY SUCCESSION **UTM:** 17 T 0605817 4786118

Start Time: 05:50 **End Time:** 05:55

Habitat: ☑Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
FISP	1	1			
GRCA	1				
SWSP		1			



** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Page ___ of ___

Signature: _____
(Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature: _____
(Project Manager)

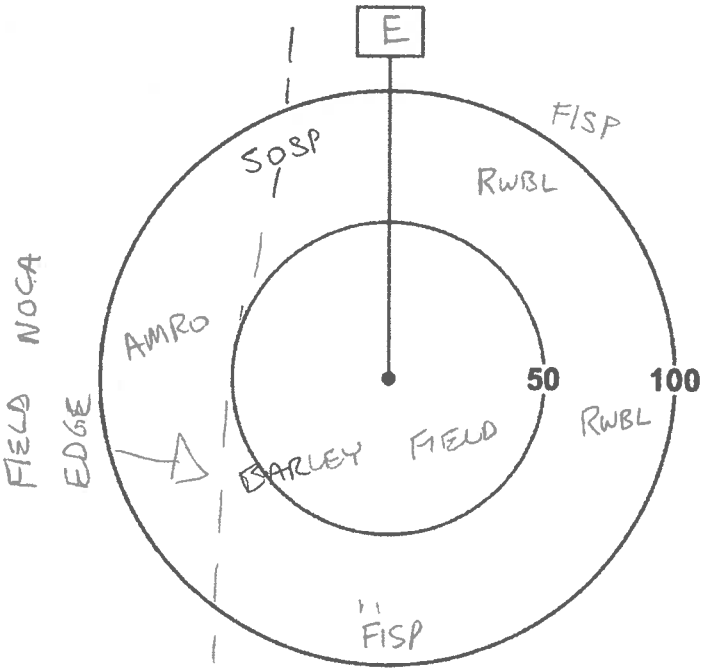
Station: 4 **Feature:** CROP FIELD **UTM:** 17 T 0606042 4786009

Start Time: 06:04 **End Time:** 06:09

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
SOSP		1			
AMRO		1			
FISP		1	1		
RWBL		2			

** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep



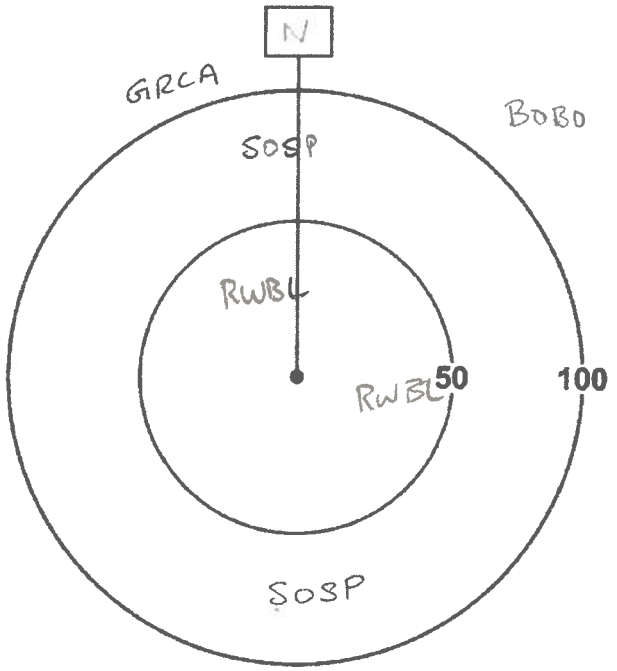
Station: 5 **Feature:** OPEN FIELD **UTM:** 17 T 0606012 4785706

Start Time: 06:17 **End Time:** 06:22

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☑Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
GRCA			1		
SOSP		2			
BOBO			1		
RWBL	2				

** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep



Page ___ of ___

Signature: _____
(Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature: _____
(Project Manager)

REV: 2011-05-04 / FORM 020

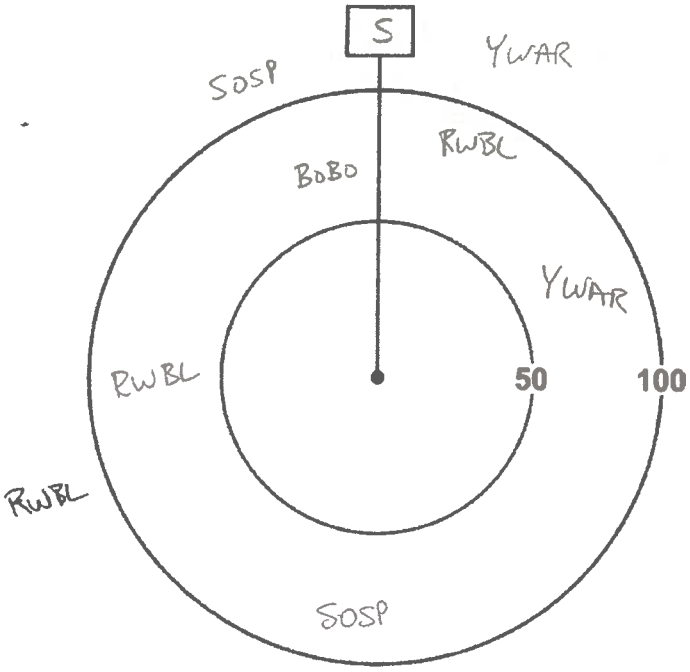
Station: 6 **Feature:** HAYFIELD **UTM:** 17T 0605709 4785872

Start Time: 06:54 **End Time:** 06:59

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☑Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
YWAR		1	1		
SOSP		1	1		
RWBL		2	1		
BOBO		1			

** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep



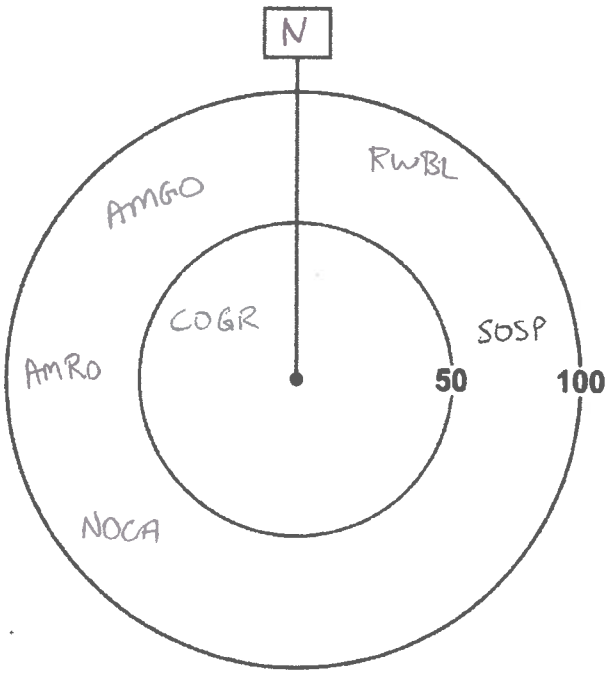
Station: 7 **Feature:** WOODLOT **UTM:** 17T 0605472 4785472

Start Time: 07:22 **End Time:** 07:27

Habitat: ☑Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
AMGO		1			
RWBL		1			
COGR	1				
SOSP		1			
NOCA		1			
AMRO		1			

** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep



Page ___ of ___

Signature: _____
(Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

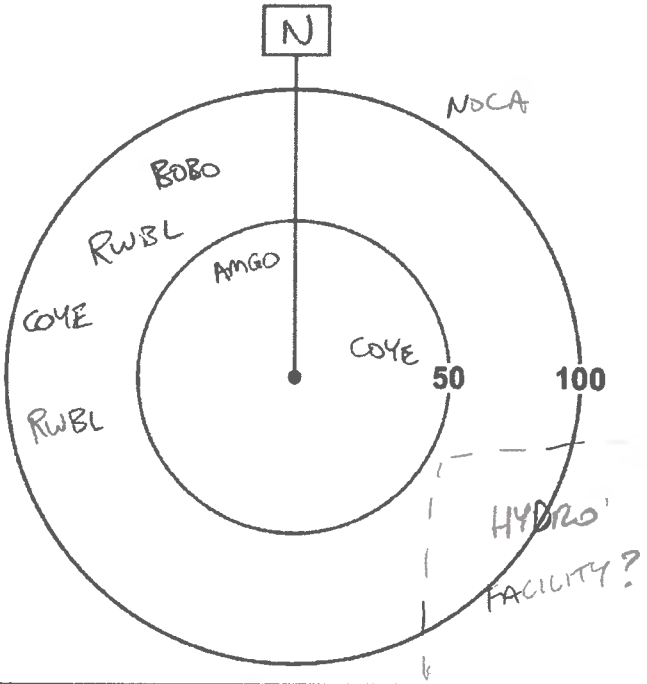
Signature: _____
(Project Manager)

Station: 8 Feature: ~~OPEN~~ FIELD / WETLAND MIX UTM: 17T 0605743 4785580

Start Time: 08:08 End Time: 08:13

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
NOCA			1		
BOBO		1			
RWBL					
COYE	1	1			
RWBL		2			
AMGO	1				



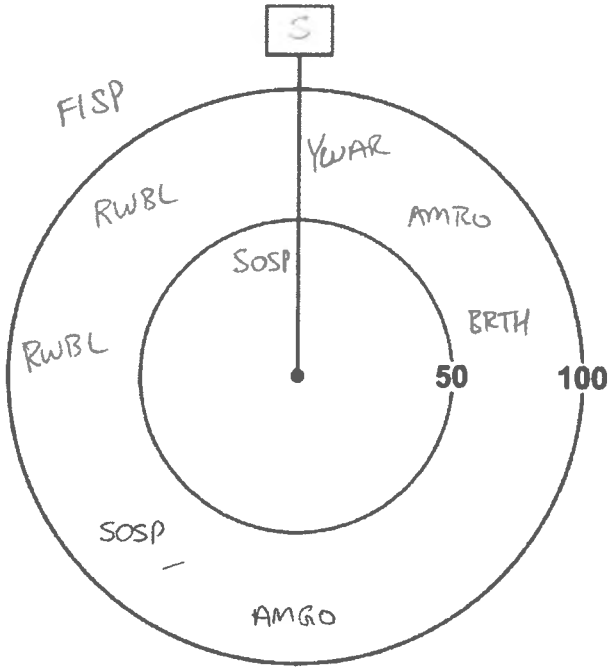
*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Station: 9 Feature: MOIST SCRUB / FIELD UTM: 17T 0605974 4785591

Start Time: 08:30 End Time: 08:35

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
FISP			1		
RWBL		2			
SOSP	1	1			
YWAR		1			
AMRO		1			
BRTH		1			
AMGO		1			



*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Page ___ of ___

Signature: _____ (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

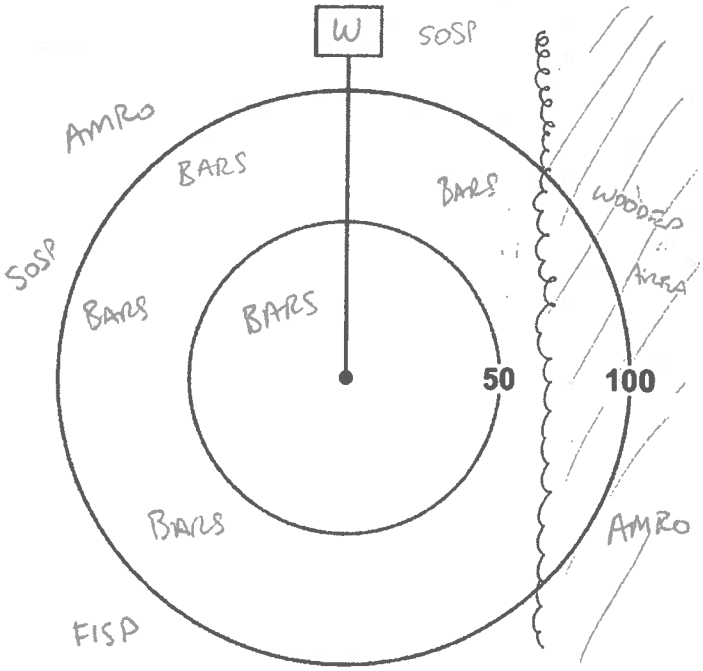
Signature: _____ (Project Manager)

Station: 10 Feature: WOODED AREA ADJACENT TO SOCCER FIELDS & BB ◇ UTM: 17T 0606501 4785428

Start Time: 09:13 End Time: 09:18

Habitat: ☑Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
BARS	1	4			
AMRO			1		
SOSP			2		
FISP			1		



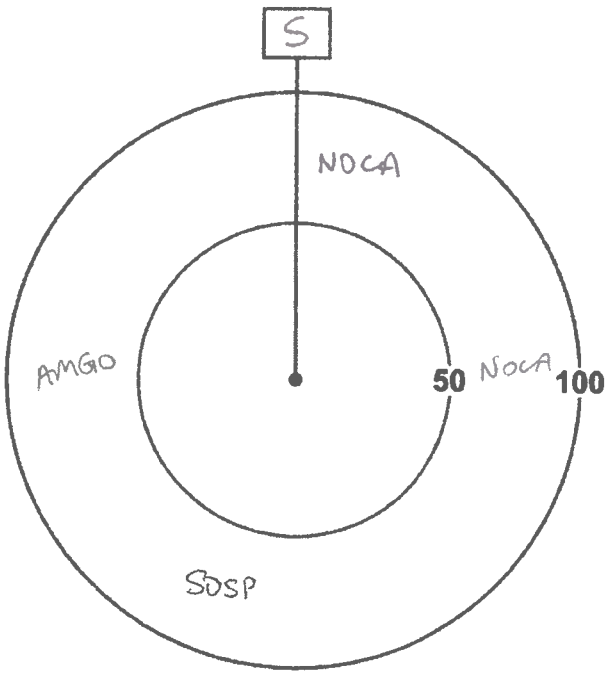
*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Station: 11 Feature: WOODLOT W SMALL CREEK UTM: 17T 0606387 4785485

Start Time: 09:26 End Time: 09:31

Habitat: ☑Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
NOCA		2			
AMGO		1			
SOSP		1			



*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Page ___ of ___

Signature: _____
(Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature: _____
(Project Manager)

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, ON
Canada N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Birding Point Counts Survey Observation Form

Project Number: 160950443 Project Name: Fruitland-Winona

Date: July 10, 2012 Field Personnel: D. Graham

Weather Conditions:	TEMP (°C):	WIND:	CLOUD:	PPT:	PPT (in last 24 hrs):
	17-24°C	1	10%	None	Light rain

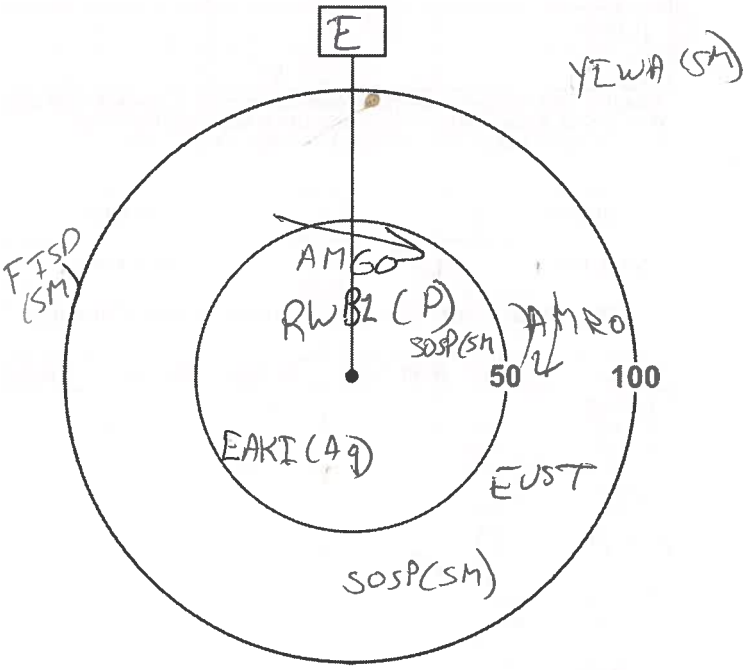
GPS #: T

Station: 1 Feature: UTM: 605665 4785945

Start Time: 5:30 End Time: 5:35

Habitat: ☑Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
RWBL	P				
EAKI	A				
AMGO	✓			✓	
SOSP	SM	SM			
EUST	✓				
AMRO		✓		✓	
YEWA			SM		
BASW	✓			✓	
FISP			SM		



** Height of blade sweep varies from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep

Page ___ of ___

Quality Control: This form is complete ☐ & legible ☐.

Signature: _____ (Field Personnel)

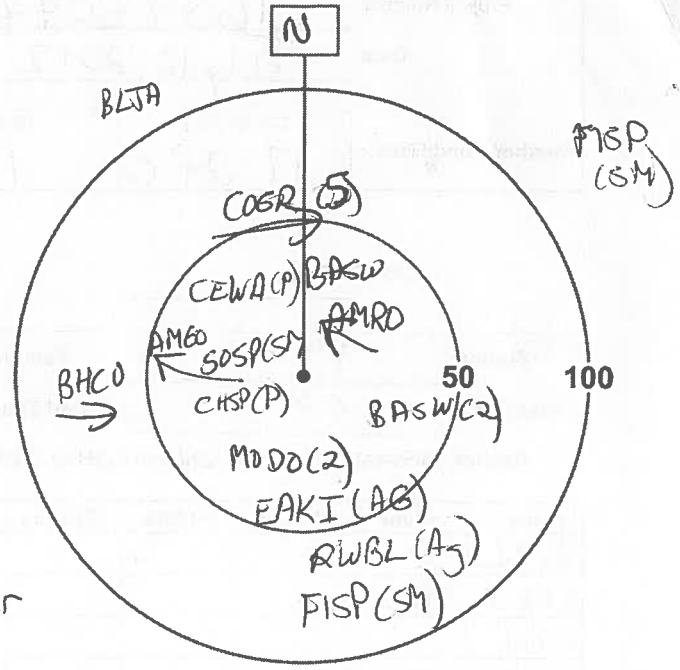
Signature: _____ (Project Manager)

Station: 2 Feature: UTM: 605685 4786087

Start Time: 5:40 End Time: 5:45

Habitat: ☑Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
COGR	✓			✓	
CEWA	P				
BASW	✓			✓	
AMRO	✓			✓	
AMGO	✓			✓	
SOSP	SM				
CHSP	P				
MODO	P				
EAKT	AG				
RWBL	~~Ag~~	Ag			
FISP		SM			
BHCO		✓		✓	
BLJA			✓		



Deer

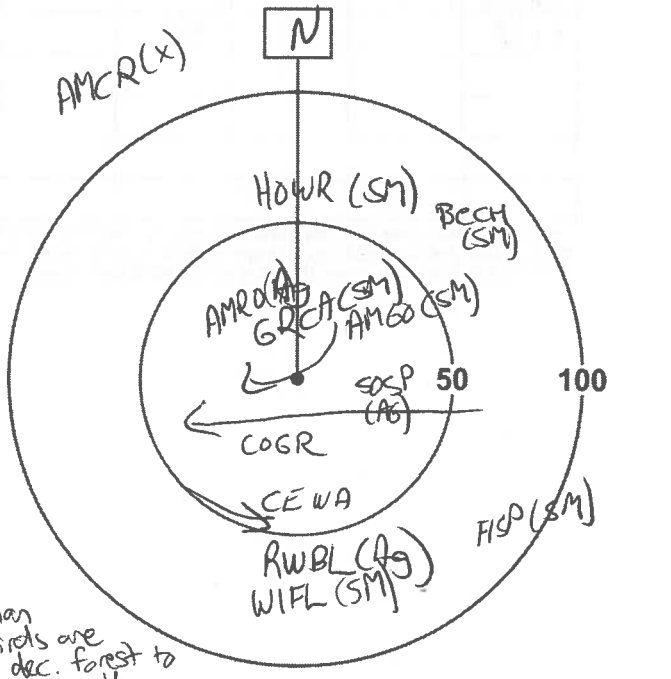
* *Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep

Station: 3 Feature: UTM: 605817 4786118

Start Time: 6:00 End Time: 6:05

Habitat: ☑Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
AMCR			✓		
HOWR	✓SM				
AMRO	Ag				
GRCA	SM				
AMGO	SM				
SOSP	Ag				
COGR	✓			✓	
BCCH		SM			
CEWA	✓			✓	
RWBL		Ag			
WIFL		SM			
FISP		SM			



* *Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep

Other than housewrens robins, birds are avoiding dec. forest to north

Page ___ of ___

Quality Control: This form is complete ☐ & legible ☐.

Signature: _____ (Field Personnel)

Signature: _____ (Project Manager)

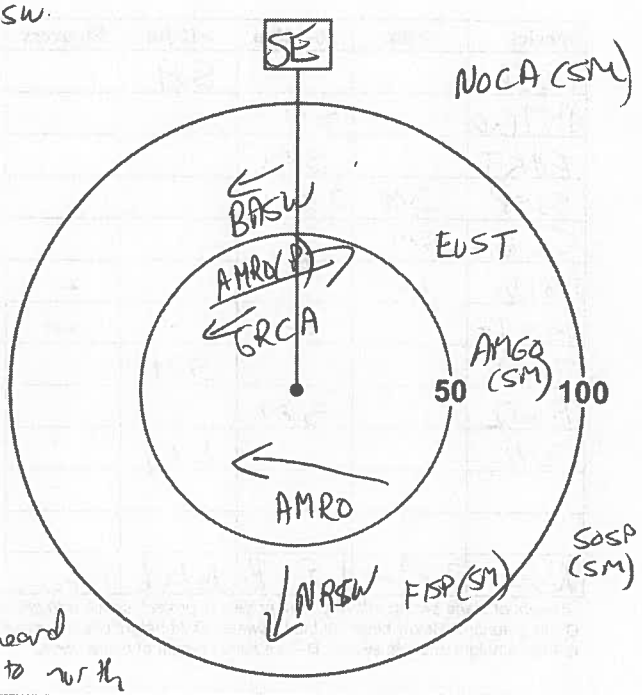
REV: 2011-05-04 / FORM 020

Station: 4 Feature: C UTM: 606042 4786009

Start Time: 6[15] End Time: 6[20]

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☑Crop grain. to SW.

Species	<50m	50-100m	>100m	Flyovers	Height*
BASW		✓		✓	
NOCA			SM		
EUST		✓			
AMRO	✓	1P		✓	
GRCA	✓			✓	
AMGO		SM			
NRSW		✓			
FISP		SM			
SOSP			SM		
No bobolinks or meadowlarks					



* Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

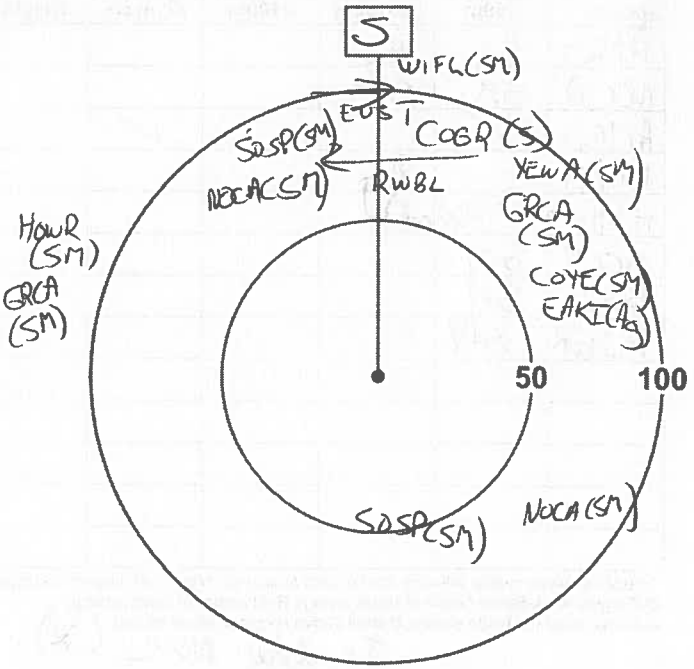
Treefrog heard in forest to north

Station: 5 Feature: UTM: 606012 4785872

Start Time: 6[20] End Time: 6[35]

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☑Crop Cultural meadow

Species	<50m	50-100m	>100m	Flyovers	Height*
WIFL			SM		
EUST		✓		✓	
COGR		✓		✓	
SOSP	SM	SM			
NOCA		2 SM			
RWBL		✓			
YEWA		SM			
GRCA		SM	SM		
COYE		SM			
EAKI		Ag			
HOWR		?	SM		



* Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Page ___ of ___

Quality Control: This form is complete ☐ & legible ☐.

Signature: _____ (Field Personnel)

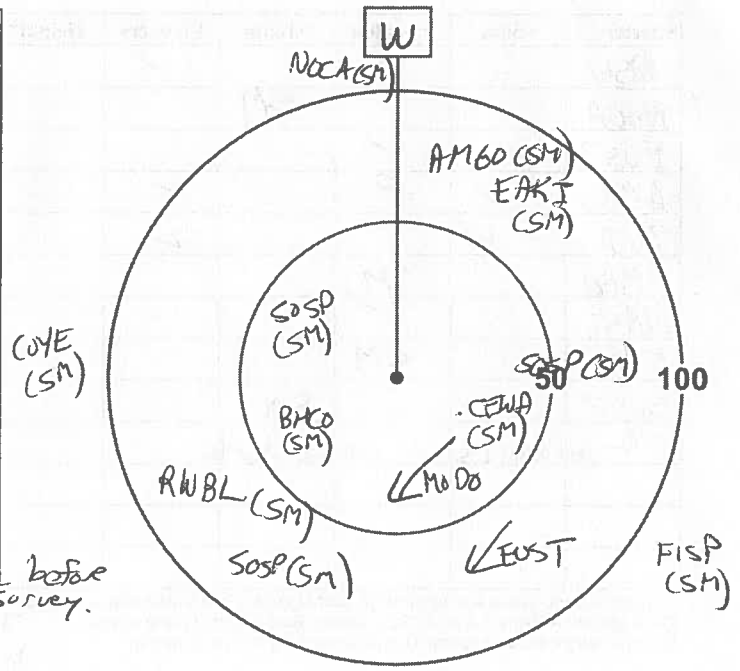
Signature: _____ (Project Manager)

Station: 6 Feature: UTM: 605709 4785872

Start Time: 6^45 End Time: 6^50

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop CUM

Species	<50m	50-100m	>100m	Flyovers	Height*
NOCA			SM		
AMGO		SM			
EAKI		SM			
SOSP	SM	2SM			
CEWA	SM				
MODO	✓			✓	
EUST		✓		✓	
FISP			SM		
RWBL		SM			
COYE			SM		
Note: 2♂ a 1♀ B. bolink flew over me before Survey.					



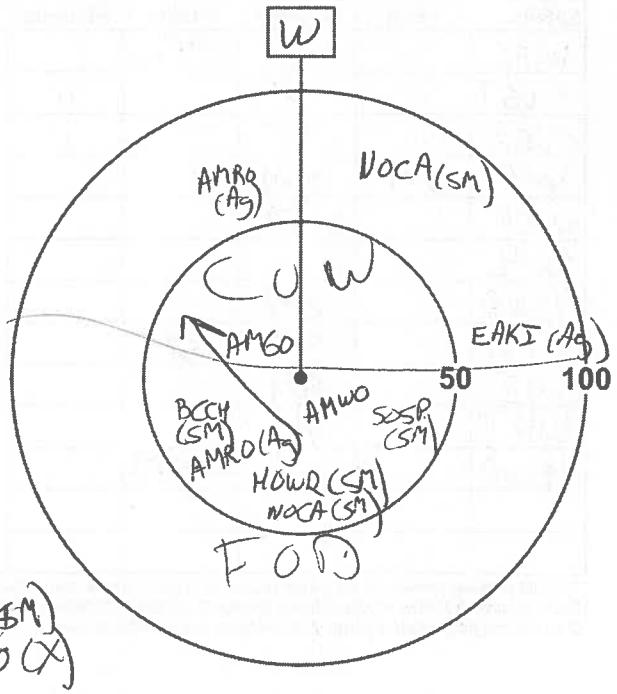
*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Station: 7 Feature: UTM: 605472 4785472

Start Time: 7^15 End Time: 7^20

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
AMRO	Ag	Ag			
NOCA	SM	SM			
AMGO	✓			✓	
EAKI		Ag			
AMWO	✓ (Flushed)				
BCCH	SM				
SOSP	SM				
HOWR	SM				



*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Incidental: NOFL (X), WAVI (SM) DOWO (X)

Page ___ of ___

Quality Control: This form is complete ❑ & legible ❑.

Signature: _____ (Field Personnel)

Signature: _____ (Project Manager)

REV: 2011-05-04 / FORM 020

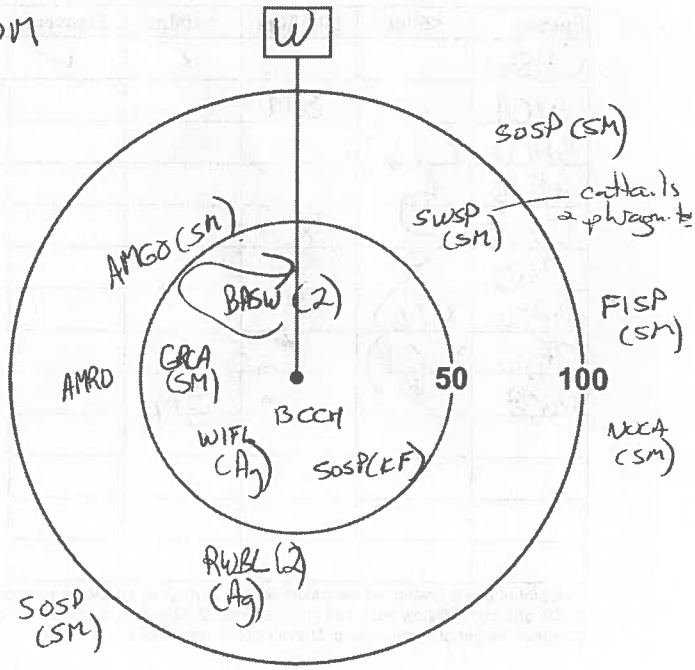
Station: 8 **Feature:** **UTM:** 605743 4785580

Start Time: 8⁰⁰ **End Time:** 8⁰⁵

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
SoSP	CF		SM(2)		
SWSP		SM			
FISP			SM		
NoCA			SM		
BCCH	X				
WIFL	Ag				
GRCA	SM				
AMGO		SM			
AMRO	V				
RWBL		Ag(2)			

CUM



** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep

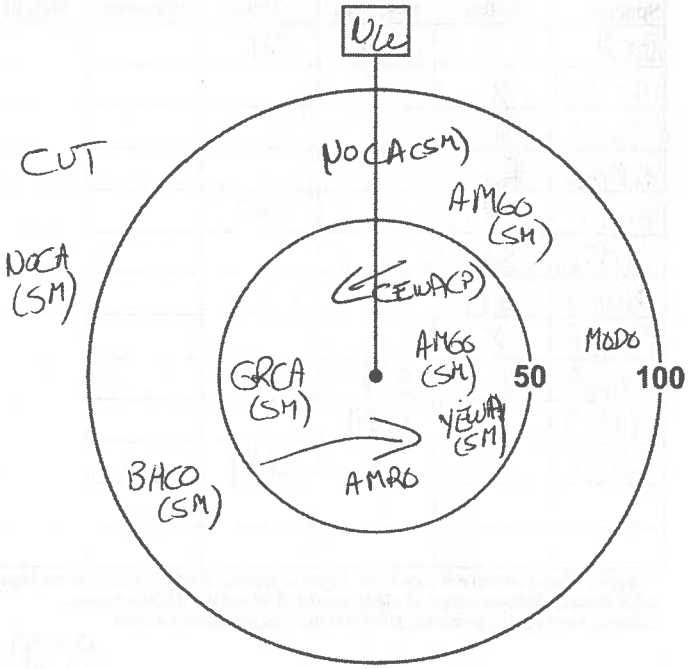
Station: 9 **Feature:** **UTM:** 605974 4785591

Start Time: 7⁴⁰ **End Time:** 7⁴⁶

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
NoCA		SM	SM		
AMGO	SM	SM			
CEWA	P				
MODO		X			
YEWA	SM				
AMRO	X				
GRCA	SM				
BHCO		SM			

CUT



** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep

Page ___ of ___

Signature: _____
(Field Personnel)

Quality Control: This form is complete ❑ & legible ❑.

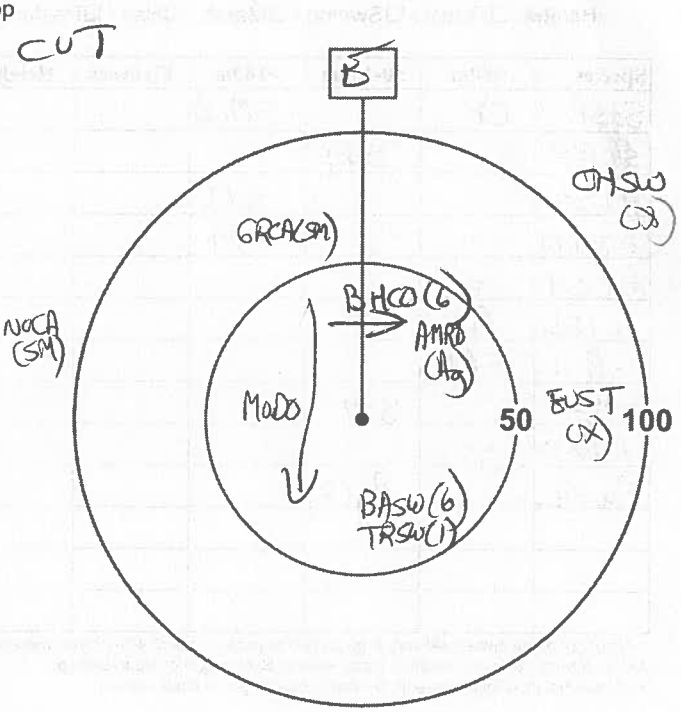
Signature: _____
(Project Manager)

Station: 10 Feature: UTM: 606591 4785428

Start Time: 8:34 End Time: 8:39

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
CHSW			X	✓	
GRCA		SM			
BHCO	P (6)				
AMRO	Ag				
EUST		X			
MODO	X				
BASW	X (6)				
TRSW	X (1)				
NOCA			SM		



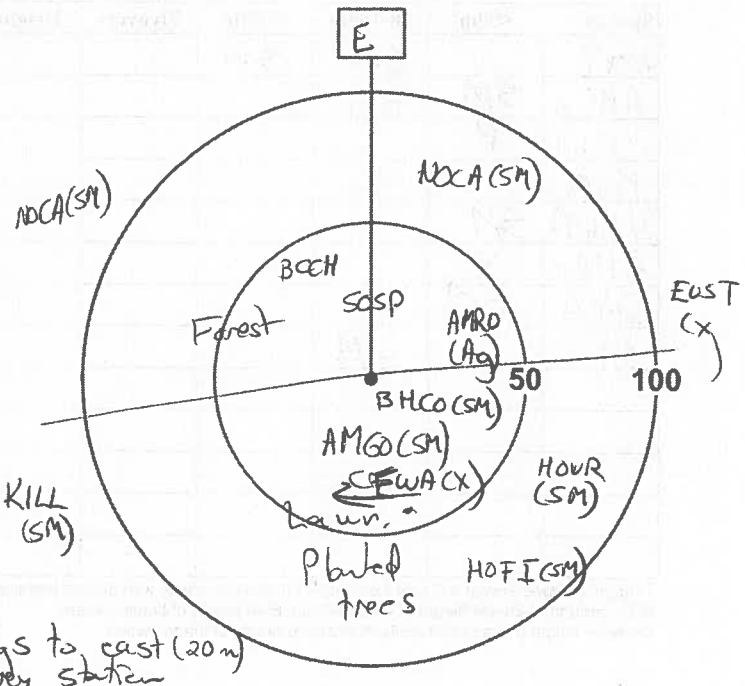
* *Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep

Station: 11 Feature: UTM: 606387 4785485

Start Time: 8:45 End Time:

Habitat: ☑Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
NOCA		SM	SM		
BCCH	X				
SOSP	X				
AMRO	Ag				
EUST			X		
AMGO	SM				
BHCO	SM				
CEWA	X				
HOWR		SM			
HOFI		SM			
KILL			SM		



* *Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep

green frogs to east (20 m) of survey station

Page ___ of ___

Quality Control: This form is complete ☐ & legible ☐.

Signature: _____ (Field Personnel)

Signature: _____ (Project Manager)

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, ON
Canada N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Birding Point Counts Survey Observation Form

Project Number: _____ Project Name: _____

Date: July 10, 2012 Field Personnel: _____

Weather Conditions:	TEMP (°C):	WIND:	CLOUD:	PPT:	PPT (in last 24 hrs):

GPS #: T _____

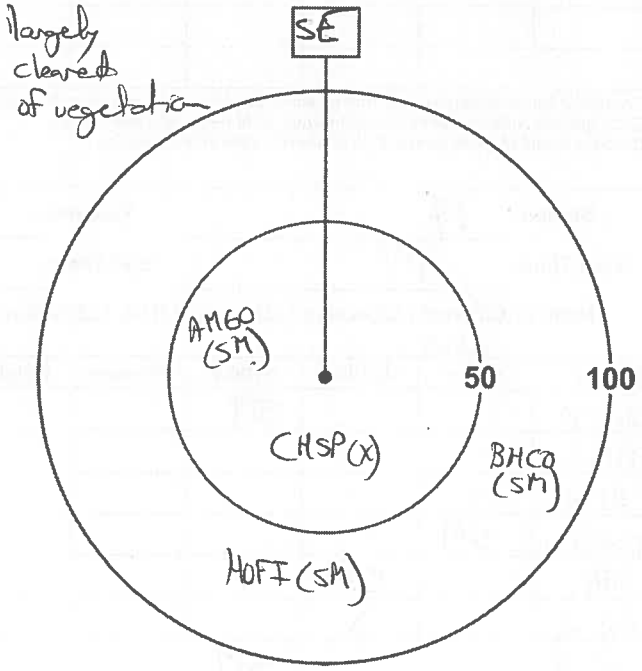
Station: 12 Feature: _____ UTM: 605692 4786278

Start Time: 855 End Time: 900

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
AMGO	SM				
CHSP	X				
BHCO		SM			
HOFI		SM			

** Height of blade sweep varies from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep



Page ___ of ___

Quality Control: This form is complete ❑ & legible ❑.

Signature: _____ **Signature:** _____

(Field Personnel) (Project Manager)

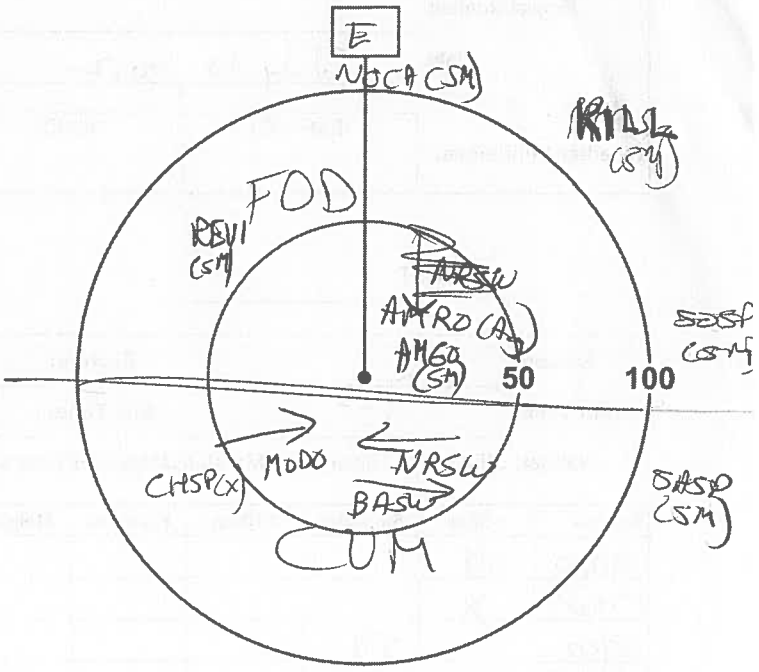
REV: 2011-05-04 / FORM 020

Station: 13 Feature: UTM: 606896 4785741

Start Time: 925 End Time: 930

Habitat: ☑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop CUM

Species	<50m	50-100m	>100m	Flyovers	Height*
NOCA			SM		
KILL			SM		
REVI		SM			
AMRO	Ag				
AMGO	SM				
SOSP			SM		
CHSP		X			
NRSW	✓			✓	
BASW	✓			✓	
SASP			SM		
MODO	✓			✓	



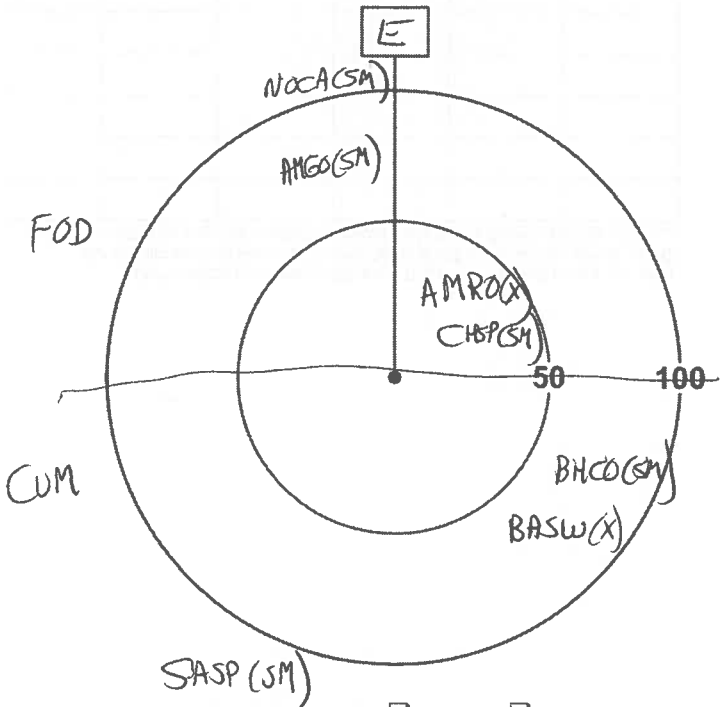
*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep

Station: 14 Feature: UTM: 606866 4785638

Start Time: 935 End Time: 940

Habitat: ☑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop CUM

Species	<50m	50-100m	>100m	Flyovers	Height*
NOCA			SM		
AMGO		SM			
AMRO	X				
CHSP	SM				
BHCO		SM			
BASW		X			
SASP			SM		



*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep

Page ___ of ___

Quality Control: This form is complete ❑ & legible ❑.

Signature: _____ (Field Personnel)

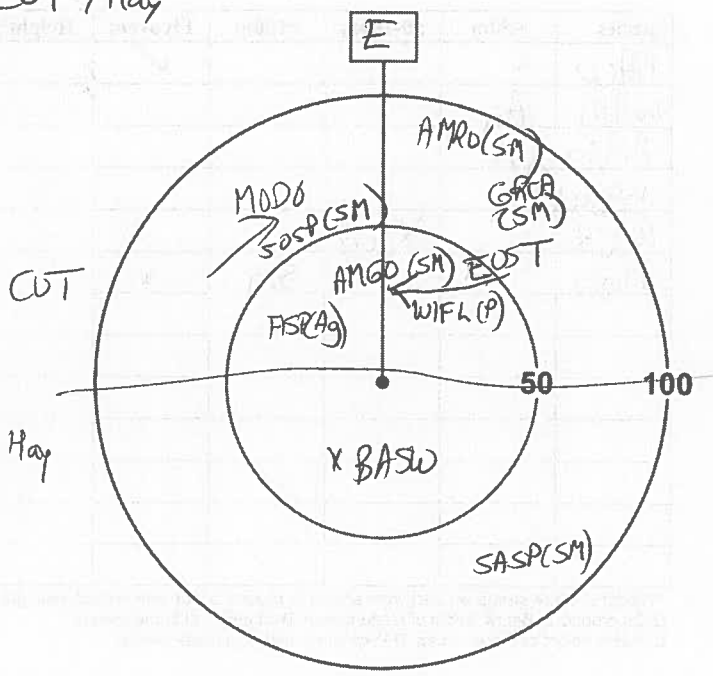
Signature: _____ (Project Manager)

Station: 15 Feature: UTM: 606832 4785515

Start Time: 945 End Time: 950

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop CUT / Hay

Species	<50m	50-100m	>100m	Flyovers	Height*
AMRO		SM			
GRCA		SM			
MODO		X			
SOSP		SM			
AMGO	SM				
EAST	X				
WIFL	P				
FISP	Ag				
SASP		SM			
BASW	X				



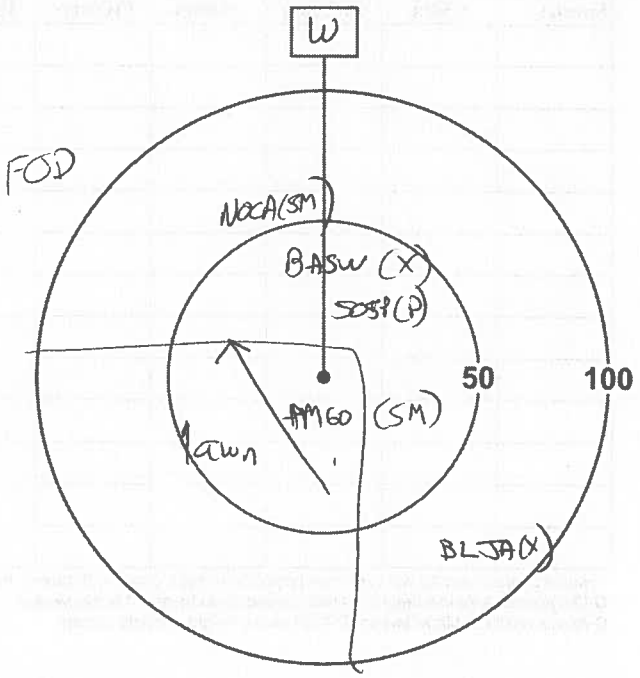
*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Station: 16 Feature: UTM: 606992 4785671

Start Time: 1005 End Time: 1013

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
NOCA		SM			
BASW	X			✓	
SOSP	P				
AMGO	SM			✓	
BLJA		X			



*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Page ___ of ___

Quality Control: This form is complete ❑ & legible ❑.

Signature: _____ (Field Personnel)

Signature: _____ (Project Manager)

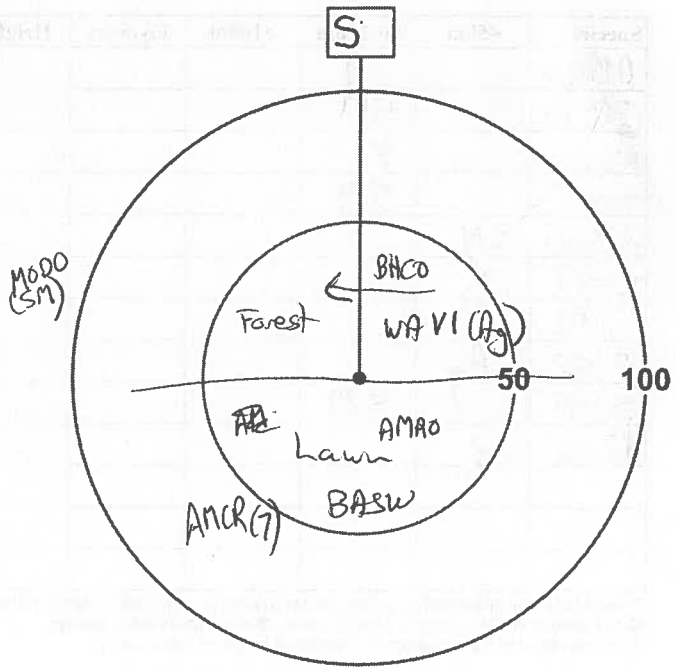
REV: 2011-05-04 / FORM 020

Station: 17 **Feature:** **UTM:** 607628 4785448

Start Time: 10¹⁵ **End Time:** 10²⁰

Habitat: ☑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
BHCO	✓			✓	
WAVI	Ag				
AMRO	X				
BASW	X				
AMCR		X (7)			
MODO			SM		



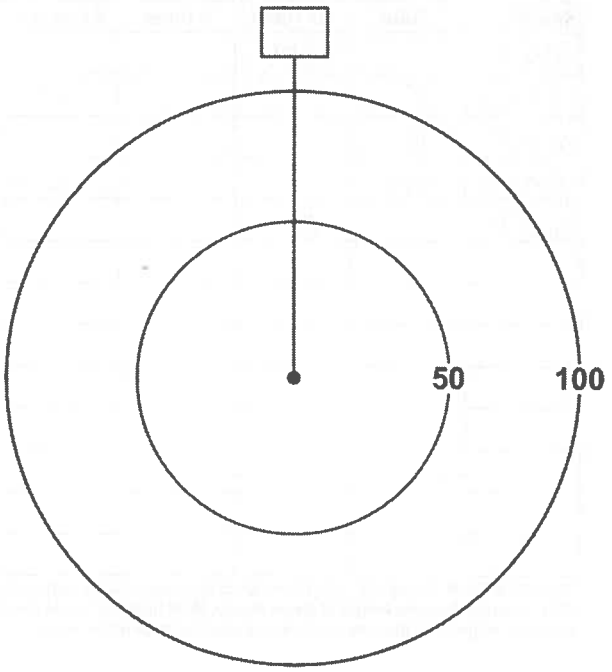
** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep

Station: **Feature:** **UTM:**

Start Time: **End Time:**

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*



** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep

Page ___ of ___

Quality Control: This form is complete ❑ & legible ❑.

Signature: _____ (Field Personnel)

Signature: _____ (Project Manager)

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, ON
Canada N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Birding Point Counts Survey Observation Form

Project Number: 60950443 Project Name: Hamilton - Fruitland

Date: June 25, 2012 05.30 – Field Personnel: N. Koprysk

Weather Conditions:	TEMP (°C):	WIND:	CLOUD:	PPT:	PPT (in last 24 hrs):
	16°T 20°	2-3 (incr. to 4 by 9.45)	10%	Ø	rain

GPS #: T

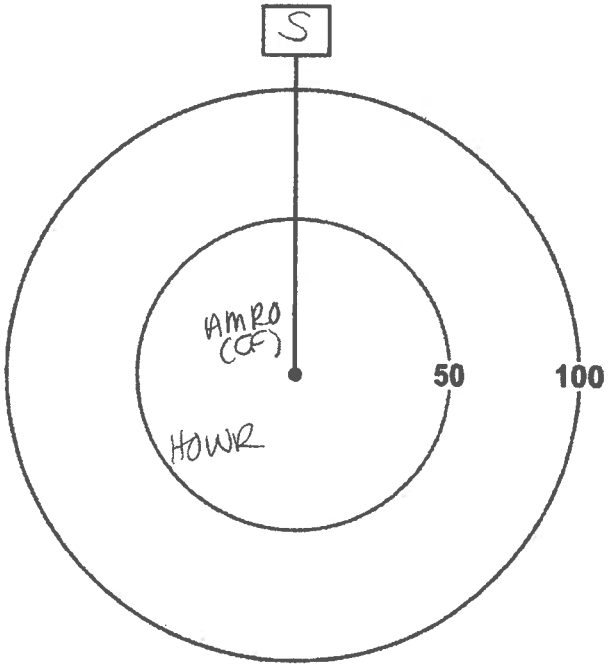
Station: 12 Feature: UTM: 17T

Start Time: 05 30 End Time: 05 35 0605692 4786278

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
AMCR	1				
HOWR	1				

** Height of blade sweep varies from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep



Signature: (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature: (Project Manager)

REV: 2011-05-04 / FORM 020

als w:\resource\internal info and teams\field forms\birds\breeding bird\form_020_bird-point-counts-survey_2-sided.docx

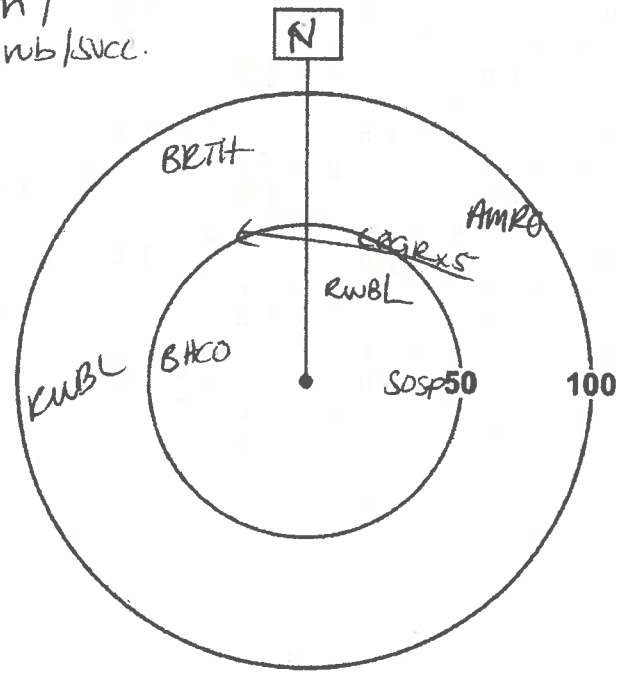
Station: 2 **Feature:** **UTM:** See Round 1

Start Time: 05:58 **End Time:** 06:03

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
BRTH		1			
BHCO	1				
RWBL	1	1			
COGR				5	
AMRO		1			
SOSP	1				

corn / shrub/succ.



** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

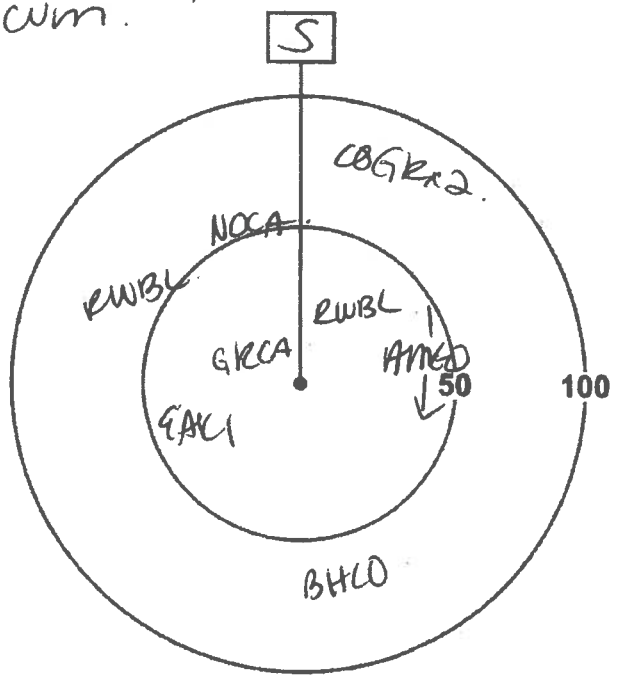
Station: 1 **Feature:** **UTM:** See round 1

Start Time: 07:15 **End Time:** 07:20

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
COGR		2			
NOCA		1			
RWBL	1	1			
GRCA	1				
GACI	1				
AMGO				1	
BHCO		1			

shrub/succ. / corn.



** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Page ___ of ___

Signature: _____
(Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature: _____
(Project Manager)

Station: 5 Feature: UTM: see round 1

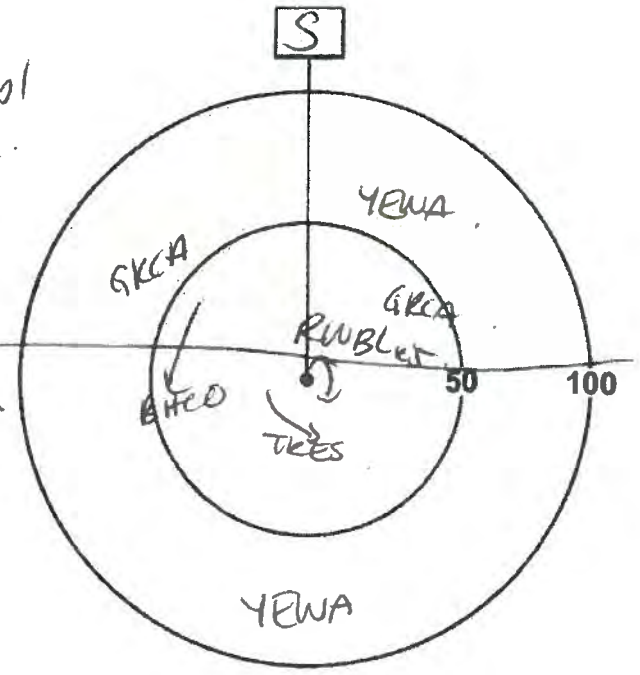
Start Time: 06:35 End Time: 06:40 -NO BARS

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
GRCA	1	1			
YEWA		2			
BHCO	1				
RWBL	5				
TRES				1	

shrubs/ succ.

cum.



*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Station: 6 Feature: UTM: see Round 1

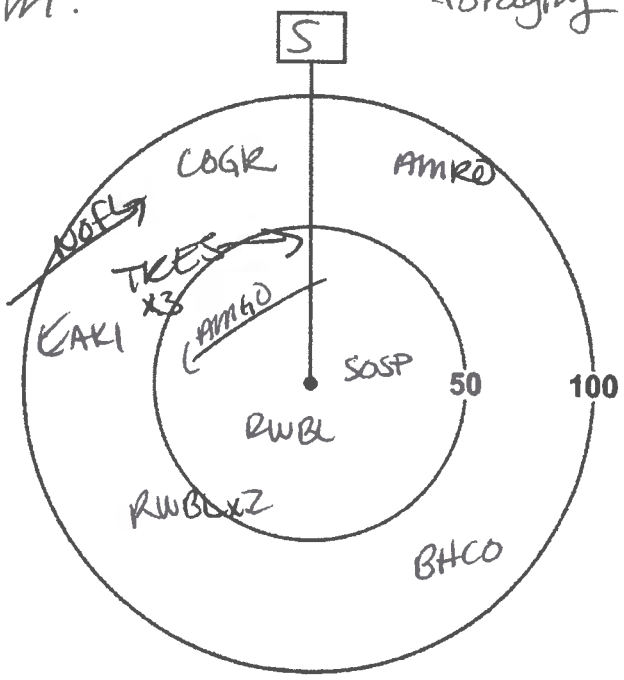
Start Time: 06:55 End Time: 07:00

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

+ 4 BARS foraging.

cum.

Species	<50m	50-100m	>100m	Flyovers	Height*
COGR		1			
AMRO		1			
TRES				3	
AMGO				1	
SOSP	1				
RWBL	1	2			
BHCO		1			
EAKI		1			
NOFL				1	



*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Signature: (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐

Signature: (Project Manager)

Station: 3 **Feature:** **UTM:**

Start Time: 06:09 **End Time:** 06:14

Habitat: ☑Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

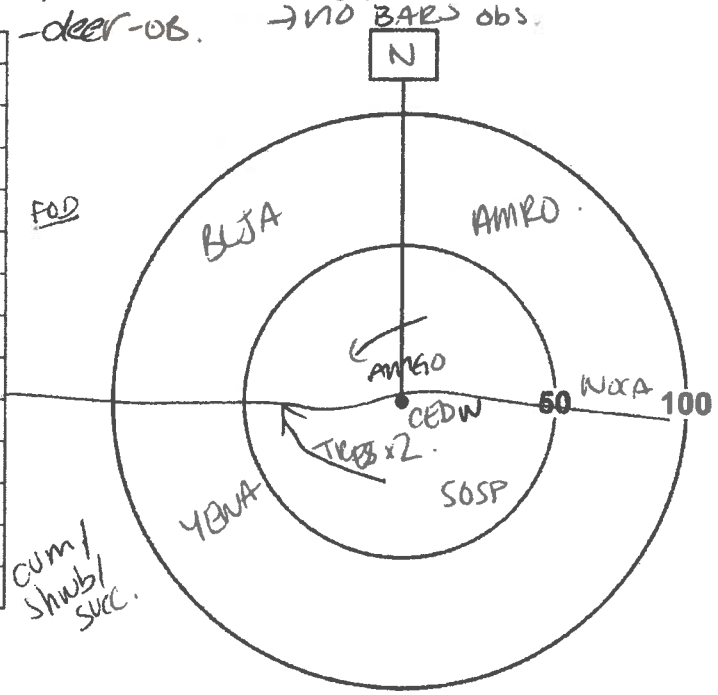
cum

→ no BOBO/same habitat
→ no BARS obs.

-deer-OB.

Species	<50m	50-100m	>100m	Flyovers	Height*
BLJA		1			
AMRO		1			
AMGO				1	
CEDW	1				
TRES				2	
YBNA		1			
SOSP	1				
NOCA		1			

FOD



cum/ shrub/ succ.

** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Station: 4 **Feature:** **UTM:**

Start Time: 06:19 **End Time:** 06:24

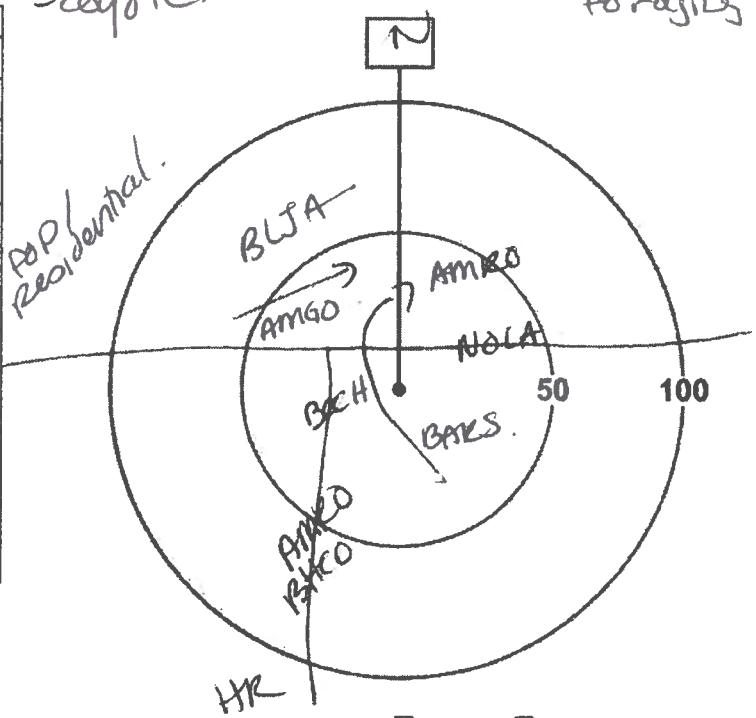
Habitat: ☑Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☑Crop

-coyote.

*BARS x2. fo raptls

Species	<50m	50-100m	>100m	Flyovers	Height*
BLJA		1			
AMGO				1	
AMRO	2				
NOCA	1				
BCCH	1				
BARS				2	
BHCO		1			

POP/ residential.



** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Page ___ of ___

Signature: _____
(Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

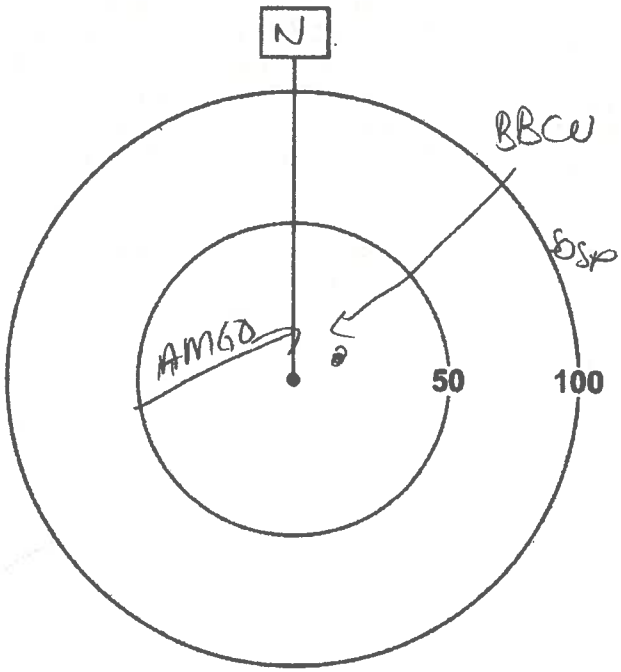
Signature: _____
(Project Manager)

Station: 7 Feature: UTM:

Start Time: 07:35 End Time: 07:40

Habitat: ☑Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
AMGO				1	
BBCU	1				
SOSP				1	



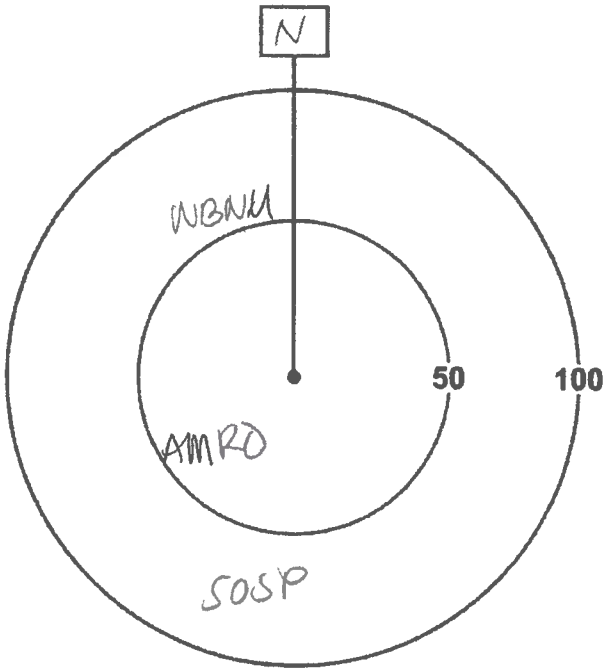
*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Station: 11 Feature: UTM:

Start Time: 08:04 End Time: 08:09

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
WBNU		1			
AMRO	1				
SOSP		1			



*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Signature: (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

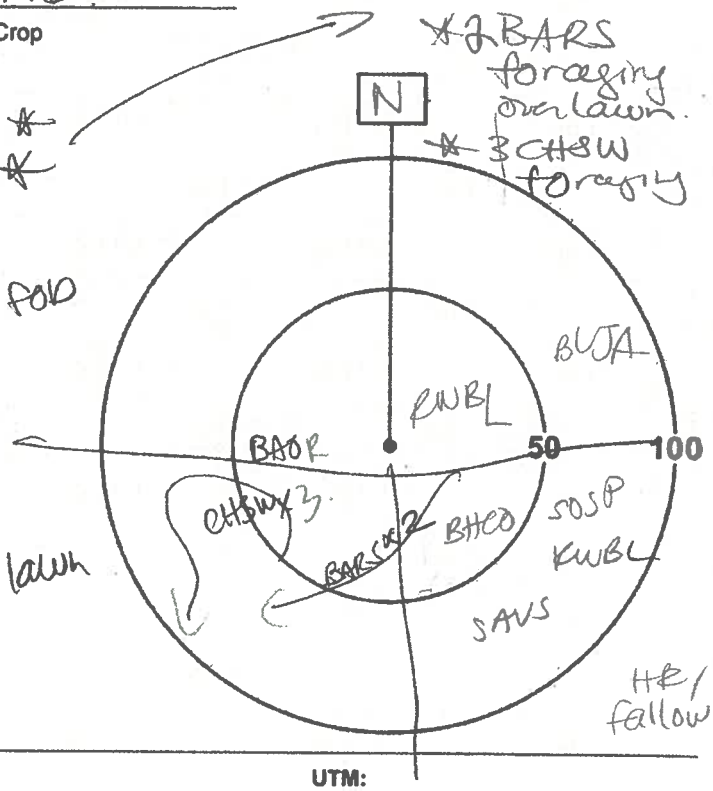
Signature: (Project Manager)

Station: 10 **Feature:** **UTM:**

Start Time: 08:11 **End Time:** 08:16

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop / lawn

Species	<50m	50-100m	>100m	Flyovers	Height*
BARS				2	
CHSW				3	
BAOR	1				
RWBL	1	1			
BHCO	1				
SOSP		1			
SAVS		1			
BLJA		1			



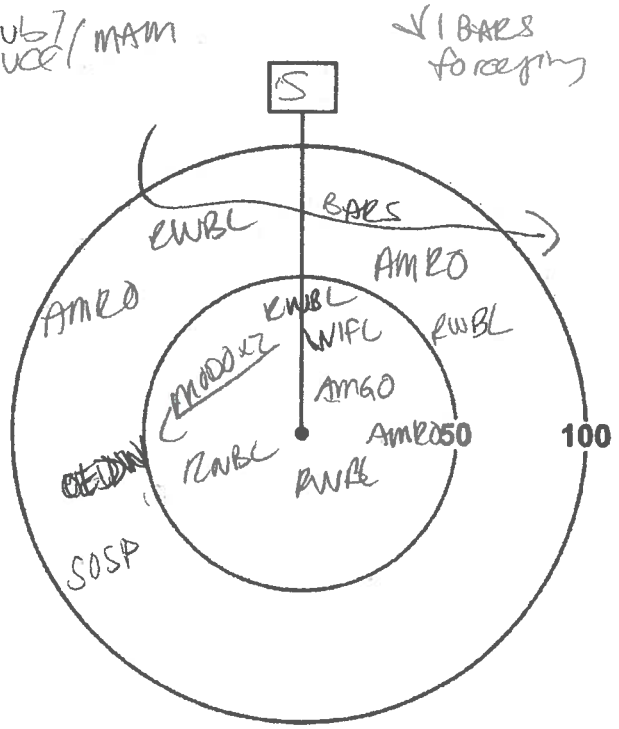
** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Station: 9 **Feature:** **UTM:**

Start Time: 08:30 **End Time:** 08:35

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop shrub/ succ/ MAM

Species	<50m	50-100m	>100m	Flyovers	Height*
BARS				1	
AMRO	1	2			
MODO				2	
AMGO	1				
RWBL	3	2			
WIFL	1				
SOSP		1			



** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Page ___ of ___

Signature: _____
(Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

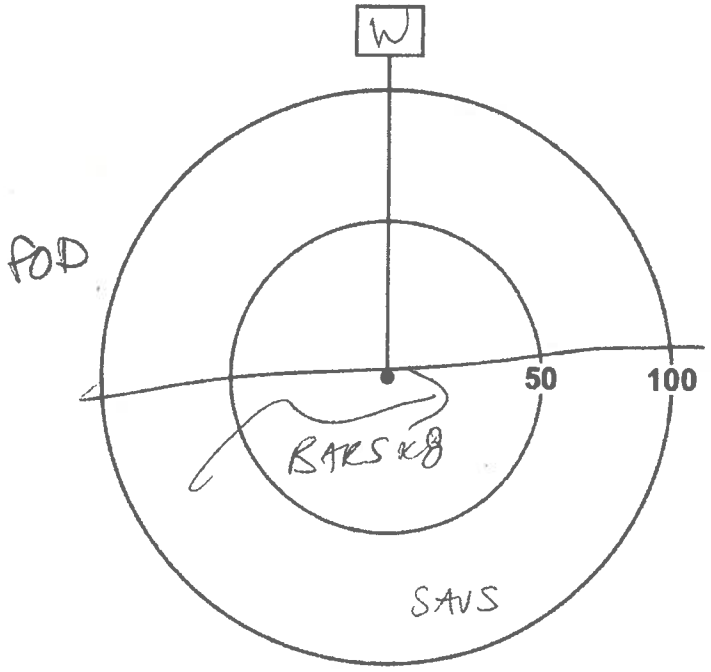
Signature: _____
(Project Manager)

Station: 14 Feature: UTM:

Start Time: 09:37 End Time: 09:42

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
BARS				8	
SAVS		1			



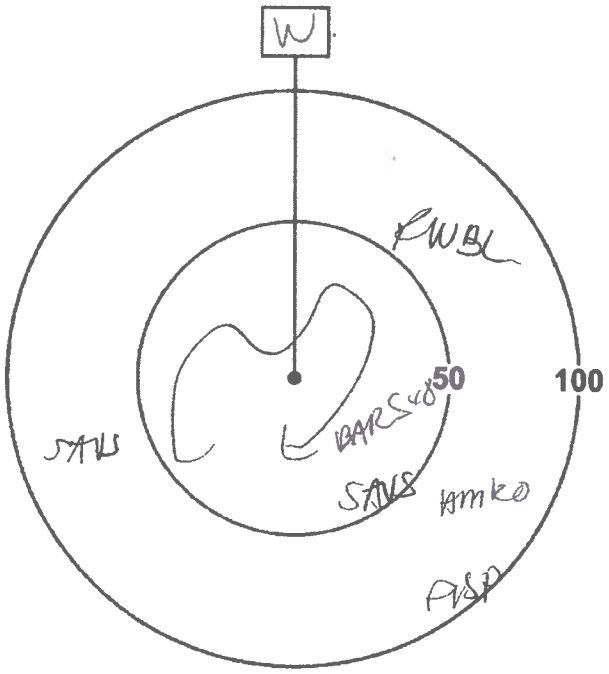
*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Station: 15 Feature: UTM:

Start Time: 09.45 End Time: 09:50

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
BARS				8	
SAV	1	1			
FISP		1			
AMKO		1			
RWBL		1			



*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Signature: (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

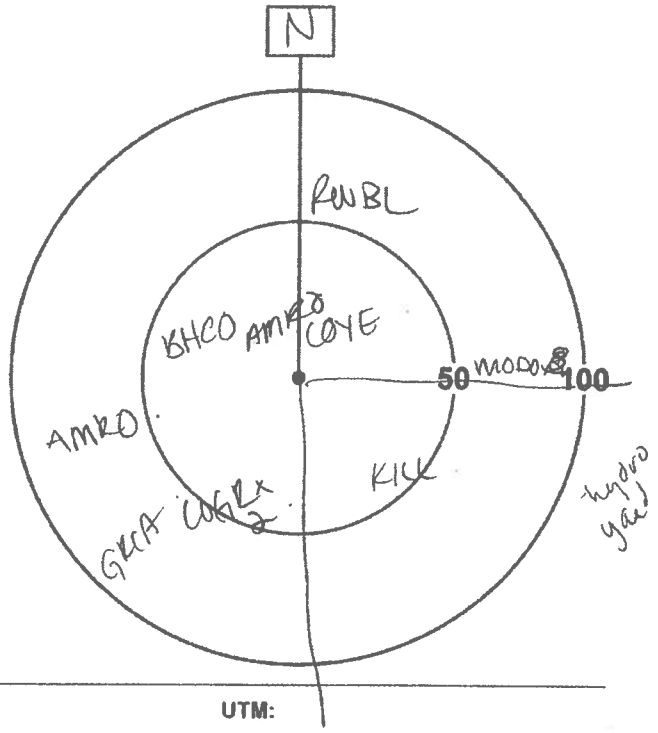
Signature: (Project Manager)

Station: 8 **Feature:** **UTM:** 0605757 / 4785545

Start Time: 09:05 **End Time:** 09:10

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
RWBL		1			
BHCO	1				
AMRO	1	1			
COYE	1				
MODO			8		
KILL	1				
GRCA		1			
COGR	2				



** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

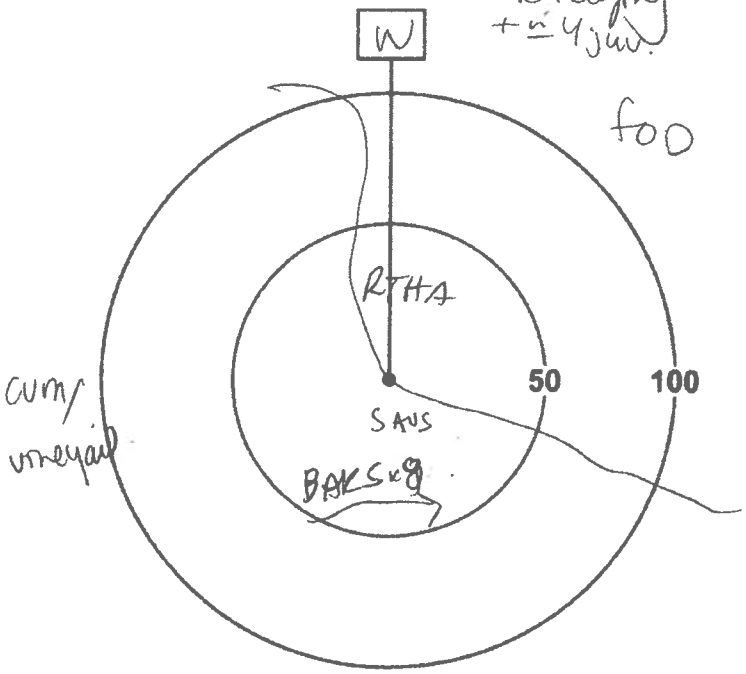
Station: 13 **Feature:** **UTM:**

Start Time: 09:30 **End Time:** 09:35

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop
corn

Species	<50m	50-100m	>100m	Flyovers	Height*
RTHA	1				
BARS				8	
SAVS	1				

* 4 adult BARS foraging +/- 4 juv.



** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Page ___ of ___

Quality Control: This form is complete ☐ & legible ☐.

Signature: _____ (Field Personnel)

Signature: _____ (Project Manager)

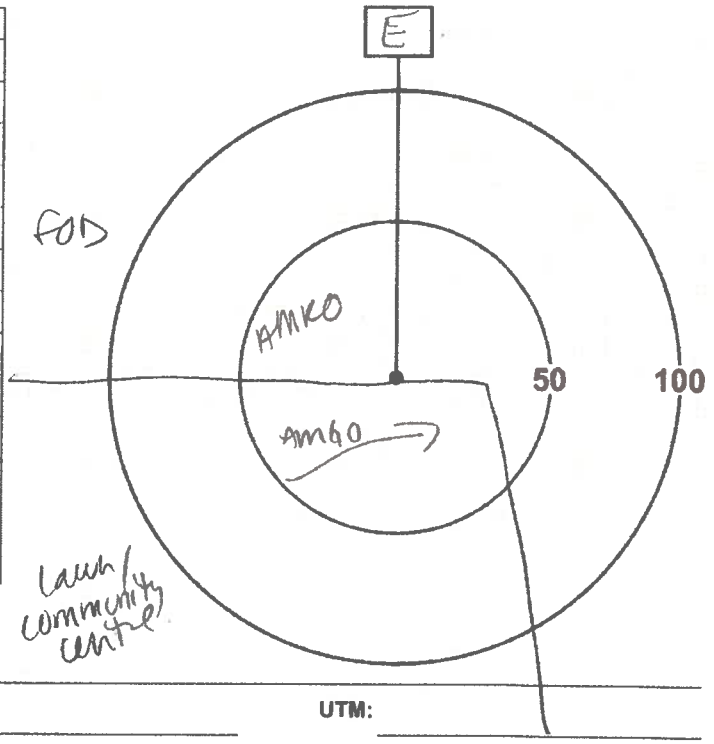
REV: 2011-05-04 / FORM 020

Station: 16 Feature: UTM:

Start Time: 09:56 End Time: 10:01

Habitat: ☑Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
AMRO	1				
AMGO				1	



*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

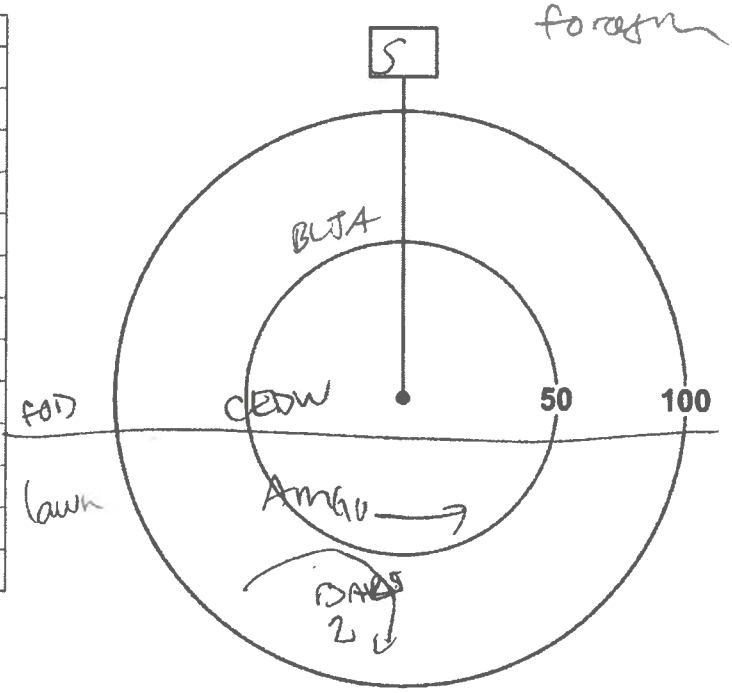
Station: 17 Feature: UTM:

Start Time: 10:04 End Time: 10:09

Habitat: ☑Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

*2 BARS foraging

Species	<50m	50-100m	>100m	Flyovers	Height*
AMGO				1	
CEDW	1				
BLJA		1			
BARS				2	



*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Signature: (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature: (Project Manager)

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, ON
Canada N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Bobolink and Eastern Meadowlark Breeding Survey Form

Project Number: 160950443
Project Name: Fruitland-Winona Secondary Plan Area
Date: June 11 2012.
Field Personnel: M. Oliveira

Weather Conditions:	TEMP (°C):	WIND:	CLOUD:	PPT:	PPT (in last 24 hrs):
	17°C	0	20%	Ø	Ø

Please mark transect location on map and indicate areas of species observations on map.

Transect No.: 1
Habitat: NO SUITABLE HABITAT (SHRUB SUCCESSIONAL)
Start Time:
End Time:
Start Point UTM:
End Point UTM:

Species	Tally
Bobolink	0
Eastern Meadowlark	0

Transect No.: 2
Habitat: NO SUITABLE HABITAT
Start Time:
End Time:
Start Point UTM:
End Point UTM:

Species	Tally
Bobolink	0
Eastern Meadowlark	0

Pg. ___ of ___

Signature: _____ (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature: _____ (Project Manager)

Transect No.: 3 **Habitat:** CROP FIELD (NOT SUITABLE HABITAT)

Start Time: [illegible] **End Time:**

Start Point UTM: **End Point UTM:**

Species	Tally
Bobolink	
Eastern Meadowlark	

Transect No.: 4 **Habitat:** HAY FIELD (UNCUT)

Start Time: 06:22 **End Time:** 06:32

Start Point UTM: 0606019 4785708 **End Point UTM:** 0606132 4785774

Species	Tally
Bobolink	11 (PAIR)
Eastern Meadowlark	0

Transect No.: 5 **Habitat:** HAY FIELD (UNCUT)

Start Time: 06:39 **End Time:** 06:50

Start Point UTM: 0605944 4785773 **End Point UTM:** 0605735S 4785841

Species	Tally
Bobolink	1 ♂
Eastern Meadowlark	0

Pg. ___ of ___

Signature: _____ (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature: _____ (Project Manager)

Transect No.: 6 Habitat: FIELD

Start Time: 07:31 End Time: 07:41

Start Point UTM: 0605501 4785499 End Point UTM: 0605585 4785606

Species	Tally
Bobolink	1 ♂
Eastern Meadowlark	0

DRY/WET MEADOW FALLOW AREA

Transect No.: 7 Habitat: FIELD / MIXED HAY/SCRUB

Start Time: 08:16 End Time: 08:26

Start Point UTM: 0605782 4785631 End Point UTM: 0605910 4785646

Species	Tally
Bobolink	1 ♂
Eastern Meadowlark	0

Transect No.: 8 Habitat: WET MEADOW ? / FIELD

Start Time: 08:35 End Time: 08:45

Start Point UTM: 0605977 4785580 End Point UTM: 0606046 4785562

Species	Tally
Bobolink	0
Eastern Meadowlark	0

Signature: _____ (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature: _____ (Project Manager)

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, ON
Canada N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Bobolink and Eastern Meadowlark Breeding Survey Form

Project Number: 160950443 Project Name: Fruitland - Winona

Date: July 10, 2012 Field Personnel: D. Graham

Weather Conditions:	TEMP (°C):	WIND:	CLOUD:	PPT:	PPT (in last 24 hrs):
	17-24°C	1	10%	None	Light rain

Please mark transect location on map and indicate areas of species observations on map.

Station ~~Transect~~ No.: 4 Habitat: Wheat field

Start Time: 6^15 End Time: 6^25

Start Point UTM: 606042, 4786009 End Point UTM:

Species	Tally
Bobolink	Ø
Eastern Meadowlark	Ø

Station ~~Transect~~ No.: 6 Habitat: Cultural meadow

Start Time: 6^45 End Time: 6^50

Start Point UTM: 605709, 4785872 End Point UTM:

Species	Tally
Bobolink	3: Two males, 1 female/juvenile
Eastern Meadowlark	Ø

Pg. ___ of ___

Quality Control: This form is complete ☐ & legible ☐.

Signature: _____ (Field Personnel)

Signature: _____ (Project Manager)

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, ON
Canada N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Stantec

Bobolink and Eastern Meadowlark Breeding Survey Form

Project Number: 60950443 Project Name: Hamilton-Fruitland

Date: June 25, 2012. Field Personnel: N. KOPYSH.

Weather Conditions:	TEMP (°C):	WIND:	CLOUD:	PPT:	PPT (in last 24 hrs):
		2.		Ø	

10 min pc + transects.

Please mark transect location on map and indicate areas of species observations on map.

stn/
Transect No.: 5 Habitat: CUM - high degree of forbs

Start Time: 06:40. End Time: 06:50.

Start Point UTM: 060612 / 4785706 End Point UTM:

Species	Tally
Bobolink	Ø
Eastern Meadowlark	Ø
→ walked transects through field - no BAME or BOBO observed	

stn/
Transect No.: 6. Habitat: CUM - high degree of forbs

Start Time: 07:00 End Time: 07:10.

Start Point UTM: 605109 / 4785872 End Point UTM:

Species	Tally
Bobolink	Ø
Eastern Meadowlark	Ø

Pg. 1 of 1

Signature: (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature: (Project Manager)

Transect No.: 7. Habitat: CUM

Start Time: 07:45 End Time: 07:55 -

Start Point UTM: 0605506 / 4785507. End Point UTM:

Species	Tally
Bobolink	Ø
Eastern Meadowlark	Ø
COGR / RWBL + BHCO	Rocks in field -

Transect No.: 9 Habitat: CUW / CUM.

Start Time: 08:30 - 08:40 End Time:

Start Point UTM: 0605974 / 4785591 End Point UTM:

Species	Tally
Bobolink	Ø not suitable habitat -
Eastern Meadowlark	Ø shrub/succ. habitat
	and - CUM / CUW
	+ patches of MAM.

Transect No.: 8. Habitat: CUM.

Start Time: 09:10 End Time: 09:20

Start Point UTM: 0605743 / 4785580 End Point UTM:

Species	Tally
Bobolink	Ø
Eastern Meadowlark	Ø,

Pg. ___ of ___

Signature: _____ (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature: _____ (Project Manager)

Chimney Assessment Form

May 17, 2012

Observer Details

Name	Phone Number	Email Address
Don Graham	( )	

Street Address	City	Prov.	Postal Code

Building Details

Street Address	City	Prov.	Postal Code
660 Barton	Hamilton	ON	

Owner Name	Phone Number	Email Address
	( )	

Type of building (please check one):

- ☐ House
- ☐ Church
- ☑ Store
- ☐ Lowrise Apartment
- ☐ School
- ☐ Factory
- ☐ Highrise Apartment
- ☐ Hospital
- ☐ Other, please specify: _____

Chimney Details

Site Name: 660 ~~Eastland~~ Barton

Chimney Code: H-660-0

GPS coordinates (DD.dddd):

Lat. 47 86 287 ° N

Long. 605674 ° W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

Chimney material (please check one):

- ☐ Brick
- ☐ Stucco
- ☐ Concrete
- ☐ Stone
- ☐ Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.

No chimney

If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- ☐ Cap
- ☐ Terra Cotta Liner
- ☐ Animal Guard
- ☐ Spark Protector
- ☐ Metal Liner
- ☐ Other, please specify: _____

Surrounding habitat (please check one):

- ☐ Residential
- ☐ Industrial
- ☑ Commercial
- ☐ Natural
- ☐ Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- ☐ Round → Diameter (cm): _____
- ☐ Square → Width (cm): _____
- ☐ Rectangular → Width (cm): _____ Length (cm): _____

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Stantec Consulting Ltd.
70-1 Southgate Drive
Guelph, Ontario, Canada
N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Barn Swallow Observation Form

Project Number: 160950443 Project Name: Scube

Date: July 12, 2012 Field Personnel: D. Graham

Weather Conditions:	Temp:	Wind:	Cloud:	PPT:	PPT in last 24 hrs:
	16-25°C	0-1	10%	None	None

Survey Station	Time AM	GPS Coordinates	# BARS observed	Type of structure (e.g. barn, culvert)	Accessible nesting sites (Y or N)	Nests	
						Active	Inactive
2	5:45	608483 4784921	2				Foraging
4	6:15	608758 4785292	3				Foraging
6	6:45		1				Foraging
8	7:05	610065 4785097	1				Foraging
11	7:45	610234 4785771	1				Foraging
14	8:15	609860 4785605	1				Foraging
15	9:05	610787 4785550	3				Foraging
16	8:35	608784 4785104	1				Foraging
17	8:50	611228 4785587	4				Foraging
Box culvert - on north Service Rd	12:10	611246 4785577	0	Box culvert	N		
Box culvert - Hwy 8	12:30	608659 4784950	0	Box culvert	N		

Quality Control: This form is complete (__) & legible (__).

Signature: _____ (Field Personnel)

Signature: _____ (Project Manager)

Stantec Consulting Ltd.
70-1 Southgate Drive
Guelph, Ontario, Canada
N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Barn Swallow Observation Form

Project Number 160950443 Project Name: Scube

Date: July 4, 2012 Field Personnel: Michael Oliveira

Weather Conditions:	Temp:	Wind:	Cloud:	PPT:	PPT in last 24 hrs:
	20° C	1-2	50%	0	0

Survey Station	Time	GPS Coordinates	# BARS observed	Type of structure (e.g. barn, culvert)	Accessible nesting sites (Y or N)	Nests	
						Active	Inactive
6	6:51-6:56	608587, 4785464	1	N.A.	Foraging only		
8	7:16-7:21	610089, 4789467	2	N.A.	Foraging only		

Quality Control: This form is complete (__) & legible (__).

Signature: _____ (Field Personnel)

Signature: _____ (Project Manager)

REV: June-09 FORM 034

Stantec Consulting Ltd.
70-1 Southgate Drive
Guelph, Ontario, Canada
N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Barn Swallow Observation Form

Project Number 60950443 Project Name: Scube

Date: June 26, 2012 Field Personnel: N. Kopysch

Weather Conditions:	Temp:	Wind:	Cloud:	PPT:	PPT in last 24 hrs:
	15 to 20°C	0-1	20%	0	0

Survey Station	Time	GPS Coordinates	# BARS observed	Type of structure (e.g. barn, culvert)	Accessible nesting sites (Y or N)	Nests	
						Active	Inactive
15	6:50-6:55	610049, 4785387	1	N.A.	Foraging only		
8	7:04-7:09	610651, 4785097	2	N.A.	Foraging only		
17	7:49-7:54	608784 4785104	1	N.A.	Foraging only		
5	8:35-8:40	608294' 4785534	1	N.A.	Foraging only		
6	8:45-8:50	608587' 4785464	3	N.A.	Foraging only		
18	9:00-9:05	610787, 4785550	1	N.A.	Foraging only		

Quality Control: This form is complete (__) & legible (__).

Signature: _____ (Field Personnel)

Signature: _____ (Project Manager)

Chimney Assessment Form

Chimney height above roofline (m):	Number of Flues:	Colour of Chimney:

Total Chimney Height (m) = _____ (Number of stories in building) × 3 m (approx height of one story) + _____ (Height above roofline (m)) = _____ m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None seen

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada Ontario Region / Environnement Canada Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

2

Observer Details

Name	Phone Number	Email Address
D. Graham	( )	

Street Address	City	Prov.	Postal Code

Building Details

Street Address	City	Prov.	Postal Code
692 Barton	Hamilton	ON	

Owner Name	Phone Number	Email Address
	( )	

Type of building (please check one):

- [x] House
- [ ] Church
- [ ] Store
- [ ] Lowrise Apartment
- [ ] School
- [ ] Factory
- [ ] Highrise Apartment
- [ ] Hospital
- [ ] Other, please specify: _____

Chimney Details

Site Name: 692 Barton

Chimney Code: H-692-1

GPS coordinates (DD.dddd):

Lat. 4786235 ° N

Long. 605881 ° W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

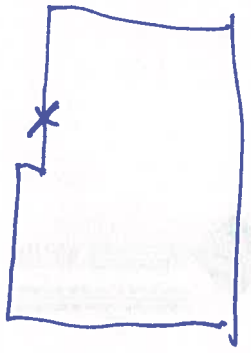
Number of years active (if known):

Chimney material (please check one):

- [x] Brick
- [ ] Stucco
- [ ] Concrete
- [ ] Stone
- [ ] Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.

X GPS N



If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- [x] Cap
- [ ] Terra Cotta Liner
- [ ] Animal Guard
- [x] Spark Protector
- [x] Metal Liner
- [ ] Other, please specify: _____

Surrounding habitat (please check one):

- [x] Residential
- [ ] Industrial
- [ ] Commercial
- [ ] Natural
- [ ] Other, please specify: limited to roadway

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- [ ] Round → Diameter (cm): _____
- [x] Square → Width (cm): 40
- [ ] Rectangular → Width (cm): _____ Length (cm): _____

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

2

Chimney height above roofline (m): 2 m	Number of Flues: 1 ✓	Colour of Chimney: Brown

Total Chimney Height (m) = 1 (Number of stories in building) × 3 m (approx height of one story) + 2 m (Height above roofline (m)) = 5 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None seen

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada / Environnement Canada
Ontario Region / Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

3

Observer Details

Name	Phone Number	Email Address
D. Graham	( )	

Street Address	City	Prov.	Postal Code

Building Details

Street Address	City	Prov.	Postal Code
720 Burton	Hamilton	ON	

Owner Name	Phone Number	Email Address
	( )	

Type of building (please check one):

- ☐ House
- ☐ Church
- ☐ Store
- ☐ Lowrise Apartment
- ☐ School
- ☐ Factory
- ☐ Highrise Apartment
- ☐ Hospital
- ☐ Other, please specify: _____

Chimney Details

Site Name: 720 Burton

Chimney Code: H-720-1

GPS coordinates (DD.dddd):

Lat. 4786169 ° N

Long. 606102 ° W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

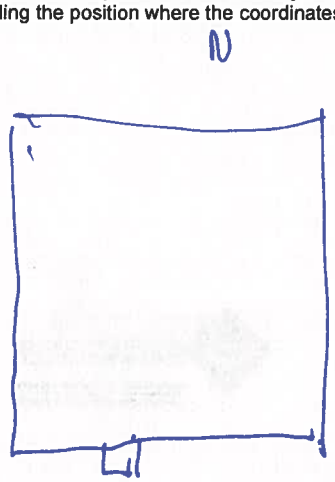
Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

Chimney material (please check one):

- ☒ Brick
- ☐ Stucco
- ☐ Concrete
- ☐ Stone
- ☐ Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.



X

If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- ☑ Cap
- ☐ Terra Cotta Liner
- ☐ Animal Guard
- ☐ Spark Protector
- ☑ Metal Liner
- ☐ Other, please specify: _____

Surrounding habitat (please check one):

- ☑ Residential
- ☐ Industrial
- ☐ Commercial
- ☐ Natural
- ☐ Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- ☐ Round → Diameter (cm): _____
- ☑ Square → Width (cm): 40
- ☐ Rectangular → Width (cm): _____ Length (cm): _____

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

3

Chimney height above roofline (m):	1	Number of Flues:	1	Colour of Chimney:	brown

Total Chimney Height (m) = 2 (Number of stories in building) × 3 m (approx height of one story) + 1 (Height above roofline (m)) = 7 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None seen

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada / Environnement Canada
Ontario Region / Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

4

Observer Details

Name	Phone Number	Email Address		
D. Graham	( )			
Street Address	City	Prov.	Postal Code	

Building Details

Street Address	City	Prov.	Postal Code
748 Barton	Hamilton	ON	
Owner Name	Phone Number	Email Address	
	( )		

Type of building (please check one):

- [x] House
- [ ] Church
- [ ] Store
- [ ] Lowrise Apartment
- [ ] School
- [ ] Factory
- [ ] Highrise Apartment
- [ ] Hospital
- [ ] Other, please specify: _____

Chimney Details

Site Name: 748 Barton

Chimney Code: H-748-1

GPS coordinates (DD.dddd):

Lat. 111 ° N

Long. 297 ° W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

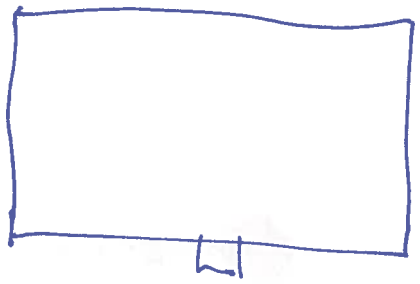
Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

Chimney material (please check one):

- [x] Brick
- [ ] Stucco
- [ ] Concrete
- [ ] Stone
- [ ] Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.



If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- [ ] Cap
- [x] Terra Cotta Liner
- [ ] Animal Guard
- [x] Spark Protector
- [ ] Metal Liner
- [ ] Other, please specify: _____

Surrounding habitat (please check one):

- [x] Residential
- [ ] Industrial
- [ ] Commercial
- [ ] Natural
- [ ] Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- [ ] Round → Diameter (cm): _____
- [x] Square → Width (cm): _____
- [x] Rectangular → Width (cm): 60 Length (cm): 21

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

4

Chimney height above roofline (m): 1	Number of Flues: 1	Colour of Chimney: brown

Total Chimney Height (m) = 2 (Number of stories in building) × 3 m (approx height of one story) + 1 (Height above roofline (m)) = 7 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None seen.

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

THE ONTARIO TRILLIUM FOUNDATION / LA FONDATION TRILLIUM DE L'ONTARIO

Environment Canada / Environnement Canada
Ontario Region / Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

5

Observer Details

Name	Phone Number	Email Address
D. Graham	( )	

Street Address	City	Prov.	Postal Code

Building Details

Street Address	City	Prov.	Postal Code
789 Barton	Ham. Hop	ON	

Owner Name	Phone Number	Email Address
	( )	

Type of building (please check one):

- ☐ House
- ☐ Church
- ☐ Store
- ☐ Lowrise Apartment
- ☐ School
- ☐ Factory
- ☐ Highrise Apartment
- ☐ Hospital
- ☐ Other, please specify: _____

Chimney Details

Site Name: 789 Barton

GPS coordinates (DD.dddd):

Lat. 4786 043536 ° N

Long. 6016 527 ° W

Number of years active (if known):

Chimney Code: H-789-1

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

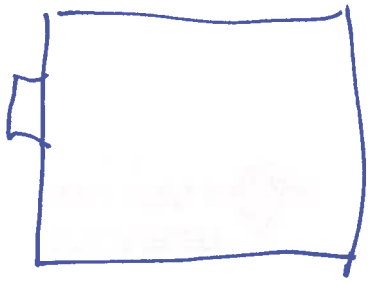
Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Chimney material (please check one):

- ☑ Brick
- ☐ Stucco
- ☐ Concrete
- ☐ Stone
- ☐ Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.

X N.



If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- ☐ Cap
- ☑ Terra Cotta Liner
- ☐ Animal Guard
- ☑ Spark Protector
- ☐ Metal Liner
- ☐ Other, please specify: _____

Surrounding habitat (please check one):

- ☑ Residential
- ☐ Industrial
- ☐ Commercial
- ☐ Natural
- ☐ Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- ☐ Round → Diameter (cm): _____
- ☑ Square → Width (cm): 40
- ☐ Rectangular → Width (cm): _____ Length (cm): _____

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

5

Chimney height above roofline (m): 3	Number of Flues: 1	Colour of Chimney: Brown

Total Chimney Height (m) = 1 (Number of stories in building) × 3 m (approx height of one story) + 3 (Height above roofline (m)) = 6 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None seen

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada Ontario Region / Environnement Canada Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

6

Observer Details

Name	Phone Number	Email Address
D Graham	( )	

Street Address	City	Prov.	Postal Code

Building Details

Street Address	City	Prov.	Postal Code
822 Barton	Hamilton	ON	

Owner Name	Phone Number	Email Address
	( )	

Type of building (please check one):

- [x] House
- [ ] Church
- [ ] Store
- [ ] Lowrise Apartment
- [ ] School
- [ ] Factory
- [ ] Highrise Apartment
- [ ] Hospital
- [ ] Other, please specify: _____

Chimney Details

Site Name: 822 Barton

Chimney Code: H-822-1

GPS coordinates (DD.dddd):

Lat. 478.5968 ° N

Long. 606758 ° W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

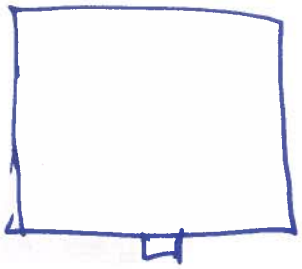
Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

Chimney material (please check one):

- [x] Brick
- [ ] Stucco
- [ ] Concrete
- [ ] Stone
- [ ] Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.



If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- [x] Cap
- [ ] Terra Cotta Liner
- [ ] Animal Guard
- [ ] Spark Protector
- [ ] Metal Liner
- [ ] Other, please specify: _____

Surrounding habitat (please check one):

- [x] Residential
- [ ] Industrial
- [ ] Commercial
- [ ] Natural
- [ ] Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- [ ] Round → Diameter (cm): _____
- [x] Square → Width (cm): 40 x 40
- [ ] Rectangular → Width (cm): _____ Length (cm): _____

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

6

Chimney height above roofline (m):	0.5	Number of Flues:	1	Colour of Chimney:	Brown

Total Chimney Height (m) = 2 (Number of stories in building) × 3 m (approx height of one story) + 0.5 (Height above roofline (m)) = 6.5 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None seen.

However several Barn Swallows observed flying in & out of wooden garage, behaviour which suggests nesting.

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada Ontario Region / Environnement Canada Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

7

Page 1

Observer Details

Name	Phone Number	Email Address
D. Graham	( )	

Street Address	City	Prov.	Postal Code

Building Details

Street Address	City	Prov.	Postal Code
844 Barton	Hamilton	ON	

Owner Name	Phone Number	Email Address
	( )	

Type of building (please check one):

- [x] House
- [ ] Church
- [ ] Store
- [ ] Lowrise Apartment
- [ ] School
- [ ] Factory
- [ ] Highrise Apartment
- [ ] Hospital
- [ ] Other, please specify: _____

Chimney Details

Site Name: 844 Barton

Chimney Code: H-844-1

GPS coordinates (DD.dddd):

Lat. 4785915 °N

Long. 6069D4 °W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

If possible, please draw a picture of the chimney location on the building, inciuding the position where the coordinates were taken.

Chimney material (please check one):

- [ ] Brick
- [ ] Stucco
- [ ] Concrete
- [ ] Stone
- [ ] Other, please specify: _____

If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- [x] Cap
- [ ] Terra Cotta Liner
- [ ] Animal Guard
- [ ] Spark Protector
- [x] Metal Liner
- [ ] Other, please specify: _____

Surrounding habitat (please check one):

- [ ] Residential
- [ ] Industrial
- [ ] Commercial
- [ ] Natural
- [x] Other, please specify: Rural/residential

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- [ ] Round → Diameter (cm): _____
- [ ] Square → Width (cm): _____
- [x] Rectangular → Width (cm): 40 Length (cm): 80

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

7

Chimney height above roofline (m): 1	Number of Flues: 2	Colour of Chimney: Black

Total Chimney Height (m) = 2 (Number of stories in building) × 3 m (approx height of one story) + 1 (Height above roofline (m)) = 7 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None seen.

At least 2 Barn Swallow seen here on 2 potential nest sites @ 832 Barton exists. (barn, garage)

Created by:

Bird Studies Canada / Études d'oiseaux Canada
understand appreciate conserve
comprendre apprécier conserver

Canadian co-partner of
un partenaire canadien de
BirdLife International

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada Ontario Region / Environnement Canada Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

Page 1

8

Observer Details

Name	Phone Number	Email Address
D. Graham	( )	

Street Address	City	Prov.	Postal Code
~~Barton~~		ON	

Building Details

Street Address	City	Prov.	Postal Code
Barton	Hamilton	ON	

Owner Name	Phone Number	Email Address
	( )	

Type of building (please check one):

- ☑ House
- ☐ Church
- ☐ Store
- ☐ Lowrise Apartment
- ☐ School
- ☐ Factory
- ☐ Highrise Apartment
- ☐ Hospital
- ☐ Other, please specify: _____

Chimney Details

Site Name: 884 Barton

Chimney Code: H-884 -1

GPS coordinates (DD.dddd):

Lat. 4785 821 ° N

Long. 607206 ° W

NOTE: Chimney codes are created using the following scheme:

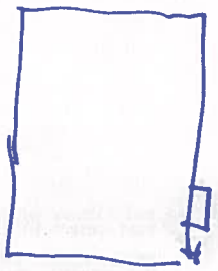
City Initials - Site Initials - Chimney Number

Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.

xN



Chimney material (please check one):

- ☑ Brick
- ☐ Stucco
- ☐ Concrete
- ☐ Stone
- ☐ Other, please specify: _____

If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- ☑ Cap
- ☐ Terra Cotta Liner
- ☐ Animal Guard
- ☐ Spark Protector
- ☑ Metal Liner
- ☐ Other, please specify: _____

Surrounding habitat (please check one):

- ☑ Residential
- ☐ Industrial
- ☐ Commercial
- ☐ Natural
- ☐ Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- ☐ Round → Diameter (cm): _____
- ☑ Square → Width (cm): 40 x 40
- ☐ Rectangular → Width (cm): _____ Length (cm): _____

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

8

Chimney height above roofline (m): 3	Number of Flues: 1	Colour of Chimney: Brown

Total Chimney Height (m) = 1 (Number of stories in building) × 3 m (approx height of one story) + 3 (Height above roofline (m)) = 6 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None seen.

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

THE ONTARIO TRILLIUM FOUNDATION / LA FONDATION TRILLIUM DE L'ONTARIO

Environment Canada / Environnement Canada
Ontario Region / Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

9

Observer Details

Name	Phone Number	Email Address
D. Graham	( )	

Street Address	City	Prov.	Postal Code

Building Details

Street Address	City	Prov.	Postal Code
Barton	Hamilton	ON	

Owner Name	Phone Number	Email Address
	( )	

Type of building (please check one):

- ☐ House
- ☑ Church
- ☐ Store
- ☐ Lowrise Apartment
- ☐ School
- ☐ Factory
- ☐ Highrise Apartment
- ☐ Hospital
- ☐ Other, please specify: _____

Chimney Details

Site Name

GPS coordinates (DD.dddd):

Lat. 4785777 ° N

Long. 607304 ° W

Number of years active (if known):

Chimney Code: H -

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Chimney material (please check one):

- ☑ Brick
- ☐ Stucco
- ☐ Concrete
- ☐ Stone
- ☐ Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.

If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- ☐ Cap
- ☑ Terra Cotta Liner
- ☑ Animal Guard
- ☑ Spark Protector
- ☐ Metal Liner
- ☐ Other, please specify: _____

Surrounding habitat (please check one):

- ☑ Residential
- ☐ Industrial
- ☐ Commercial
- ☐ Natural
- ☐ Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- ☐ Round → Diameter (cm): _____
- ☐ Square → Width (cm): _____
- ☑ Rectangular → Width (cm): 90 Length (cm): 270

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

9

Chimney height above roofline (m): 2	Number of Flues: 1	Colour of Chimney: Tan.

Total Chimney Height (m) = 2 (Number of stories in building) × 3 m (approx height of one story) + 2 (Height above roofline (m)) = 8 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None seen.

1 Barn Swallow nesting on east side of church under eaves. 2nd BASW pair present.

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada Ontario Region / Environnement Canada Région de l'Ontario

Mcilwraith Field Naturalists

Chimney Assessment Form

10

Observer Details

Name	Phone Number	Email Address
Dan Graham	( )	

Street Address	City	Prov.	Postal Code

Building Details

Street Address	City	Prov.	Postal Code
26 Glover	Ham. Hap	ON	

Owner Name	Phone Number	Email Address
	( )	

Type of building (please check one):

- [x] House
- [ ] Church
- [ ] Store
- [ ] Lowrise Apartment
- [ ] School
- [ ] Factory
- [ ] Highrise Apartment
- [ ] Hospital
- [ ] Other, please specify: _____

Chimney Details

Site Name: 26 Glover

Chimney Code: H-26-1

GPS coordinates (DD.dddd):

Lat. 4785563 ° N

Long. 607173 ° W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

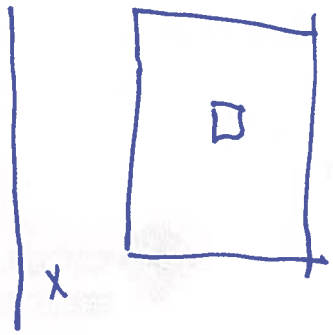
Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

Chimney material (please check one):

- [x] Brick
- [ ] Stucco
- [ ] Concrete
- [ ] Stone
- [ ] Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.



If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- [x] Cap
- [x] Terra Cotta Liner
- [ ] Animal Guard
- [x] Spark Protector
- [ ] Metal Liner
- [ ] Other, please specify: _____

Surrounding habitat (please check one):

- [x] Residential
- [ ] Industrial
- [ ] Commercial
- [ ] Natural
- [ ] Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- [ ] Round → Diameter (cm): _____
- [x] Square → Width (cm): 40
- [ ] Rectangular → Width (cm): _____ Length (cm): _____

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

10

Chimney height above roofline (m): 2	Number of Flues: 1	Colour of Chimney: Brown

Total Chimney Height (m) = 1.5 (Number of stories in building) × 3 m (approx height of one story) + 2 (Height above roofline (m)) = 6.5 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None seen

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada Ontario Region / Environnement Canada Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

11

Observer Details

Name	Phone Number	Email Address
D. Graham	( )	

Street Address	City	Prov.	Postal Code

Building Details

Street Address	City	Prov.	Postal Code
239 Glover	Hamilton	ON	

Owner Name	Phone Number	Email Address
	( )	

Type of building (please check one):

- [x] House
- [ ] Church
- [ ] Store
- [ ] Lowrise Apartment
- [ ] School
- [ ] Factory
- [ ] Highrise Apartment
- [ ] Hospital
- [ ] Other, please specify: Rm

Chimney Details

Site Name: 239 Glover

Chimney Code: H-239-1

GPS coordinates (DD.dddd):

Lat. 4785327 ° N

Long. 607101 ° W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

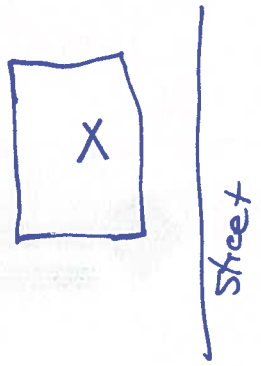
Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

Chimney material (please check one):

- [x] Brick
- [ ] Stucco
- [ ] Concrete
- [ ] Stone
- [ ] Other, please specify:

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.



If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- [ ] Cap
- [x] Terra Cotta Liner
- [ ] Animal Guard
- [ ] Spark Protector
- [ ] Metal Liner
- [ ] Other, please specify:

Surrounding habitat (please check one):

- [x] Residential
- [ ] Industrial
- [ ] Commercial
- [ ] Natural
- [ ] Other, please specify:

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- [ ] Round → Diameter (cm): ____
- [ ] Square → Width (cm): ____
- [x] Rectangular → Width (cm): 40 Length (cm): 80

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

Chimney height above roofline (m): 1.5	Number of Flues: 2	Colour of Chimney: Tan

Total Chimney Height (m) = 1 (Number of stories in building) × 3 m (approx height of one story) + 1.5 (Height above roofline (m)) = 4.5 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None seen

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of
un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

THE ONTARIO TRILLIUM FOUNDATION / LA FONDATION TRILLIUM DE L'ONTARIO

Environment Canada / Environnement Canada
Ontario Region / Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

Page 1

12

Observer Details

Name	Phone Number	Email Address
D. Graham	( )	

Street Address	City	Prov.	Postal Code

Building Details

Street Address	City	Prov.	Postal Code
Glover	Hamilton	ON	

Owner Name	Phone Number	Email Address
	( )	

Type of building (please check one):

- ☐ House
- ☑ Church — Kingdom Hall of Jehovah Witnesses
- ☐ Store
- ☐ Lowrise Apartment
- ☐ School
- ☐ Factory
- ☐ Highrise Apartment
- ☐ Hospital
- ☐ Other, please specify: _____

Chimney Details

Site Name: Glover

Chimney Code: H - - O

GPS coordinates (DD.dddd):

Lat. 4785169 ° N

Long. 607057 ° W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.

None seen

Chimney material (please check one):

- ☐ Brick
- ☐ Stucco
- ☐ Concrete
- ☐ Stone
- ☐ Other, please specify: _____

If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- ☐ Cap
- ☐ Terra Cotta Liner
- ☐ Animal Guard
- ☐ Spark Protector
- ☐ Metal Liner
- ☐ Other, please specify: _____

Surrounding habitat (please check one):

- ☑ Residential → rural
- ☐ Industrial
- ☐ Commercial
- ☐ Natural
- ☐ Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- ☐ Round → Diameter (cm): _____
- ☐ Square → Width (cm): _____
- ☐ Rectangular → Width (cm): _____ Length (cm): _____

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

12

Chimney height above roofline (m):	Number of Flues:	Colour of Chimney:

Total Chimney Height (m) = _____ (Number of stories in building) × 3 m (approx height of one story) + _____ (Height above roofline (m)) = _____ m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None. seen

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve
comprendre apprécier conserver

Canadian co-partner of
un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada / Environnement Canada
Ontario Region / Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

13

Page 1

Observer Details

Name	Phone Number	Email Address
D. Graham	( )	

Street Address	City	Prov.	Postal Code

Building Details

Street Address	City	Prov.	Postal Code
873 Hwy 8	Hamilton	ON	

Owner Name	Phone Number	Email Address
	( )	

Type of building (please check one):

- ☐ House
- ☐ Church
- ☐ Store
- ☐ Lowrise Apartment
- ☐ School
- ☐ Factory
- ☐ Highrise Apartment
- ☐ Hospital
- ☐ Other, please specify: _____

Chimney Details

Site Name: 873 Hwy 8

GPS coordinates (DD.dddd):

Lat. 4785087 ° N

Long. 606915 ° W

Number of years active (if known):

Chimney Code: H -

NOTE: Chimney codes are created using the following scheme:

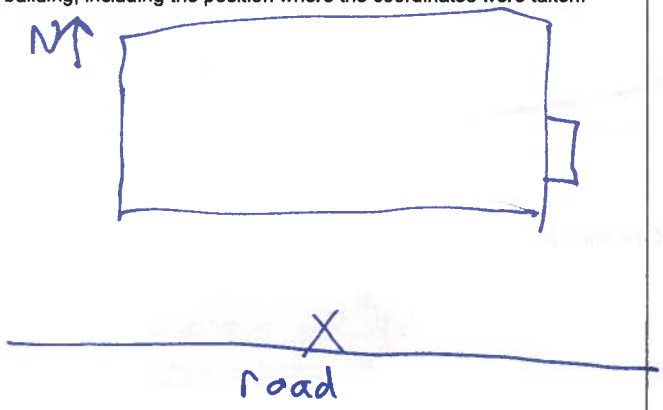
City Initials - Site Initials - Chimney Number

Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Chimney material (please check one):

- ☑ Brick
- ☐ Stucco
- ☐ Concrete
- ☐ Stone
- ☐ Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.



If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- ☑ Cap
- ☑ Terra Cotta Liner
- ☐ Animal Guard
- ☐ Spark Protector
- ☐ Metal Liner
- ☐ Other, please specify: _____

Surrounding habitat (please check one):

- ☑ Residential / Rural
- ☐ Industrial
- ☐ Commercial
- ☐ Natural
- ☐ Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- ☐ Round → Diameter (cm): _____
- ☐ Square → Width (cm): _____
- ☑ Rectangular → Width (cm): 40 Length (cm): 120

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

13

Chimney height above roofline (m): 2	Number of Flues: 2	Colour of Chimney: Brown

Total Chimney Height (m) = 1 (Number of stories in building) × 3 m (approx height of one story) + 2 (Height above roofline (m)) = 5 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None seen

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada Ontario Region / Environnement Canada Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

14

Observer Details

Name	Phone Number	Email Address
D Graham	( )	

Street Address	City	Prov.	Postal Code

Building Details

Street Address	City	Prov.	Postal Code
843 Hwy 8	Ham. Han	ON.	

Owner Name	Phone Number	Email Address
	( )	

Type of building (please check one):

- [x] House
- [ ] Church
- [ ] Store
- [ ] Lowrise Apartment
- [ ] School
- [ ] Factory
- [ ] Highrise Apartment
- [ ] Hospital
- [ ] Other, please specify: _____

Chimney Details

Site Name: 843 Hwy 8

GPS coordinates (DD.dddd):

Lat. 4785187 ° N

Long. 606734 ° W

Number of years active (if known):

Chimney Code: H-843-1

NOTE: Chimney codes are created using the following scheme:

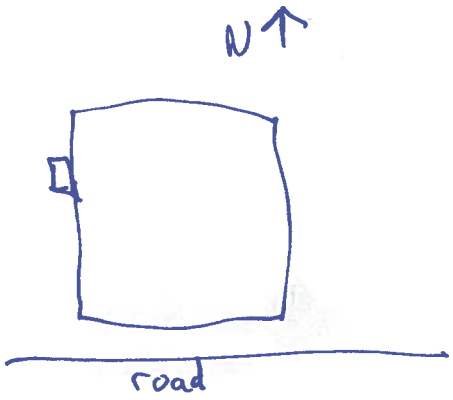
City Initials - Site Initials - Chimney Number

Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Chimney material (please check one):

- [ ] Brick
- [ ] Stucco
- [x] Concrete
- [ ] Stone
- [ ] Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.



If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- [ ] Cap
- [x] Terra Cotta Liner
- [ ] Animal Guard
- [ ] Spark Protector
- [ ] Metal Liner
- [ ] Other, please specify: _____

Surrounding habitat (please check one):

- [x] Residential (rural)
- [ ] Industrial
- [ ] Commercial
- [ ] Natural
- [ ] Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- [ ] Round → Diameter (cm): _____
- [x] Square → Width (cm): 40cm
- [ ] Rectangular → Width (cm): _____ Length (cm): _____

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

14

Chimney height above roofline (m): 2	Number of Flues: 1	Colour of Chimney: Grey

Total Chimney Height (m) = 2 (Number of stories in building) × 3 m (approx height of one story) + 2 (Height above roofline (m)) = 8 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None seen.

BASW seen in area. Potential nest sites in area.

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada / Environnement Canada
Ontario Region / Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

15

Observer Details

Name	Phone Number	Email Address
D. Graham	( )	

Street Address	City	Prov.	Postal Code

Building Details

Street Address	City	Prov.	Postal Code
809 Hwy 8	Hamilton	ON	

Owner Name	Phone Number	Email Address
	( )	

Type of building (please check one):

- [x] House
- [ ] Church
- [ ] Store
- [ ] Lowrise Apartment
- [ ] School
- [ ] Factory
- [ ] Highrise Apartment
- [ ] Hospital
- [ ] Other, please specify: _____

Chimney Details

Site Name: 809 Hwy 8

Chimney Code: H-809

GPS coordinates (DD.dddd):

Lat. 43.12 ° N

Long. 79.41 ° W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.

Chimney material (please check one):

- [x] Brick
- [ ] Stucco
- [ ] Concrete
- [ ] Stone
- [ ] Other, please specify: _____

If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- [x] Cap
- [x] Terra Cotta Liner
- [ ] Animal Guard
- [ ] Spark Protector
- [ ] Metal Liner
- [ ] Other, please specify: _____

Surrounding habitat (please check one):

- [x] Residential / rural
- [ ] Industrial
- [ ] Commercial
- [ ] Natural
- [ ] Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- [ ] Round → Diameter (cm): _____
- [ ] Square → Width (cm): _____
- [x] Rectangular → Width (cm): 20 Length (cm): 120

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

15

Chimney height above roofline (m): 3	Number of Flues: 2	Colour of Chimney: Brown

Total Chimney Height (m) = 1 (Number of stories in building) × 3 m (approx height of one story) + 3 (Height above roofline (m)) = 6 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None seen.

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve
comprendre apprécier conserver

Canadian co-partner of
un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada Ontario Region / Environnement Canada Région de l'Ontario

Mcilwraith Field Naturalists

Chimney Assessment Form

16

Observer Details

Name	Phone Number	Email Address
D. Graham	( )	

Street Address	City	Prov.	Postal Code

Building Details

Street Address	City	Prov.	Postal Code
777 Hwy 8	Ham. Hon	ON	

Owner Name	Phone Number	Email Address
	( )	

Type of building (please check one):

- ☐ House
- ☐ Church
- ☐ Store
- ☐ Lowrise Apartment
- ☐ School
- ☐ Factory
- ☐ Highrise Apartment
- ☐ Hospital
- ☑ Other, please specify: Stoney Creek Municipal Building

Chimney Details

Site Name: 777 Hwy 8

GPS coordinates (DD.dddd):

Lat. 43.12.731 °N

Long. 79.41.500 °W

Number of years active (if known):

Chimney material (please check one):

- ☐ Brick
- ☐ Stucco
- ☐ Concrete
- ☐ Stone
- ☐ Other, please specify: _____

If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- ☐ Cap
- ☐ Terra Cotta Liner
- ☐ Animal Guard
- ☐ Spark Protector
- ☐ Metal Liner
- ☐ Other, please specify: _____

Surrounding habitat (please check one):

- ☐ Residential
- ☐ Industrial
- ☐ Commercial
- ☐ Natural
- ☐ Other, please specify: _____

Chimney Code: H-777-0

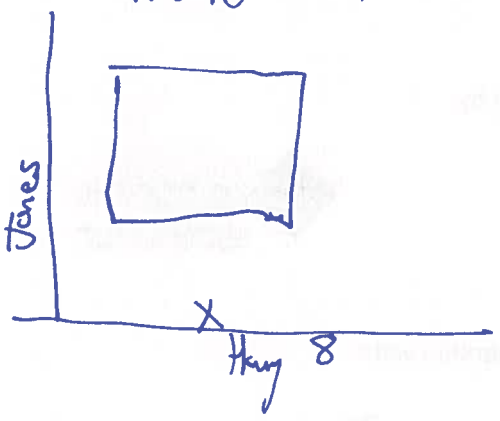
NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.

None seen



Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- ☐ Round → Diameter (cm): _____
- ☐ Square → Width (cm): _____
- ☐ Rectangular → Width (cm): _____ Length (cm): _____

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

16

Chimney height above roofline (m):	Number of Flues:	Colour of Chimney:

Total Chimney Height (m) = _____ (Number of stories in building) × 3 m (approx height of one story) + _____ (Height above roofline (m)) = _____ m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada / Environnement Canada
Ontario Region / Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

17

Observer Details

Name	Phone Number	Email Address
D. Graham	( )	

Street Address	City	Prov.	Postal Code

Building Details

Street Address	City	Prov.	Postal Code
743 Hwy 8	Ham. Hbg	ON	

Owner Name	Phone Number	Email Address
	( )	

Type of building (please check one):

- [x] House
- [ ] Church
- [ ] Store
- [ ] Lowrise Apartment
- [ ] School
- [ ] Factory
- [ ] Highrise Apartment
- [ ] Hospital
- [ ] Other, please specify: _____

Chimney Details

Site Name: 743 Hwy 8

Chimney Code: H-

GPS coordinates (DD.dddd):

Lat. 4785182 ° N

Long. 605959 ° W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

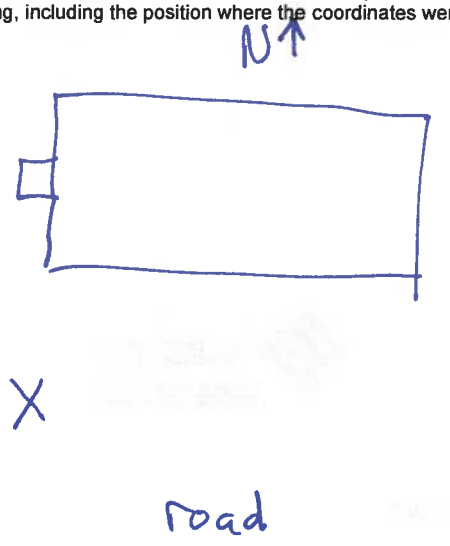
Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

Chimney material (please check one):

- [x] Brick
- [ ] Stucco
- [ ] Concrete
- [ ] Stone
- [ ] Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.



If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- [ ] Cap
- [x] Terra Cotta Liner
- [ ] Animal Guard
- [ ] Spark Protector
- [ ] Metal Liner
- [ ] Other, please specify: _____

Surrounding habitat (please check one):

- [x] Residential / rural
- [ ] Industrial
- [ ] Commercial
- [ ] Natural
- [ ] Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- [ ] Round → Diameter (cm): _____
- [x] Square → Width (cm): 50 x 50
- [ ] Rectangular → Width (cm): _____ Length (cm): _____

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

17

Chimney height above roofline (m):	Number of Flues:	Colour of Chimney:
1	1	Brown

Total Chimney Height (m) = 2 (Number of stories in building) × 3 m (approx height of one story) + 1 (Height above roofline (m)) = 7 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None seen

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada Ontario Region / Environnement Canada Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

18

Observer Details

Name	Phone Number	Email Address	
D. Graham	( )		
Street Address	**City**	**Prov.**	**Postal Code**

Building Details

Street Address	City	Prov.	Postal Code
703 Hwy 8	Hamilton	ON.	
Owner Name	**Phone Number**	**Email Address**	
	( )		

Type of building (please check one):

- ☐ House
- ☐ Church
- ☑ Store
- ☐ Lowrise Apartment
- ☐ School
- ☐ Factory
- ☐ Highrise Apartment
- ☐ Hospital
- ☐ Other, please specify: _____

Chimney Details

Site Name: 703 Hwy 8

Chimney Code: H - 703

GPS coordinates (DD.dddd):

Lat. 4785231 ° N

Long. 605701 ° W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

Chimney material (please check one):

- ☐ Brick
- ☐ Stucco
- ☐ Concrete
- ☐ Stone
- ☐ Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.

No chimney

If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- ☐ Cap
- ☐ Terra Cotta Liner
- ☐ Animal Guard
- ☐ Spark Protector
- ☐ Metal Liner
- ☐ Other, please specify: _____

Surrounding habitat (please check one):

- ☐ Residential
- ☐ Industrial
- ☐ Commercial
- ☐ Natural
- ☐ Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- ☐ Round → Diameter (cm): _____
- ☐ Square → Width (cm): _____
- ☐ Rectangular → Width (cm): _____ Length (cm): _____

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

18

Chimney height above roofline (m):	Number of Flues:	Colour of Chimney:

Total Chimney Height (m) = _____ (Number of stories in building) × 3 m (approx height of one story) + _____ (Height above roofline (m)) = _____ m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

No birds seen

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada / Environnement Canada
Ontario Region / Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

19

Observer Details

Name	Phone Number	Email Address
D. Graham	( )	

Street Address	City	Prov.	Postal Code

Building Details

Street Address	City	Prov.	Postal Code
669 Hwy 8	Ham. Hon	ON	

Owner Name	Phone Number	Email Address
	( )	

Type of building (please check one):

- [x] House
- [ ] Church
- [ ] Store
- [ ] Lowrise Apartment
- [ ] School
- [ ] Factory
- [ ] Highrise Apartment
- [ ] Hospital
- [ ] Other, please specify: _____

Chimney Details

Site Name: 669 Hwy 8

Chimney Code: H-669-1

GPS coordinates (DD.dddd):

Lat. 4785285 ° N

Long. 605454 ° W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

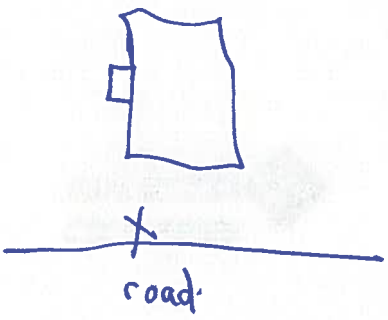
Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

Chimney material (please check one):

- [ ] Brick
- [x] Stucco
- [ ] Concrete
- [x] Stone
- [ ] Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.



If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- [ ] Cap
- [x] Terra Cotta Liner
- [ ] Animal Guard
- [ ] Spark Protector
- [ ] Metal Liner
- [ ] Other, please specify: _____

Surrounding habitat (please check one):

- [x] Residential (road.)
- [ ] Industrial
- [ ] Commercial
- [ ] Natural
- [ ] Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- [ ] Round → Diameter (cm): _____
- [x] Square → Width (cm): 40 cm
- [ ] Rectangular → Width (cm): _____ Length (cm): _____

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form 19

Page 2

Chimney height above roofline (m): 2	Number of Flues: 1	Colour of Chimney: Gray

Total Chimney Height (m) = 1 (Number of stories in building) × 3 m (approx height of one story) + 2 (Height above roofline (m)) = 5 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None seen.

Barn Swallow foraging. Apparently suitable nesting sites nearby.

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada / Environnement Canada
Ontario Region / Région de l'Ontario

McIlwraith Field Naturalists

20

Chimney Assessment Form

Observer Details

Name	Phone Number	Email Address
D. Graham	( )	

Street Address	City	Prov.	Postal Code

Building Details

Street Address	City	Prov.	Postal Code
196 Fruitland Rd	Ham. Han	ON	

Owner Name	Phone Number	Email Address
	( )	

Type of building (please check one):

- [x] House
- [ ] Church
- [ ] Store
- [ ] Lowrise Apartment
- [ ] School
- [ ] Factory
- [ ] Highrise Apartment
- [ ] Hospital
- [ ] Other, please specify: _____

Chimney Details

Site Name: 196 Fruitland

Chimney Code: H-

GPS coordinates (DD.dddd):

Lat. 4785502 ° N

Long. 605353 ° W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

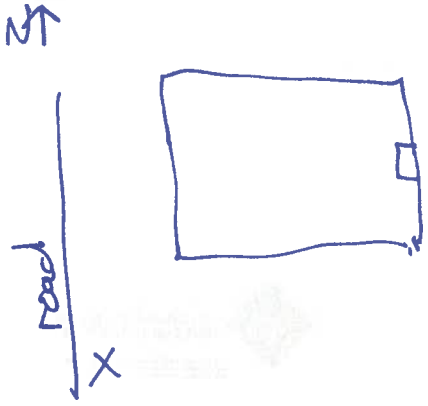
Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

Chimney material (please check one):

- [x] Brick
- [ ] Stucco
- [ ] Concrete
- [ ] Stone
- [ ] Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.



If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- [x] Cap
- [ ] Terra Cotta Liner
- [ ] Animal Guard
- [ ] Spark Protector
- [x] Metal Liner
- [ ] Other, please specify: _____

Surrounding habitat (please check one):

- [x] Residential
- [ ] Industrial
- [ ] Commercial
- [ ] Natural
- [ ] Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- [ ] Round → Diameter (cm): _____
- [ ] Square → Width (cm): _____
- [x] Rectangular → Width (cm): 15 Length (cm): 30

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

20

Chimney height above roofline (m):	0.5	Number of Flues:	1	Colour of Chimney:	Brown

Total Chimney Height (m) = 2 (Number of stories in building) × 3 m (approx height of one story) + 1 (Height above roofline (m)) = 7 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None seen

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

THE ONTARIO TRILLIUM FOUNDATION / LA FONDATION TRILLIUM DE L'ONTARIO

Environment Canada / Environnement Canada
Ontario Region / Région de l'Ontario

McIlwraith Field Naturalists

21

Chimney Assessment Form

Observer Details

Name	Phone Number	Email Address		
D. Graham	( )			
Street Address	**City**	**Prov.**	**Postal Code**	

Building Details

Street Address	City	Prov.	Postal Code
222 Fruitland Rd	Hamilton	ON	
Owner Name	**Phone Number**	**Email Address**	
	( )		

Type of building (please check one):

- [x] House
- [ ] Church
- [ ] Store
- [ ] Lowrise Apartment
- [ ] School
- [ ] Factory
- [ ] Highrise Apartment
- [ ] Hospital
- [ ] Other, please specify: _____

Chimney Details

Site Name: 222 Fruitland

Chimney Code: H-222-1

GPS coordinates (DD.dddd):

Lat. 4985727 ° N

Long. 605406 ° W

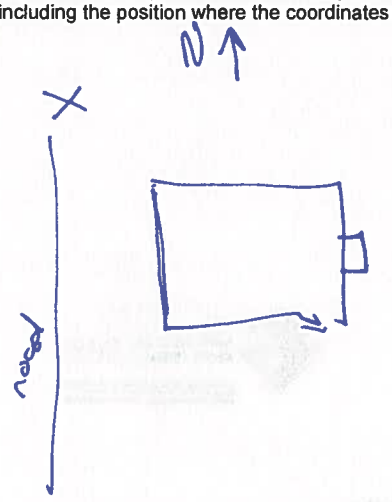
NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.



Chimney material (please check one):

- [ ] Brick
- [ ] Stucco
- [x] Concrete
- [ ] Stone
- [ ] Other, please specify: _____

If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- [x] Cap
- [ ] Terra Cotta Liner
- [ ] Animal Guard
- [ ] Spark Protector
- [ ] Metal Liner
- [ ] Other, please specify: _____

Surrounding habitat (please check one):

- [x] Residential/rural
- [ ] Industrial
- [ ] Commercial
- [ ] Natural
- [ ] Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- [ ] Round → Diameter (cm): _____
- [ ] Square → Width (cm): _____
- [x] Rectangular → Width (cm): 20 Length (cm): 60

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

21

Chimney height above roofline (m):	1	Number of Flues:	1	Colour of Chimney:	Gray

Total Chimney Height (m) = 2 (Number of stories in building) × 3 m (approx height of one story) + 1 (Height above roofline (m)) = 7 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None seen.

Barn Swallow foraging overhead

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada Ontario Region / Environnement Canada Région de l'Ontario

McIlwraith Field Naturalists

22

Chimney Assessment Form

Observer Details

Name	Phone Number	Email Address
D. Graham	( )	

Street Address	City	Prov.	Postal Code

Building Details

Street Address	City	Prov.	Postal Code
250 Fruitland Rd	Hamilton	ON	

Owner Name	Phone Number	Email Address
	( )	

Type of building (please check one):

- [x] House
- [ ] Church
- [ ] Store
- [ ] Lowrise Apartment
- [ ] School
- [ ] Factory
- [ ] Highrise Apartment
- [ ] Hospital
- [ ] Other, please specify: _____

Chimney Details

Site Name: 250 Fruitland

Chimney Code: H-250-1

GPS coordinates (DD.dddd):

Lat. 4785921 ° N

Long. 605459 ° W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

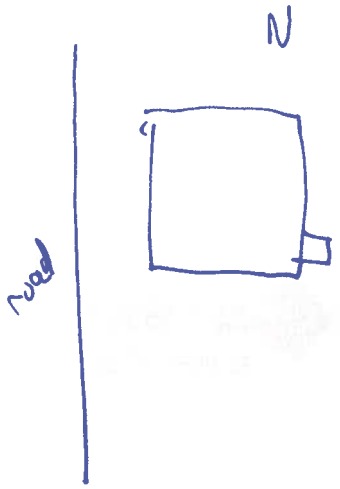
Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

Chimney material (please check one):

- [x] Brick
- [ ] Stucco
- [ ] Concrete
- [ ] Stone
- [ ] Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.



If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- [x] Cap
- [ ] Terra Cotta Liner
- [ ] Animal Guard
- [x] Spark Protector
- [ ] Metal Liner
- [ ] Other, please specify: _____

Surrounding habitat (please check one):

- [x] Residential / Rural
- [ ] Industrial
- [ ] Commercial
- [ ] Natural
- [ ] Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- [ ] Round → Diameter (cm): _____
- [ ] Square → Width (cm): _____
- [x] Rectangular → Width (cm): 25 Length (cm): 50

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

22

Chimney height above roofline (m): 3	Number of Flues: 1	Colour of Chimney: Brown

Total Chimney Height (m) = 1 (Number of stories in building) × 3 m (approx height of one story) + 3 (Height above roofline (m)) = 6 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None seen

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada / Environnement Canada
Ontario Region / Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

23

Page 1

Observer Details

Name	Phone Number	Email Address
D. Graham	( )	

Street Address	City	Prov.	Postal Code

Building Details

Street Address	City	Prov.	Postal Code
288 Fruitland Rd	Hamilton	ON	

Owner Name	Phone Number	Email Address
	( )	

Type of building (please check one):

- [x] House
- [ ] Church
- [ ] Store
- [ ] Lowrise Apartment
- [ ] School
- [ ] Factory
- [ ] Highrise Apartment
- [ ] Hospital
- [ ] Other, please specify: _____

Chimney Details

Site Name: 288 Fruitland

Chimney Code: H-288-1

GPS coordinates (DD.dddd):

Lat. 4786204 ° N

Long. 605526 ° W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

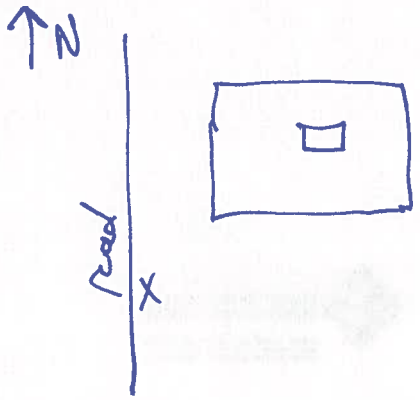
Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

Chimney material (please check one):

- [ ] Brick
- [ ] Stucco
- [x] Concrete
- [ ] Stone
- [ ] Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.



If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- [x] Cap
- [ ] Terra Cotta Liner
- [ ] Animal Guard
- [ ] Spark Protector
- [ ] Metal Liner
- [ ] Other, please specify: _____

Surrounding habitat (please check one):

- [x] Residential / rural
- [ ] Industrial
- [ ] Commercial
- [ ] Natural
- [ ] Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- [ ] Round → Diameter (cm): _____
- [x] Square → Width (cm): 50
- [ ] Rectangular → Width (cm): _____ Length (cm): _____

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

23

Chimney height above roofline (m):	Number of Flues:	Colour of Chimney:
1	1	Gray

Total Chimney Height (m) = 2 (Number of stories in building) × 3 m (approx height of one story) + 1 (Height above roofline (m)) = 7 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None seen

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

THE ONTARIO TRILLIUM FOUNDATION / LA FONDATION TRILLIUM DE L'ONTARIO

Environment Canada / Environnement Canada
Ontario Region / Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

24

Observer Details

Name	Phone Number	Email Address
D. Graham	( )	

Street Address	City	Prov.	Postal Code

Building Details

Street Address	City	Prov.	Postal Code
287 Jones Rd.	Hamilton	ON	

Owner Name	Phone Number	Email Address
	( )	

Type of building (please check one):

- [x] House
- [ ] Church
- [ ] Store
- [ ] Lowrise Apartment
- [ ] School
- [ ] Factory
- [ ] Highrise Apartment
- [ ] Hospital
- [ ] Other, please specify: _____

Chimney Details

Site Name: 287 Jones

Chimney Code: H-287

GPS coordinates (DD.dddd):

Lat. 4785965 ° N

Long. 606379 ° W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

Chimney material (please check one):

- [ ] Brick
- [ ] Stucco
- [x] Concrete
- [ ] Stone
- [ ] Other, please specify: _____

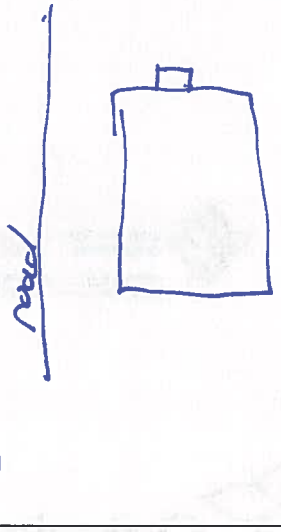
If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- [x] Cap
- [ ] Terra Cotta Liner
- [ ] Animal Guard
- [ ] Spark Protector
- [ ] Metal Liner
- [ ] Other, please specify: _____

Surrounding habitat (please check one):

- [x] Residential / Rural
- [ ] Industrial
- [ ] Commercial
- [ ] Natural
- [ ] Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.



Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- [ ] Round → Diameter (cm): _____
- [x] Square → Width (cm): 50
- [ ] Rectangular → Width (cm): _____ Length (cm): _____

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

24

Chimney height above roofline (m): 1	Number of Flues: 1	Colour of Chimney: Gray

Total Chimney Height (m) = 1 (Number of stories in building) × 3 m (approx height of one story) + 1 (Height above roofline (m)) = 4 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None seen

Created by:

Canadian co-partner of
un partenaire canadien de

In partnership with:

Chimney Assessment Form

25

Observer Details

Name	Phone Number	Email Address
D. Graham	( )	

Street Address	City	Prov.	Postal Code

Building Details

Street Address	City	Prov.	Postal Code
259 Jones Rd	Ham. Hon	ON	

Owner Name	Phone Number	Email Address
	( )	

Type of building (please check one):

- [x] House
- [ ] Church
- [ ] Store
- [ ] Lowrise Apartment
- [ ] School
- [ ] Factory
- [ ] Highrise Apartment
- [ ] Hospital
- [ ] Other, please specify: _____

Chimney Details

Site Name: 259 Jones

Chimney Code: H-259

GPS coordinates (DD.dddd):

Lat. 4785796 ° N

Long. 606335 ° W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

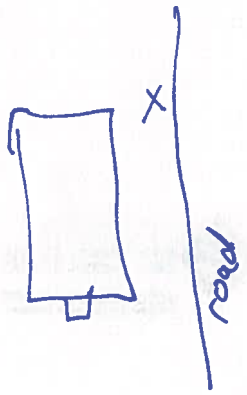
Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

Chimney material (please check one):

- [x] Brick
- [ ] Stucco
- [ ] Concrete
- [ ] Stone
- [ ] Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.



If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- [ ] Cap
- [x] Terra Cotta Liner
- [ ] Animal Guard
- [ ] Spark Protector
- [ ] Metal Liner
- [ ] Other, please specify: _____

Surrounding habitat (please check one):

- [x] Residential / Rural
- [ ] Industrial
- [ ] Commercial
- [ ] Natural
- [ ] Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- [ ] Round → Diameter (cm): _____
- [ ] Square → Width (cm): _____
- [x] Rectangular → Width (cm): 50 Length (cm): 80

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form 25

Chimney height above roofline (m): 2.5	Number of Flues: 1	Colour of Chimney: Brown

Total Chimney Height (m) = 1 (Number of stories in building) × 3 m (approx height of one story) + 2.5 (Height above roofline (m)) = 5.5 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None seen

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

THE ONTARIO TRILLIUM FOUNDATION / LA FONDATION TRILLIUM DE L'ONTARIO

Environment Canada / Environnement Canada
Ontario Region / Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form 26

Page 1

Observer Details

Name	Phone Number	Email Address
D. Graham	( )	

Street Address	City	Prov.	Postal Code

Building Details

Street Address	City	Prov.	Postal Code
238 Jones Rd	Ham. Hts	ON	

Owner Name	Phone Number	Email Address
	( )	

Type of building (please check one):

- [x] House
- [ ] Church
- [ ] Store
- [ ] Lowrise Apartment
- [ ] School
- [ ] Factory
- [ ] Highrise Apartment
- [ ] Hospital
- [ ] Other, please specify: _____

Chimney Details

Site Name: 238 Jones

Chimney Code: H-238-1

GPS coordinates (DD.dddd):

Lat. 4785562 ° N

Long. 6062861 ° W

Number of years active (if known):

NOTE: Chimney codes are created using the following scheme:

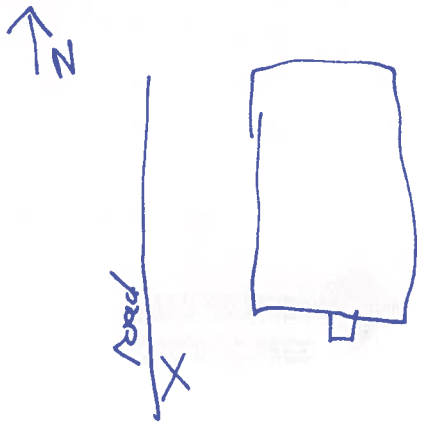
City Initials - Site Initials - Chimney Number

Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Chimney material (please check one):

- [x] Brick
- [ ] Stucco
- [ ] Concrete
- [ ] Stone
- [ ] Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.



If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- [x] Cap
- [ ] Terra Cotta Liner
- [ ] Animal Guard
- [ ] Spark Protector
- [ ] Metal Liner
- [ ] Other, please specify: _____

Surrounding habitat (please check one):

- [x] Residential / rural
- [ ] Industrial
- [ ] Commercial
- [ ] Natural
- [ ] Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- [ ] Round → Diameter (cm): _____
- [ ] Square → Width (cm): _____
- [x] Rectangular → Width (cm): 40 Length (cm): 80

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form 26

Chimney height above roofline (m): 0.5	Number of Flues: 1	Colour of Chimney: Brown

Total Chimney Height (m) = 2 (Number of stories in building) × 3 m (approx height of one story) + 0.5 (Height above roofline (m)) = 6.5 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None seen

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada Ontario Region / Environnement Canada Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

27

Page 1

Observer Details

Name	Phone Number	Email Address
D. Graham	( )	

Street Address	City	Prov.	Postal Code

Building Details

Street Address	City	Prov.	Postal Code
197 Jones Rd	Hamilton	ON.	

Owner Name	Phone Number	Email Address
	( )	

Type of building (please check one):

- [x] House
- [ ] Church
- [ ] Store
- [ ] Lowrise Apartment
- [ ] School
- [ ] Factory
- [ ] Highrise Apartment
- [ ] Hospital
- [ ] Other, please specify: _____

Chimney Details

Site Name: 197 Jones

Chimney Code: H-197-1

GPS coordinates (DD.dddd):

Lat. 4785332 ° N

Long. 606228 ° W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

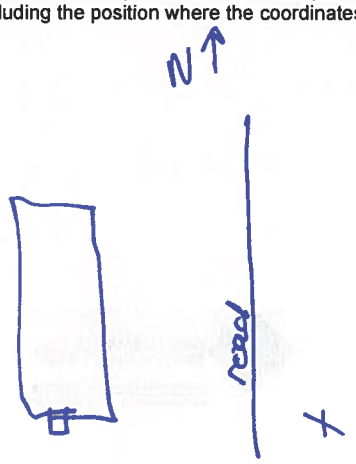
Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

Chimney material (please check one):

- [x] Brick
- [ ] Stucco
- [ ] Concrete
- [ ] Stone
- [ ] Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.



If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- [x] Cap
- [x] Terra Cotta Liner
- [ ] Animal Guard
- [ ] Spark Protector
- [ ] Metal Liner
- [ ] Other, please specify: _____

Surrounding habitat (please check one):

- [x] Residential / rural
- [ ] Industrial
- [ ] Commercial
- [ ] Natural
- [ ] Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- [ ] Round → Diameter (cm): _____
- [ ] Square → Width (cm): _____
- [x] Rectangular → Width (cm): 50 Length (cm): 120

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

27

Chimney height above roofline (m):	1	Number of Flues:	1	Colour of Chimney:	Tan

Total Chimney Height (m)	=	1	×	3 m	+	1	=	4	m
		Number of stories in building		(approx height of one story)		Height above roofline (m)			

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None seen

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada Ontario Region / Environnement Canada Région de l'Ontario

McIlwraith Field Naturalists

Hamilton
60950443 June 25 2012 - wind ≤ 4m
- 20°C
- 10% cloud
- ∅ precip.

CHSW

① Stn 14 - 843 Hwy 8
10:15 - 10:30 - ∅ CHSW observed.

② Stn 15 - 809 - Hwy 8
10:35 - 10:50
→ ∅ CHSW obs. BUT
→ note ★ 3 CHSW obs.
on BBS #10 adjacent to
this stn (earlier)

Daytime Chimney Observation Form

Province: Ontario
City: Hamilton
Site Name: Fruitland Winona
Chimney Code:
GPS Coord. (UTMs or Lat/Long):

Observer Name: D. Graham
Observer Address: Stantec Markham
300-675 Cochrane Dr. West Tower
Telephone: 905-415-6417
E-mail: dan.graham@stantec.com

Date (dd/mm/yy)	Observation start time (hh:mm)	Observation end time (hh:mm)	Visit #	Estimated # of birds using chimney
31/05/12	14:45	21:15	1	

Precipitation	Cloud	Wind	Temperature (°C)
(None) Trace Rain	(1) 2 3 4 5	0 1 ~~2~~ (3) 4 5 6	18° C.

Additional Comments:

No chimneys suitable for chimney swift roosting or nesting were observed at the following 27 sites during a reconnaissance survey conducted May 2012. This additional survey conducted to provide evidence that Chimney Swift is absent as a nesting or roosting species in the Fruitland-Winona Secondary Plan Area

Wind (Beaufort Scale)	Cloud Cover
0 Calm, smoke rises vertically	1 0-25%
1 Light air movement, smoke drifts	2 25-50%
2 Slight breeze, wind felt on face	3 50-75%
3 Gentle breeze, small twigs move	4 75-100%
4 Moderate breeze, small branches move	5 Fog
5 Fresh breeze, small trees sway	
6 Strong breeze, large branches in motion	

Easting & Northing recorded on 2 nd sheet

Station #	Entrances				Exits			
	Time (hh:mm)	# Birds	Time (hh:mm)	# Birds	Time (hh:mm)	# Birds	Time (hh:mm)	# Birds
1	14:45	0			14:45	0		
2	15:00	0			15:00	0		
3	15:15	0			15:15	0		
4	15:30	0			15:30	0		
5	15:45	0			15:45	0		
6	16:00	0			16:00	0		
7	16:20	0			16:20	0		
8	16:40	0			16:40	0		
9	17:00	0			17:00	0		
10	17:20	0			17:20	0		
11	17:40	0			17:40	0		
12	18:00	0			18:00	0		
13	18:20	0			18:20	0		
14	18:40	0	2 birds flew over but made no effort to fly into Chimney Site and adjacent House Chimneys unsuited for CHSW using criteria in the CHSW Monitoring Protocol.		18:40	0		
15	19:00	0			19:00	0		

Incidental:

Barn Swallow seen @ #7, #6, #14, #18, #19
Cooper's Hawk: #19
C. Nighthawk (THR) #22

Daytime Chimney Observation Form

Entrances

	Time (hh:mm)	# Birds	Time (hh:mm)	# Birds
16	19:20	0		
17	19:40	0		
18	20:00	0		
19	20:15	0		
20	20:30	0		
21	20:40	0		
22	20:50	0		
23	21:00	0		
24				
25				
26				
27				

Exits

Time (hh:mm)	# Birds	Time (hh:mm)	# Birds
19:20	0		
19:40	0		
20:00	0		
20:15	0		
20:30	0		
20:40	0		
20:50	0		
21:00	0		

Property	Site Number	Easting	Northing
660 Barton	1	605674	4786287
692 Barton	2	605881	4786235
720 Barton	3	606102	4786169
748 Barton	4	606297	4786111
788 Barton	5	606527	4786043
822 Barton	6	606758	4785968
844 Barton	7	606904	4785915
884 Barton	8	607206	4785821
Barton (Stoney Creek Christian Fellowship)	9	607304	4785777
26 Glover	10	607173	4785563
239 Glover	11	607101	4785327
Glover (Kingdom Hall of Jehovah's Witness	12	607057	4785169
873 Hwy 8	13	606915	4785087
843 Hwy 8	14	606734	4785187
809 Hwy 8	15	43.12	79.41
777 Hwy 8	16	43.12	79.41
743 Hwy 8	17	605959	4785182
703 Hwy 8	18	605701	4785231
669 Hwy 8	19	605454	4785285
196 Fruitland	20	605353	4785502
222 Fruitland	21	605406	4785727
250 Fruitland	22	605459	4785921
288 Fruitland	23	605526	4786204
287 Jones	24	606379	4785965
259 Jones	25	606335	4785796
238 Jones	26	606281	4785562
197 Jones	27	606228	4785332

CHSW
606448; 4785209
606241; 4785242

May 31st Daytime Chimney Swift Survey

Comments

Site 2: AMKE, a declining grassland species observed overflying site - adjacent properties. Chimneys of subject property & adjacent properties appeared unsuitable for species based on criteria contained in the CHSW Monitoring Protocol.

Site 14: 2 CHSW aerial foraging over site. Birds made no effort to fly into chimney of this or

Site 15: As at site 14, only differing in 4 CHSW aerial foraging

Daytime Chimney Observation Form

Province: Ontario
City: Hamilton
Site Name: Fruitland - Winona
Chimney Code:
GPS Coord. (UTMs or Lat/Long):

Observer Name: ~~D. Goodhram~~ N. KOPYSH.
Observer Address: Stantec Markham 300-675 Cochrane Dr West Tower
Telephone: 905-415-6417
E-mail: ~~dan.goodham~~@stantec.com nicole.kopysh

Date (dd/mm/yy)	Observation start time (hh:mm)	Observation end time (hh:mm)	Visit #	Estimated # of birds using chimney
12/06/12	08:15	09:15	1	

Precipitation	Cloud	Wind	Temperature (°C)
(None) Trace Rain	1 2 3 (4) 5	0 1 2 (3) 4 5 6	20°C.

Additional Comments:

Wind (Beaufort Scale)	Cloud Cover
0 Calm, smoke rises vertically	1 0-25%
1 Light air movement, smoke drifts	2 25-50%
2 Slight breeze, wind felt on face	3 50-75%
3 Gentle breeze, small twigs move	4 75-100%
4 Moderate breeze, small branches move	5 Fog
5 Fresh breeze, small trees sway	
6 Strong breeze, large branches in motion	

Station #

Entrances

	Time (hh:mm)	# Birds	Time (hh:mm)	# Birds
24	08:15	Ø		
25	08:30	Ø		
26	08:45	Ø		
27	09:00	Ø		

Exits

Time (hh:mm)	# Birds	Time (hh:mm)	# Birds
09:15	Ø		
08:30	Ø		
08:45	Ø		
09:00	Ø		

Daytime Chimney Observation Form

Page 2

Entrances

Time (hh:mm)	# Birds	Time (hh:mm)	# Birds

Exits

Time (hh:mm)	# Birds	Time (hh:mm)	# Birds

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, ON
Canada N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Birding Point Counts Survey Observation Form

Project Number: 160950443 Project Name: Scube parcels

Date: July 12, 2012 Field Personnel: D. Graham

Weather Conditions:	TEMP (°C):	WIND:	CLOUD:	PPT:	PPT (in last 24 hrs):
	16- 25	0-1	10%	None	None

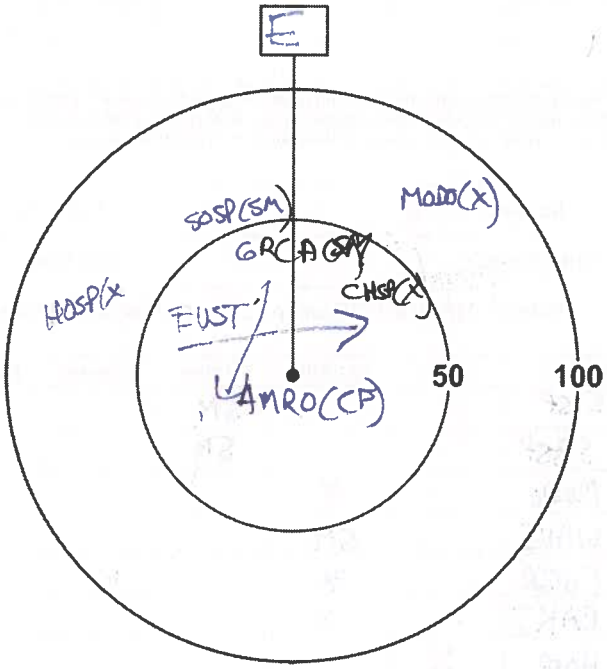
GPS #: T

Station: 1 Feature: UTM: 607994 4785266

Start Time: 5:30 End Time: 5:35

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop residential

Species	<50m	50-100m	>100m	Flyovers	Height*
MODO		X			
SOSP		SM			
GRCA	SM				
CHSP	X				
EUST	X			✓	
AMRO	CF				
HOSP		X			



** Height of blade sweep varies from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep

Page ___ of ___

Quality Control: This form is complete ☐ & legible ☐.

Signature: _____ (Field Personnel)

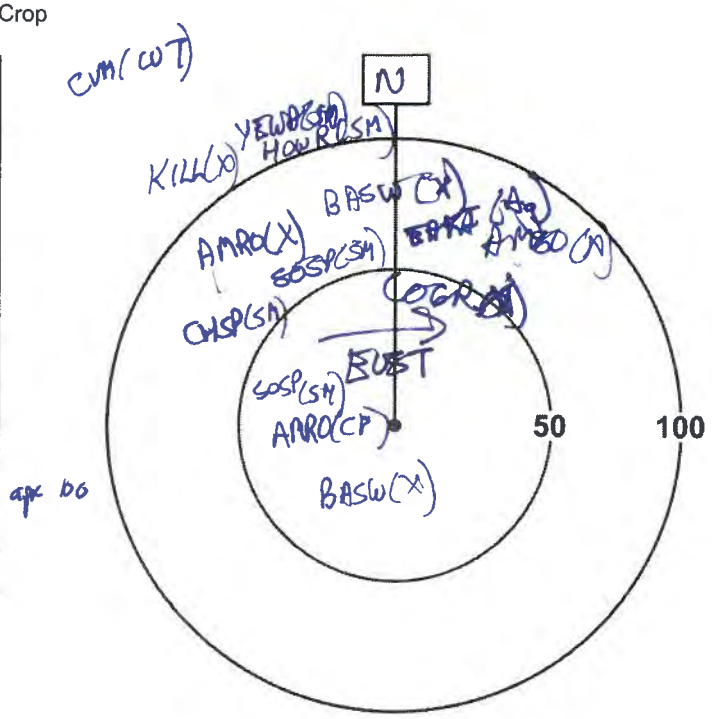
Signature: _____ (Project Manager)

Station: 2 Feature: UTM: 608483 4784921

Start Time: 5 45 End Time: 5 50

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
YEWA			SM		
HOWR			SM		
KILL			X		
AMRO	CF	X			
CHSP		SM			
BASW	V	X		✓	
SOSP	SM	SM			
EAKI		Ag			
AMGO		X		✓	
COGR	X			✓	
EUST	X			✓	



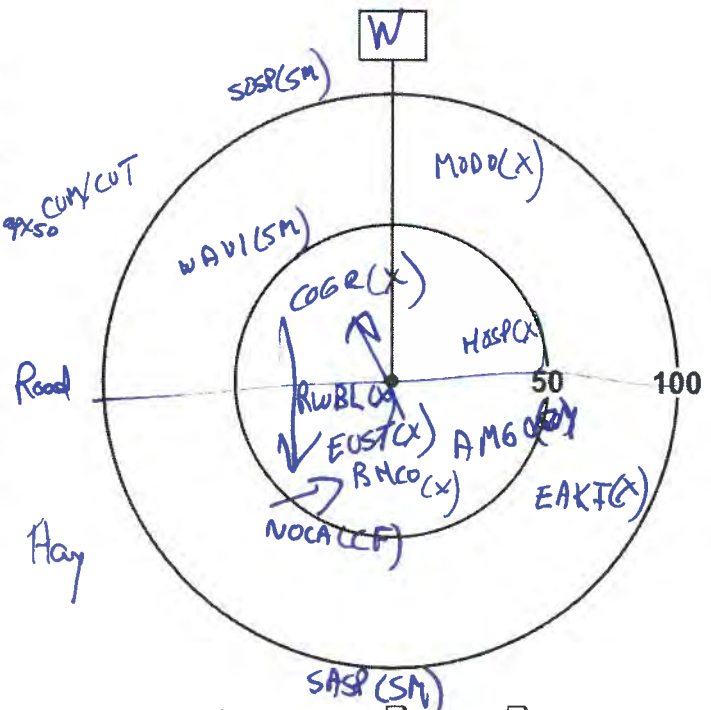
* Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Station: 3 Feature: UTM: 608816 4785156

Start Time: 6 00 End Time: 6 10

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
SOSP			SM		
SASP			SM		
MODO		X			
WAVI		SM			
COGR		X		✓	
EAKI		X			
HOSP	X				
AMGO	SM				
RWBL	X			✓	
EUST	X				
BHCO	X				
NOCA		CF			



* Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Page ___ of ___

Signature: _____
(Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature: _____
(Project Manager)

REV: 2011-05-04 / FORM 020

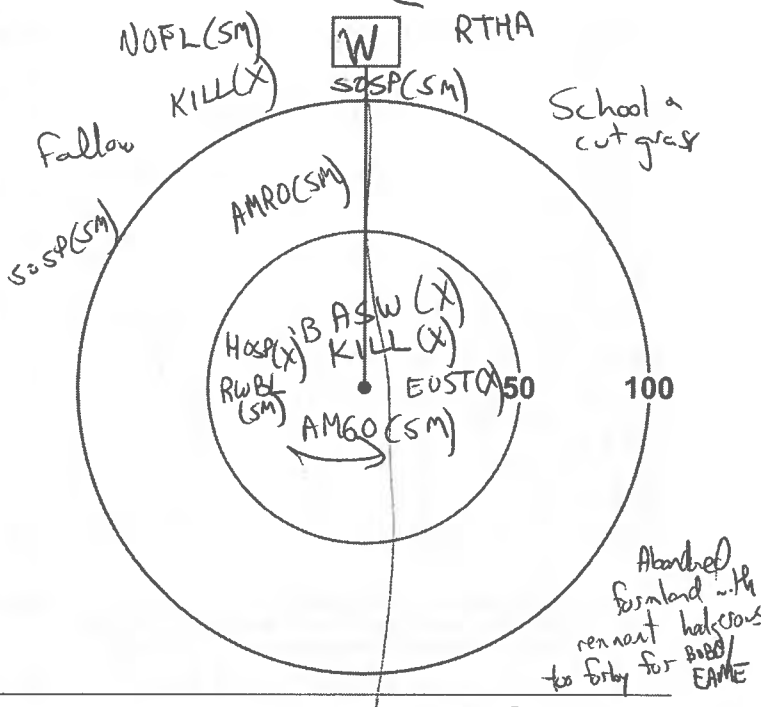
Station: 4 Feature: UTM: 608758 4785292

Start Time: 6^15 End Time: 6^20

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
RTHA			8 FY	✓	
NOFL			SM		
KILL	X		X		
SOSP			SM		
AMRO		SM			
BASW	3 X			✓	
HOSP	X				
RWBL	SM				
AMGO	SM				
EUST	X				

** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep



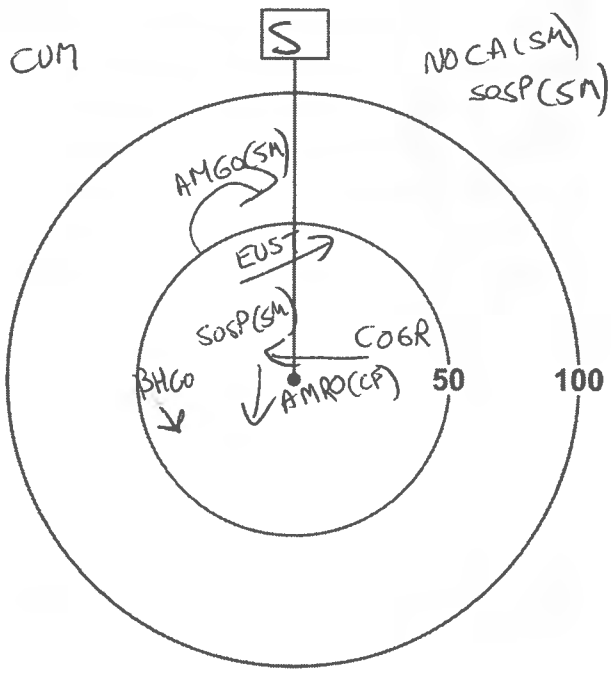
Station: 5 Feature: UTM: 608294 4785534

Start Time: 6^35 End Time: 6^40

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
NOCA			SM		
SOSP	SM		SM		
AMGO		SM			
EUST	X			✓	
COGR	X			✓	
AMRO	CF				
BHCO	X			✓	

** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep



Page ___ of ___

Quality Control: This form is complete ❑ & legible ❑.

Signature: _____ (Field Personnel)

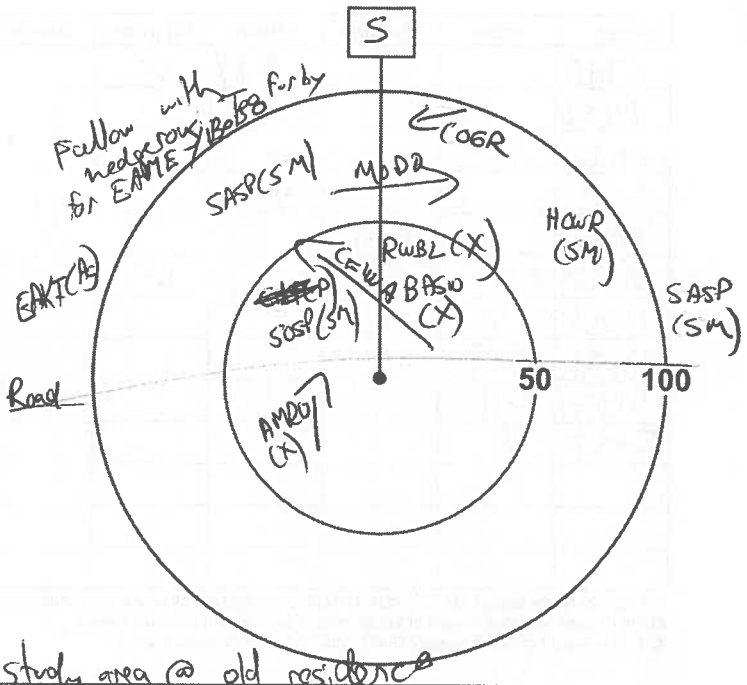
Signature: _____ (Project Manager)

Station: 6 Feature: UTM: 608587

Start Time: 6:45 End Time: 6:50 4785464

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
EAKI			Ag		
SASP		SM	SM		
COGR		X		✓	
MODO		X		✓	
HOWR		SM			
RWBL	X				
CEWA	X			✓	
BASW	X			✓	
SOSP	SM				
AMRO	X				
CF					



* *Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep

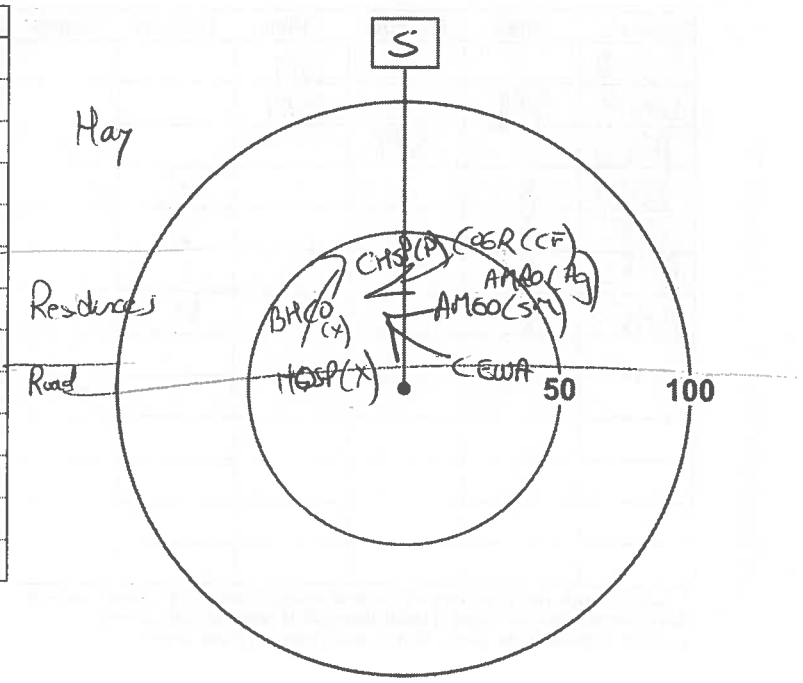
Butternut or hybrid butternut noted just north of study area @ old residence

Station: 7 Feature: UTM: 609246

Start Time: 6:55 End Time: 7:00 4785339

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
COGR	CF				
AMRO	Ag				
AMGO	SM				
CEWA	X				
HOSP	X				
BHCO	X			✓	
CHSP	P				



* *Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep

Page ___ of ___

Quality Control: This form is complete ☐ & legible ☐.

Signature: _____ (Field Personnel)

Signature: _____ (Project Manager)

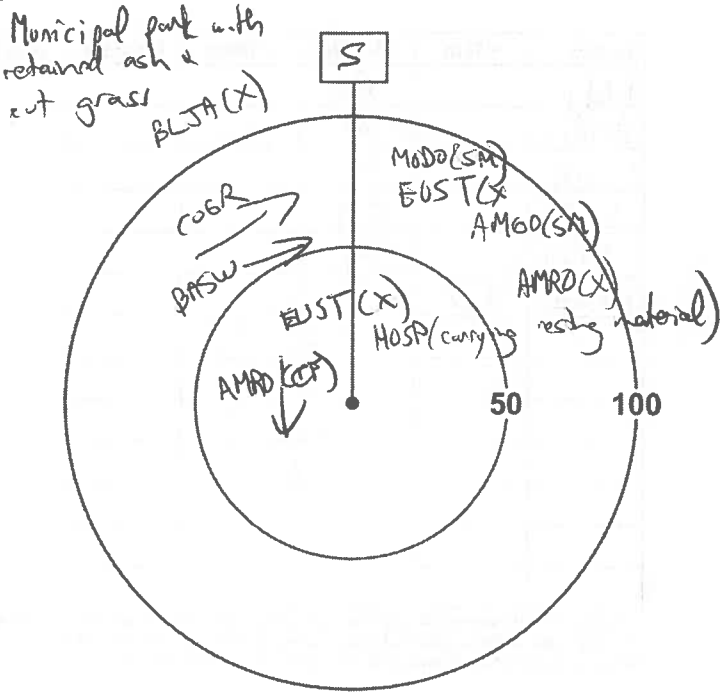
REV: 2011-05-04 / FORM 020

Station: 8 Feature: UTM: 610065 4785097

Start Time: 705 End Time: 710

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
BLJA			X		
COGR		X		✓	
MODO		SM			
EUST	X	X			
AMGO		SM			
AMRO	CF	X			
HOSP	carrying	nesting	material		
BASW		X			



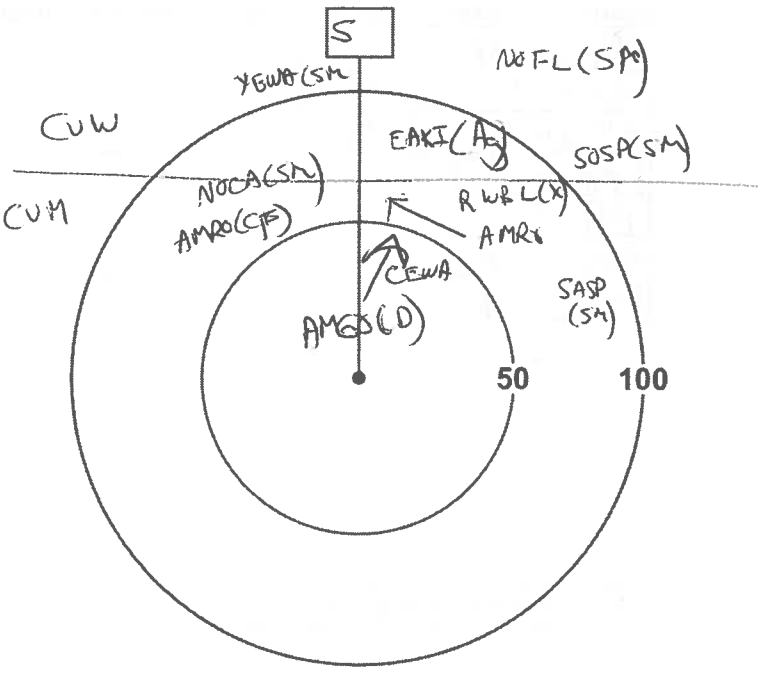
*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep

Station: 9 Feature: UTM: 610535 478553

Start Time: 720 End Time: 725

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
YEWA			SM		
NOFL			SM		
EAKI		Ag			
SOSP			SM		
NOCA		SM			
AMRO		CF		✓	
CEWA	X				
AMGO	D				
SASP		SM			
RWBL		X			



*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep

Page ___ of ___

Quality Control: This form is complete ❑ & legible ❑.

Signature: _____ (Field Personnel)

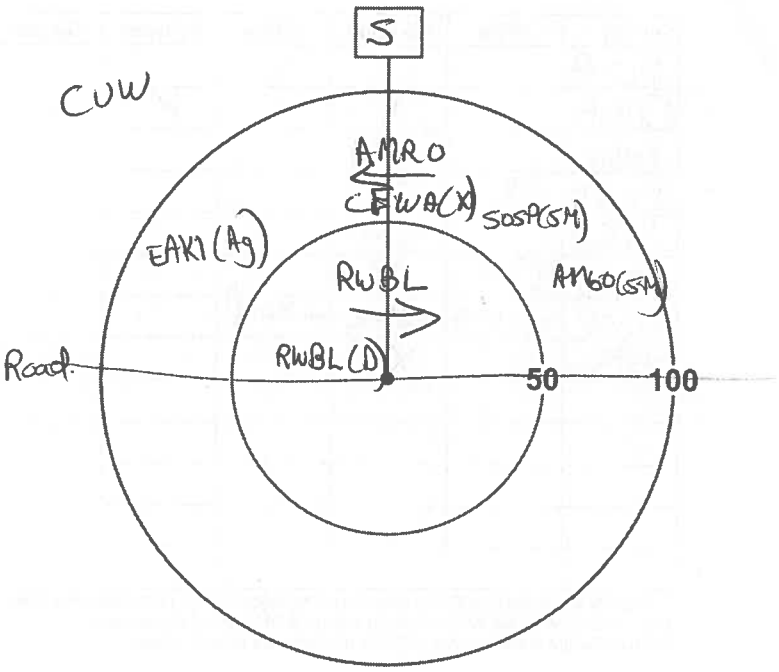
Signature: _____ (Project Manager)

Station: 10 Feature: UTM: 610406 4785845

Start Time: 730 End Time: 735

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
EAKI		Ag			
AMRO		X			
CEWA		X			
SOSP		SM			
AMGO		SM			
RWBL	D				



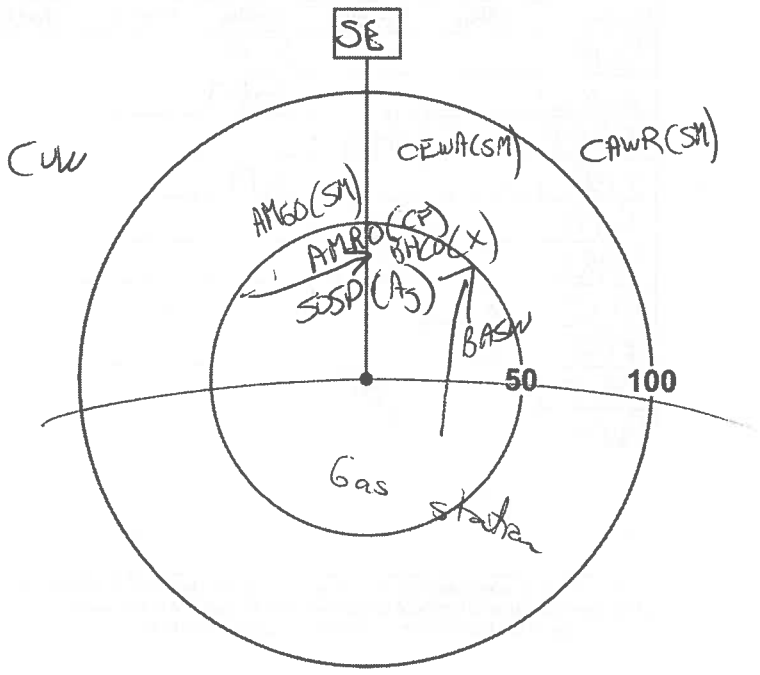
*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Station: 11 Feature: UTM: 610234 4785771

Start Time: 745 End Time: 750

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
CAWR	SM				
CEWA		SM			
AMGO		SM			
AMRO	CF				
BHCO	X				
SOSP	Ag				
BASW	X			✓	



*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Page ___ of ___

Signature: _____
(Field Personnel)

Quality Control: This form is complete ❑ & legible ❑.

Signature: _____
(Project Manager)

REV: 2011-05-04 / FORM 020

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, ON
Canada N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Birding Point Counts Survey Observation Form

Project Number: 160950443 Project Name: Scube Parcels

Date: July 12, 2012 Field Personnel:

Weather Conditions:	TEMP (°C):	WIND:	CLOUD:	PPT:	PPT (in last 24 hrs):
	16-25	0-1	10%	None	None

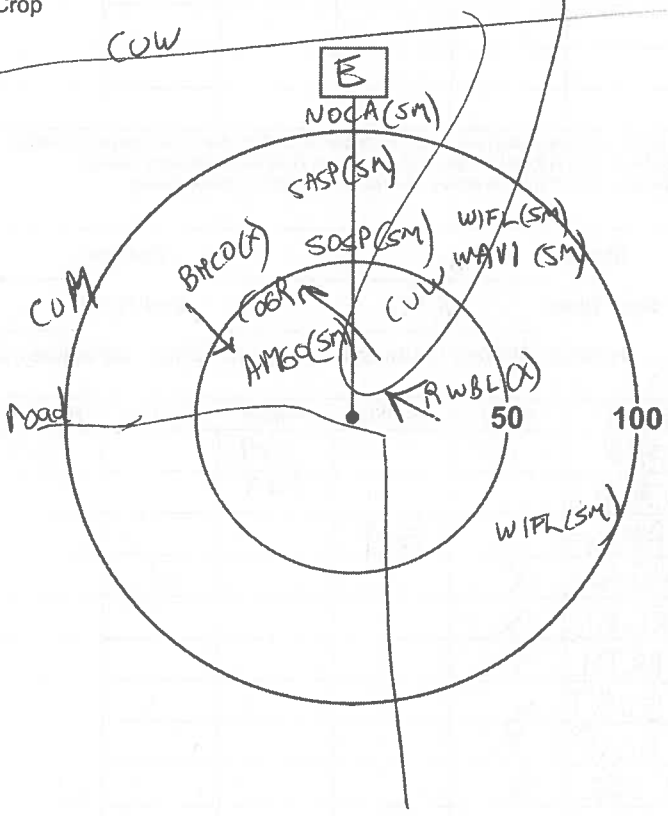
GPS #: T

Station: 12 Feature: UTM: 610037 4785737

Start Time: 7^50 End Time: 7^55

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
NOCA			SM		
SASP		SM			
SOSP		SM			
BHCO	X			✓	
COGR	X			✓	
AMGO	SM				
WIFL		SM			
WAVI		SM			
RWBL	X			✓	



** Height of blade sweep varies from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep

Page ___ of ___

Quality Control: This form is complete ☐ & legible ☐.

Signature: _____ (Field Personnel)

Signature: _____ (Project Manager)

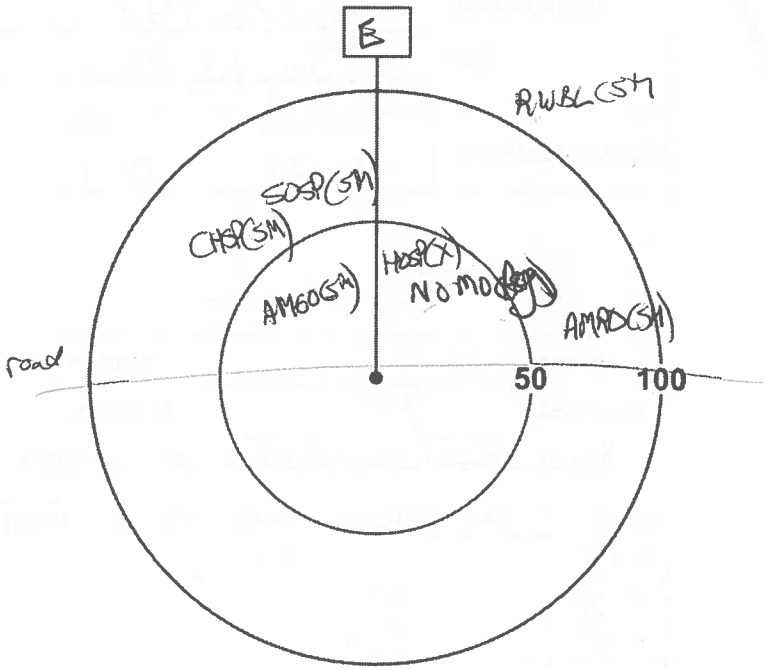
REV: 2011-05-04 / FORM 020

Station: 13 Feature: UTM: 610049

Start Time: 800 End Time: 4785387

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
RWBL			SM		
SOSP		SM			
CHSP		SM			
AMGO	SM				
HOSP	X				
NOMO	Ag				
AMRO		SM			



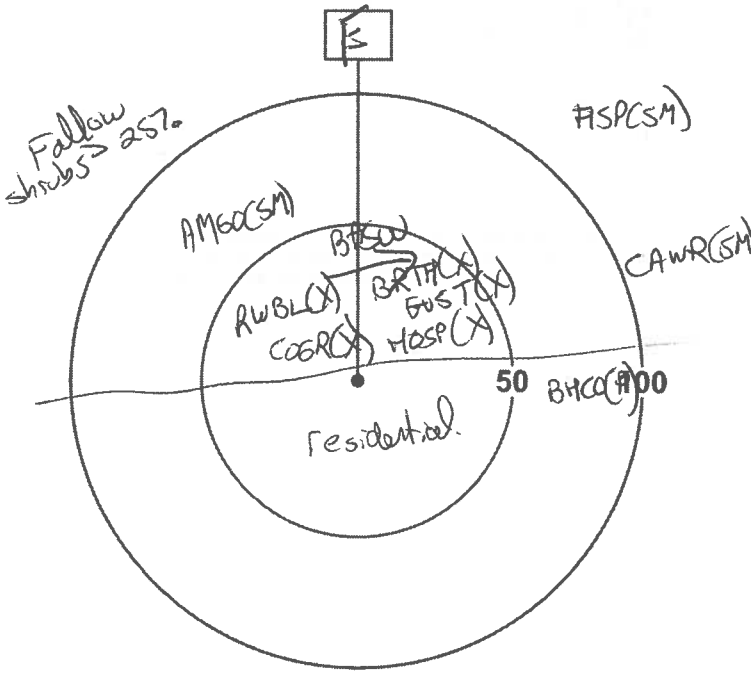
*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep

Station: 14 Feature: UTM: 609860

Start Time: 815 End Time: 820 4785605

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
FISP			SM		
CAWR			SM		
AMGO		SM			
BASW	X			✓	
RWBL	X				
BRTH	X				
EUST	X				
HOSP	X				
COGR	X				
BHCO		P			



*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep

Page ___ of ___

Quality Control: This form is complete ❑ & legible ❑.

Signature: _____ **Signature:** _____

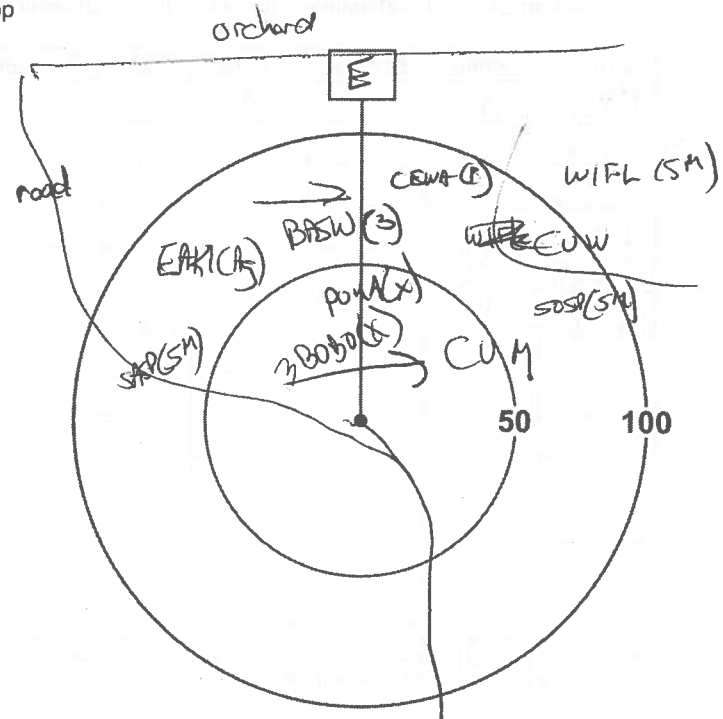
(Field Personnel) (Project Manager)

REV: 2011-05-04 / FORM 020

Station: 16 Feature: UTM: 608784
Start Time: 8 35 End Time: 840 4785104

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
WIFL			SM		
CEWA		P			
BASW		X		✓	
PUMA	X			✓	
EAKI		Ag			
SASP		SM			
BOBO	3X			✓	
SOSP		SM			



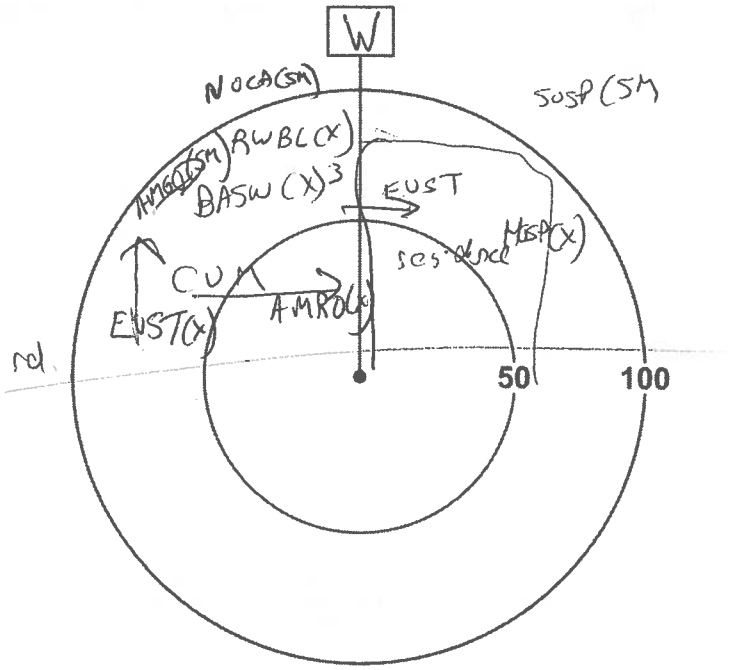
* *Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep

Incidental: BAOR

Station: ~~15~~ 15 Feature: UTM: 610787
Start Time: 905 End Time: 910 4785550

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
NOCA			SM		
RWBL		X			
BASW		X(3)			
AMGO		SM			
EUST		X			
AMRO	X				
HOSP		X			
SOSP			SM		



* *Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep

Page ___ of ___

Signature: _____
(Field Personnel)

Quality Control: This form is complete ❑ & legible ❑.

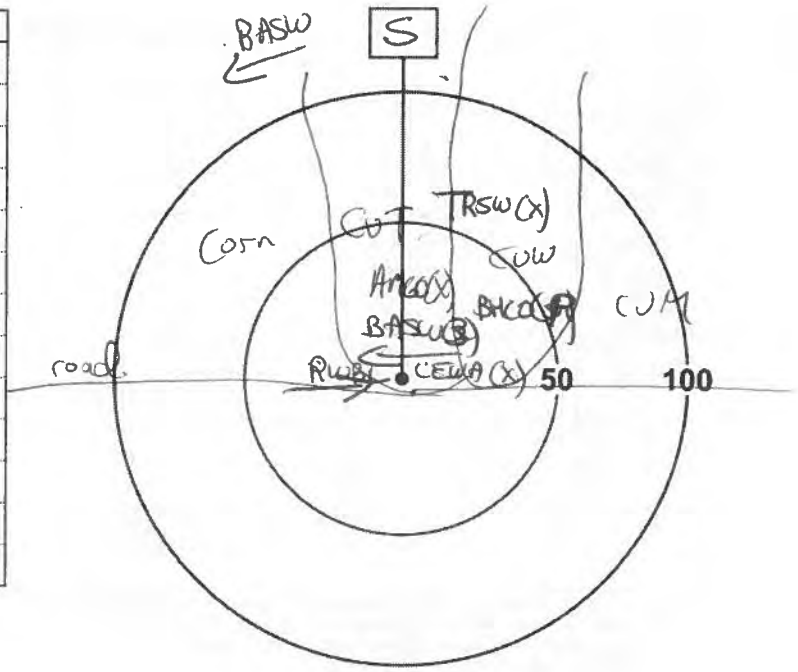
Signature: _____
(Project Manager)

Station: 17 **Feature:** _____ **UTM:** 611228 4785587

Start Time: 8:50 **End Time:** 8:55

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
BASW	3X		X	✓✓✓✓	
TRSW		X		✓	
BHCO	P				
AMGO	X				
CEWA	X				
RWBL	X			✓	



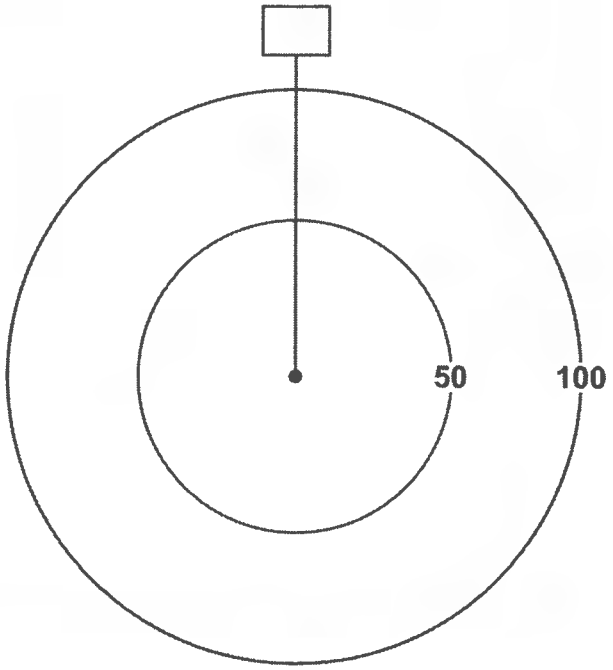
** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep

Station: _____ **Feature:** _____ **UTM:** _____

Start Time: _____ **End Time:** _____

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*



** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep

Page ___ of ___

Quality Control: This form is complete ❑ & legible ❑.

Signature: _____ (Field Personnel)

Signature: _____ (Project Manager)

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, ON
Canada N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Stantec

Birding Point Counts Survey Observation Form

Project Number: 160950443 Project Name: HAMILTON – SCUBE

Date: JULY 4, 2012 Field Personnel: MICHAEL OLIVEIRA

Weather Conditions:	TEMP (°C):	WIND:	CLOUD:	PPT:	PPT (in last 24 hrs):
	19°C	1	20%	Ø	Ø

GPS #: T N/A

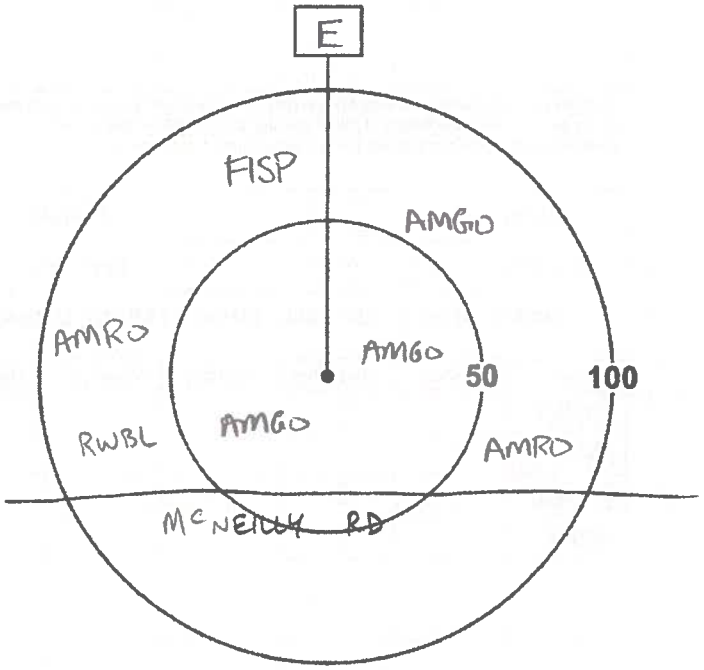
Station: 1 Feature: UTM: 0607994

Start Time: 05:43 End Time: 05:48 4785266

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
AMGO	2	1			
AMRO		2			
FISP		1			
RWBL		1			

** Height of blade sweep varies from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep



Signature: (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature: (Project Manager)

REV: 2011-05-04 / FORM 020

als w:\resource\internal info and teams\field forms\birds\breeding bird\form_020_bird-point-counts-survey_2-sided.docx

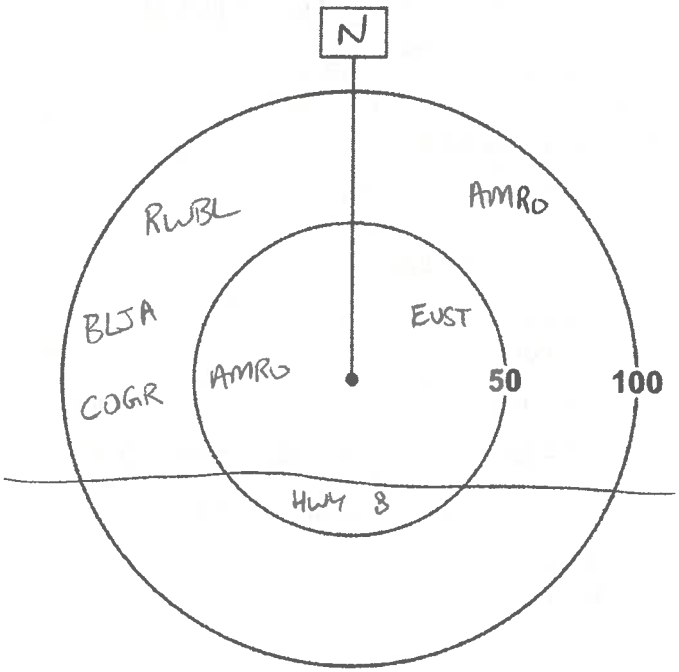
Station: 2 **Feature:** **UTM:** 0608483 4784921

Start Time: 05:57 **End Time:** 06:02

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
AMRO	1	1			
RWBL		1			
BLJA		1			
COGR		1			
EUST	1				

** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep



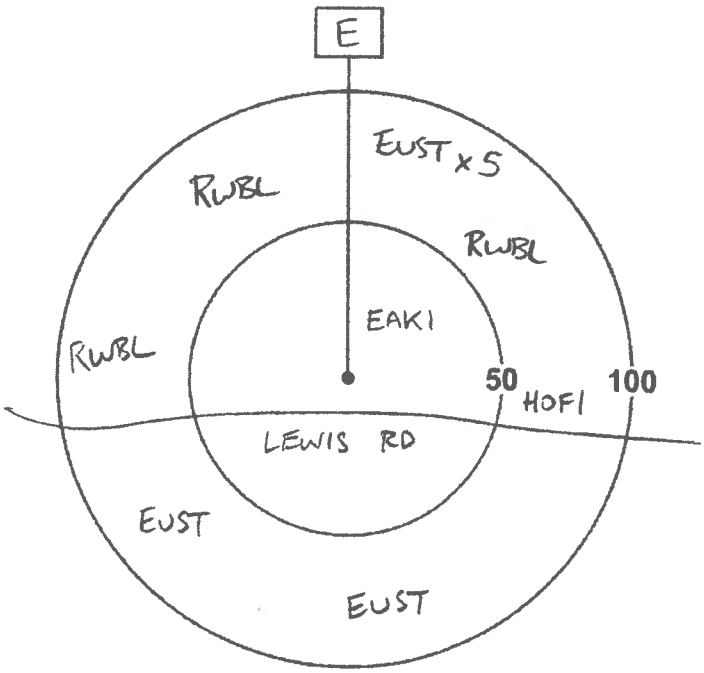
Station: 3 **Feature:** **UTM:** 0608813 4785148

Start Time: 6:09 **End Time:** 6:14

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
EUST		7			
EAKI	1				
RWBL		3			
HOFI		1			

** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep



Signature: (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

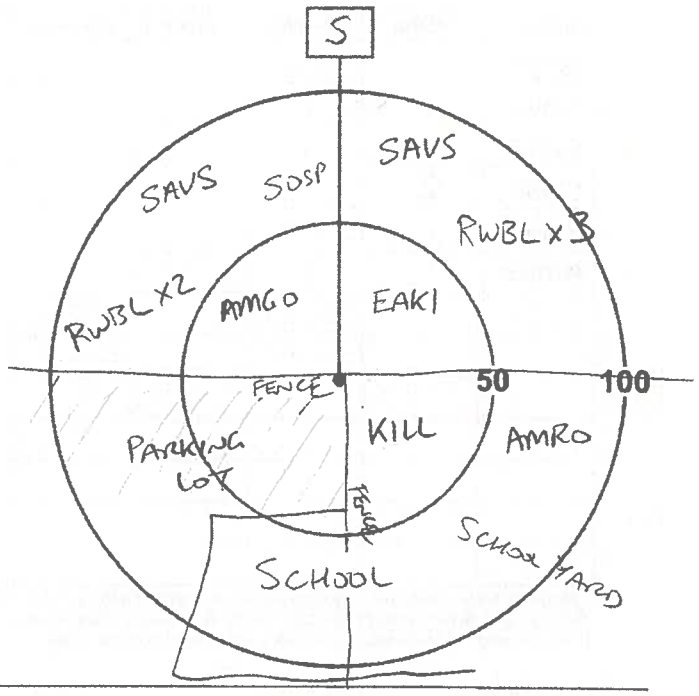
Signature: (Project Manager)

Station: 4 **Feature:** **UTM:** 0608764 4785285

Start Time: 06:29 **End Time:** 06:34

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
AMGO	1				
SAVS		2			
KILL	1				
RWBL		5			
SOSP		1			
AMRO		1			
EAKI	1				



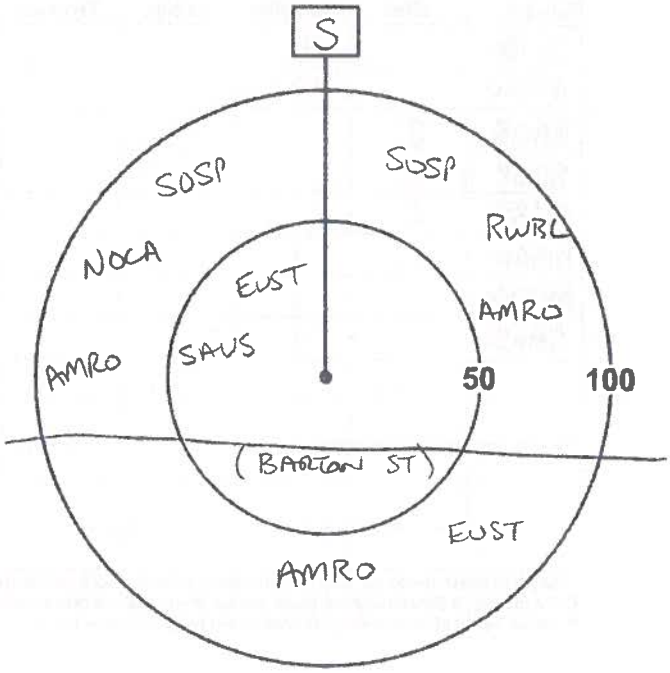
** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Station: 5 **Feature:** **UTM:** 0608293 4785532

Start Time: 06:40 **End Time:** 06:45

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
EUST	1	1			
AMRO		3			
SOSP		2			
NOCA		1			
SAVS	1				
RWBL		1			



** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Signature: (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature: (Project Manager)

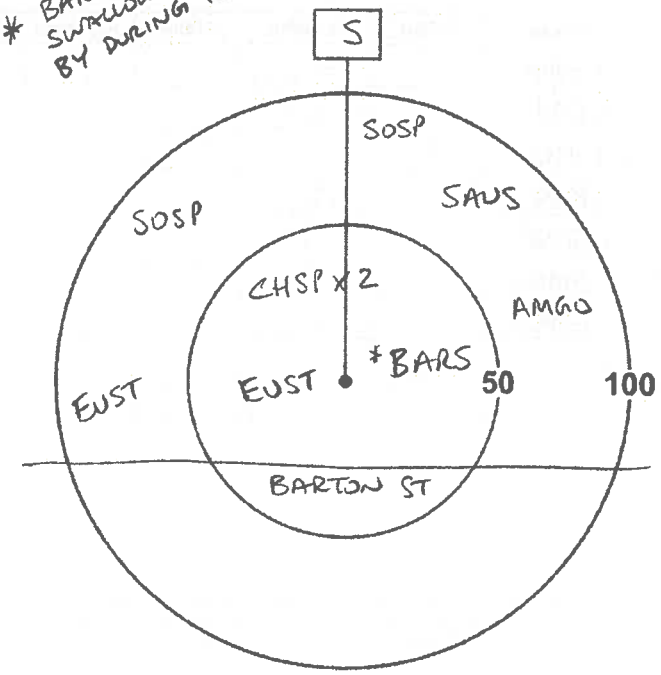
Station: 6 Feature: UTM: 0608587 4785464

Start Time: 06:51 End Time: 06:56

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
SOSP		2			
SAUS		1			
EUST	1	1			
CHSP	2				
BARS	1				
AMGO		1			

* BARN SWALLOW FLEW BY DURING P.C. (1)



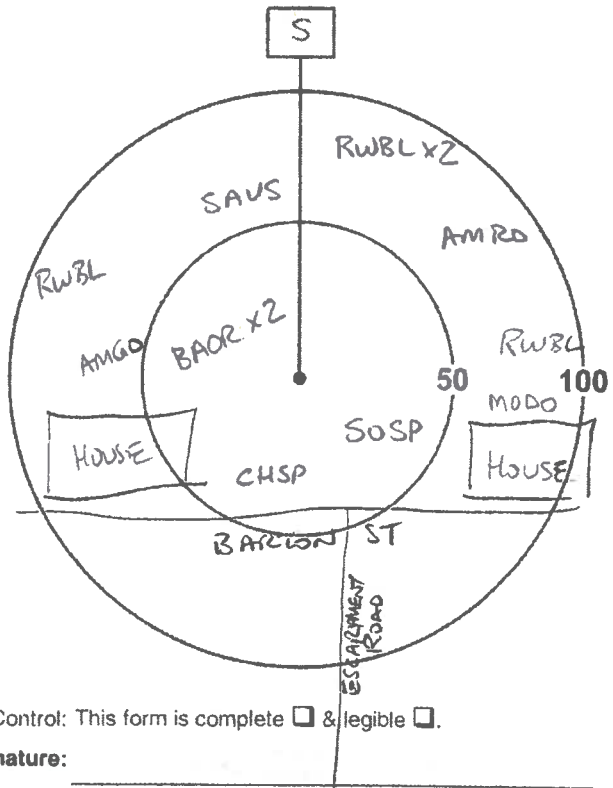
Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Station: 7 Feature: UTM: 0609227 4785257

Start Time: 07:03 End Time: 07:08

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
RWBL		4			
AMRO		1			
BAOR	2				
SOSP	1				
CHSP	1				
AMGO		1			
MODO		1			
SAUS		1			



Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Signature: (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

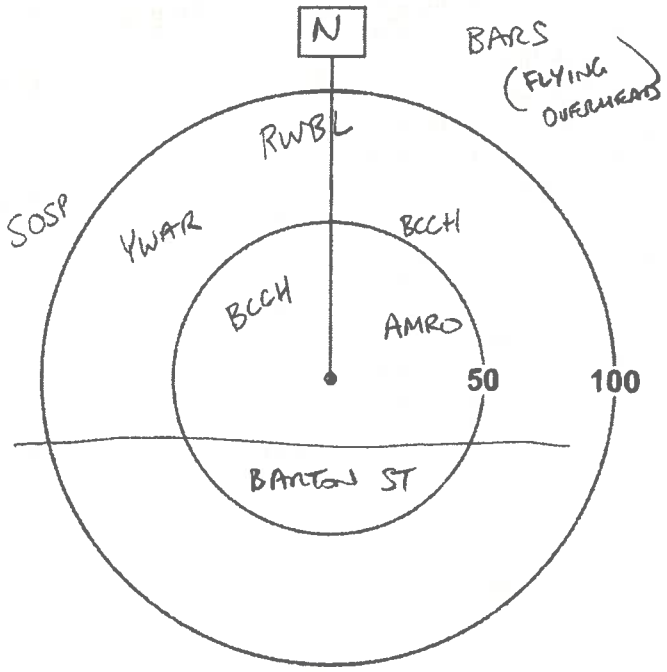
Signature: (Project Manager)

Station: 8 Feature: UTM: 0610089 4785167

Start Time: 07:16 End Time: 07:21

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
BCCH	1	1			
AMRO	1				
RWBL		1			
YWAR		1			
SOSP			1		
BARS			2		



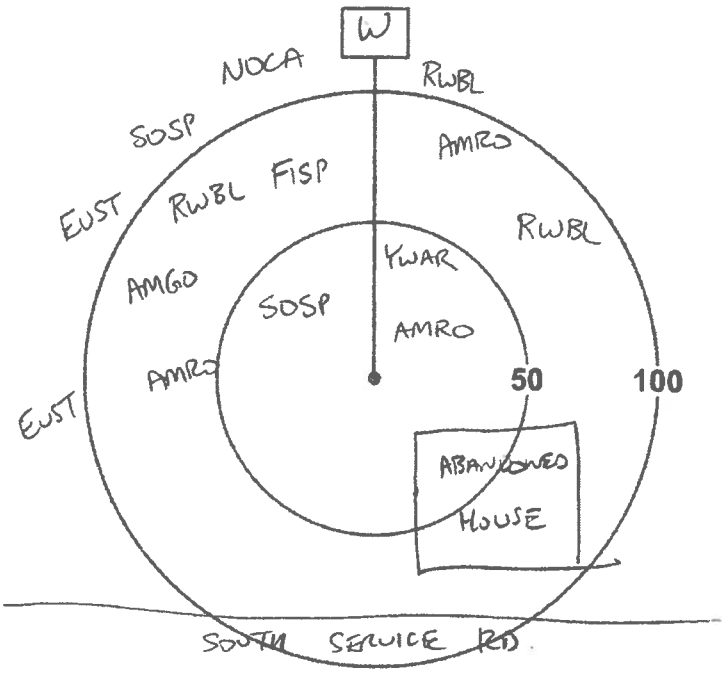
* Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Station: 11 Feature: UTM: 0610501 4785518

Start Time: 07:36 End Time: 07:41

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
EUST			2		
AMRO	1	2			
SOSP	1		1		
YWAR	1				
RWBL		2	1		
NOCA			1		
FISP		1			
AMGO		1			



* Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Signature: (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

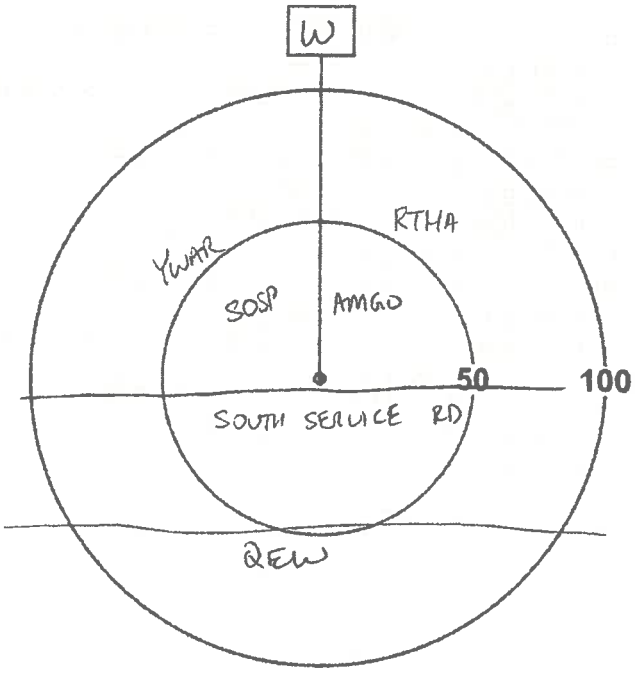
Signature: (Project Manager)

Station: 12 Feature: UTM: 0610405 4785844

Start Time: 07:46 End Time: 07:51

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
AMGO	1				
SOSP	1				
RTHA		1			
YWAR		1			



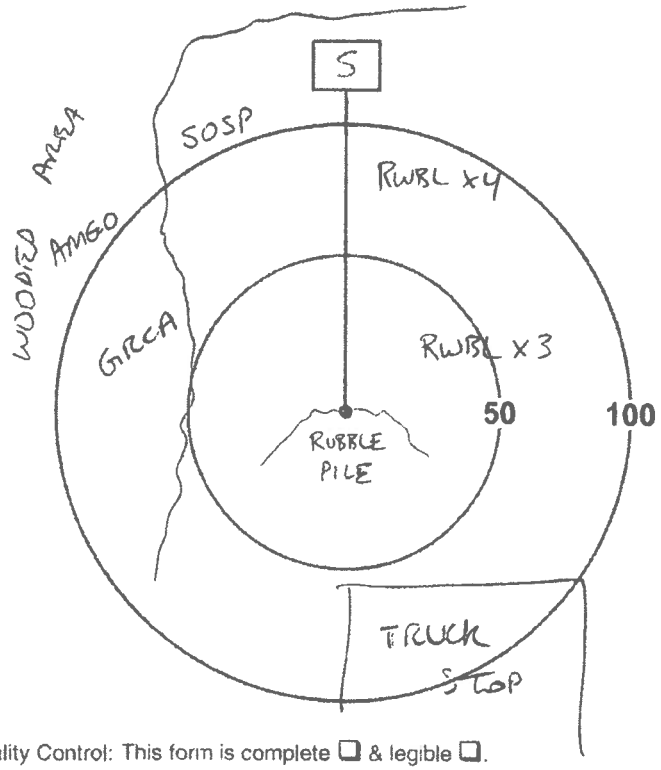
* Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Station: 13 Feature: UTM: 0610234 4785765

Start Time: 08:00 End Time: 08:05

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
RWBL	3	4			
AMGO			1		
GRCA		1			
SOSP			1		



* Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Signature: (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

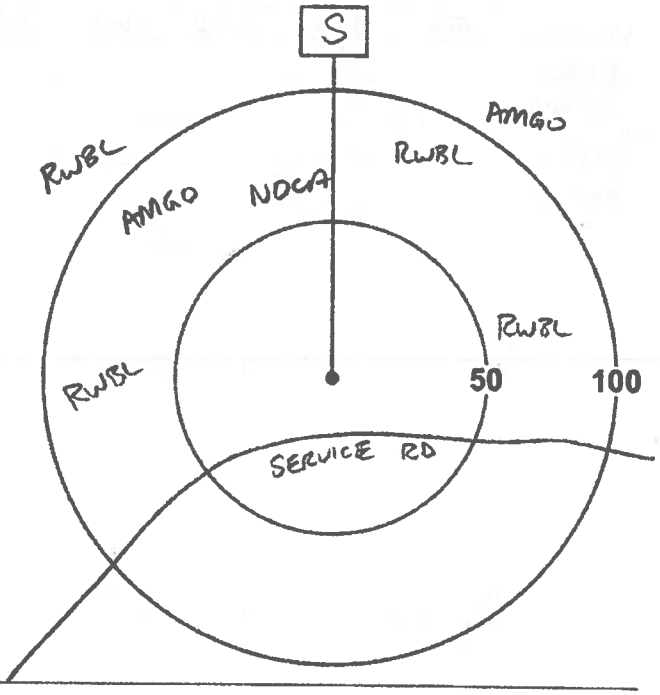
Signature: (Project Manager)

Station: 14 Feature: UTM: 0610034 4785729

Start Time: 08:09 End Time: 08:14

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
RWBL		3	1		
NOCA		1			
AMGO		1	1		



* Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

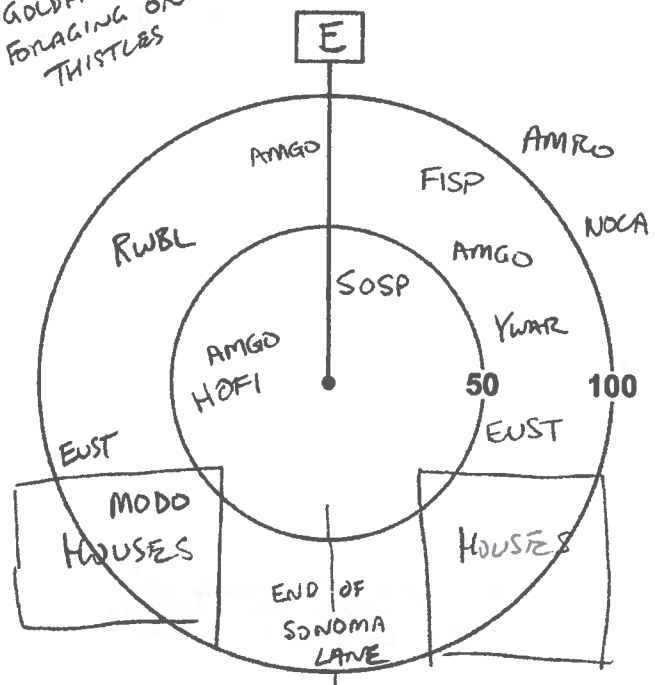
Station: 15 Feature: UTM: 0610047 4785387

Start Time: 08:21 End Time: 08:26

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
AMGO	1	2			
HOFI	1				
SOSP	1				
YWAR		1			
EUST		2			
AMRO			1		
NOCA			1		
FISP		1			
MODO		1			
RWBL		1			

GOLDFINCHES FORAGING ON THISTLES



* Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Signature: (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

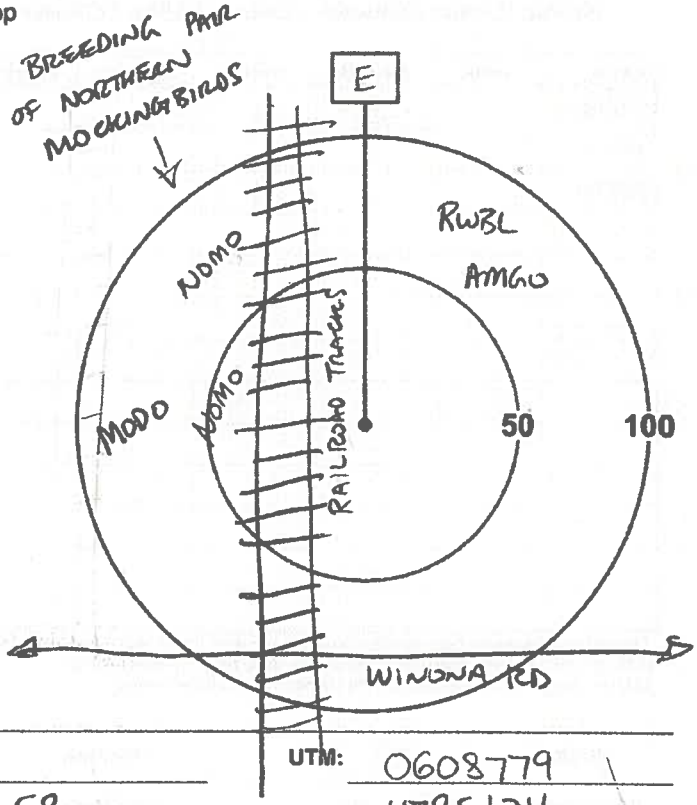
Signature: (Project Manager)

Station: 16 Feature: UTM: 0609848 4785592

Start Time: 08:36 End Time: 08:41

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
RWBL		1			
AMGO		1			
NOMO	1	1			
MODO		1			



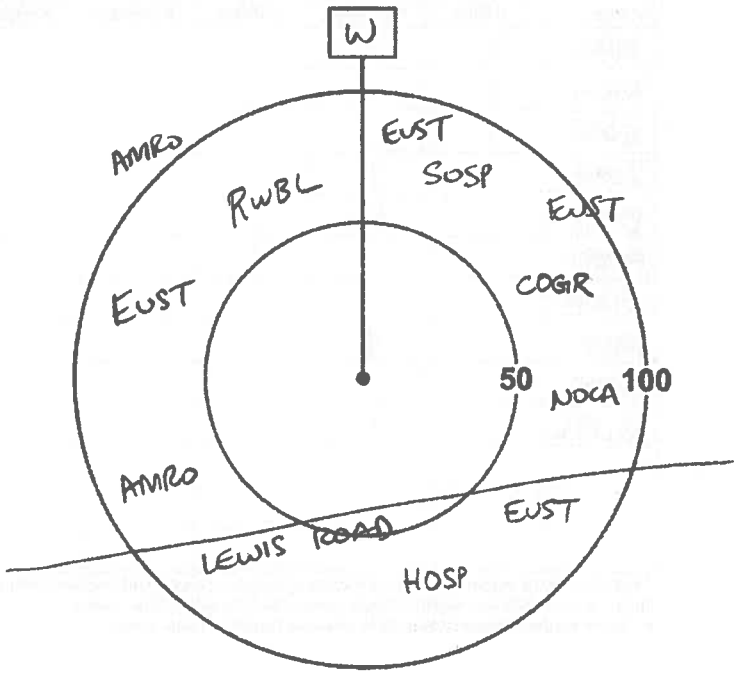
* Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Station: 17 Feature: UTM: 0608779 4785104

Start Time: 08:53 End Time: 08:58

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
EUST		4			
RWBL		1			
SOSP		1			
COGR		1			
NOCA		1			
AMRO		1	1		
HOSP		1			



* Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Signature: (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature: (Project Manager)

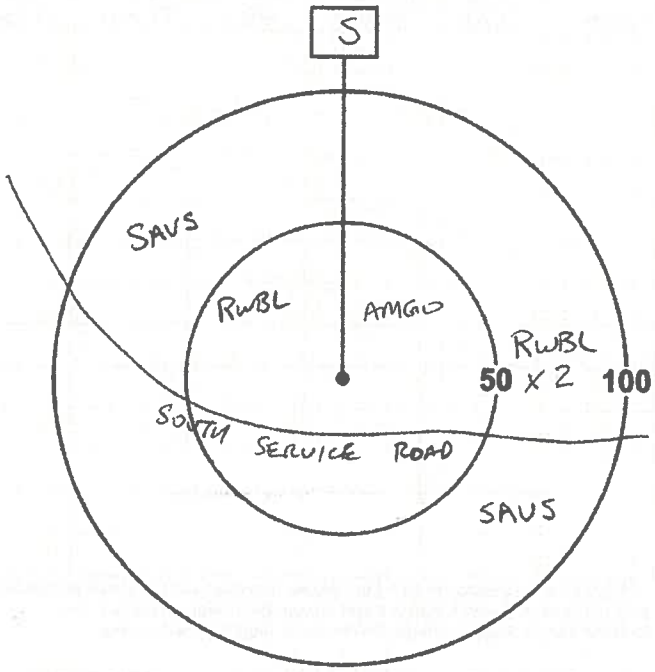
REV: 2011-05-04 / FORM 020

Station: 18 **Feature:** **UTM:** 0610793 4785545

Start Time: 09:08 **End Time:** 09:13

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
SAVS		2			
RWBL	1	2			
AMGO	1				



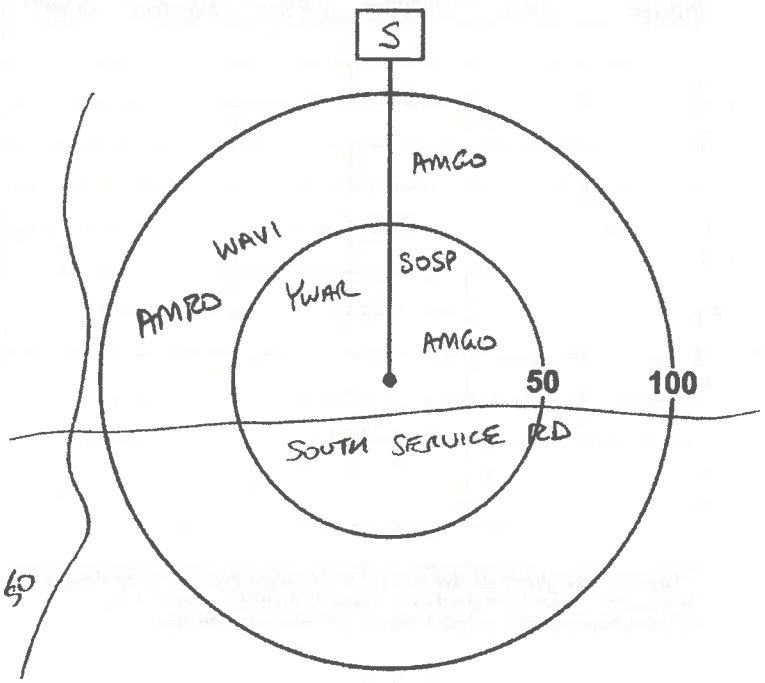
** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Station: 19 **Feature:** **UTM:** 0611221 4785578

Start Time: 09:35 **End Time:** 09:40

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
YWAR	1				
WAVI		1			
AMRO		1			
SOSP	1				
AMGO	1	1			



** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Signature: (Field Personnel)

Quality Control: This form is complete ❑ & legible ❑.

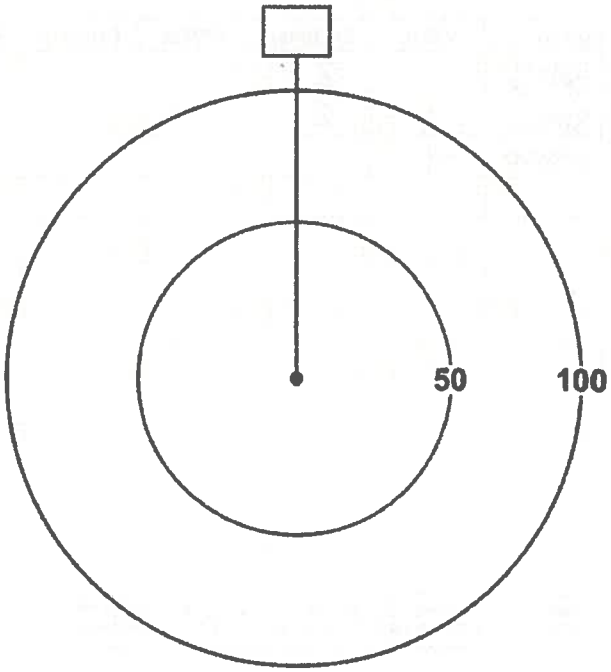
Signature: (Project Manager)

Station: _____ **Feature:** _____ **UTM:** _____

Start Time: _____ **End Time:** _____

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*



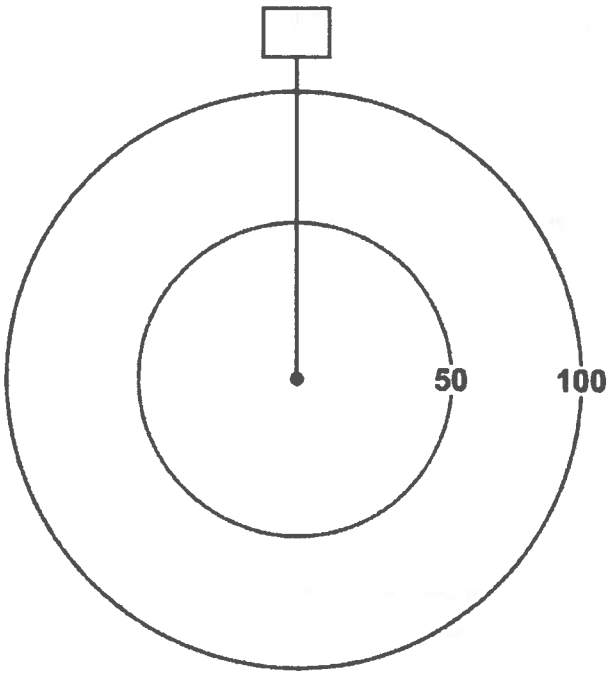
** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep

Station: _____ **Feature:** _____ **UTM:** _____

Start Time: _____ **End Time:** _____

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*



** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; **A**-Below height of blade sweep; **B**-At height of blade sweep;
C-Above height of blade sweep; **D**-Well above height of blade sweep

Page ___ of ___

Quality Control: This form is complete ❑ & legible ❑.

Signature: _____ **Signature:** _____

(Field Personnel) (Project Manager)

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, ON
Canada N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Stantec

Birding Point Counts Survey Observation Form

Project Number: 160950443 Project Name: Hamilton - SCUBE

Date: June 26, 2012 Field Personnel: N. Kopysh.

Weather Conditions:	TEMP (°C):	WIND:	CLOUD:	PPT:	PPT (in last 24 hrs):
	15°C to 20°C	0-1	20°	Ø	Ø

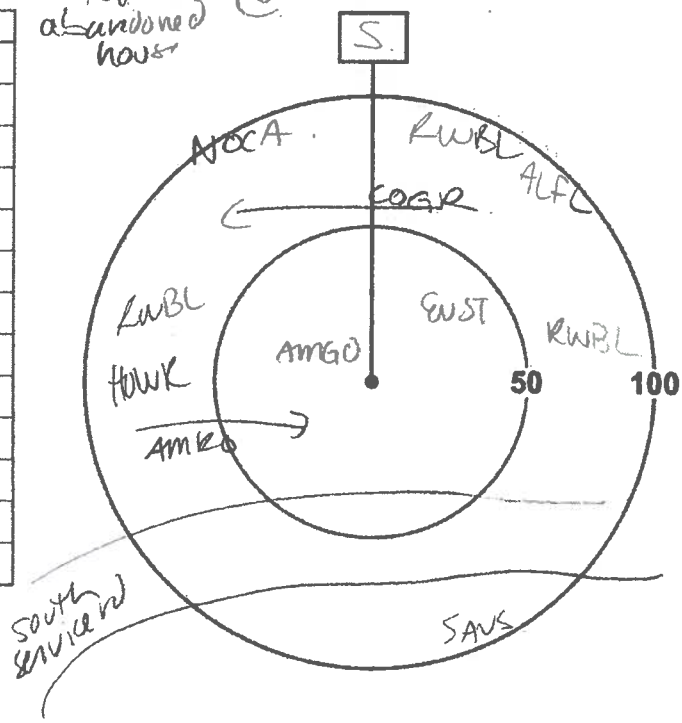
GPS #: T

Station: 11 Feature: UTM: 0610535 4785535

Start Time: 05:50 End Time: 05:55

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop fallow @ abandoned house on south service RD

Species	<50m	50-100m	>100m	Flyovers	Height*
NOCA		1			
RWBL		3			
AMGO	1				
EUST	1				
AMRO				1	
SAVS		1			
HAWK		1			



* Height of blade sweep varies from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

note: hwy + south service rd. noise

Page 1 of 5

Signature: (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature: (Project Manager)

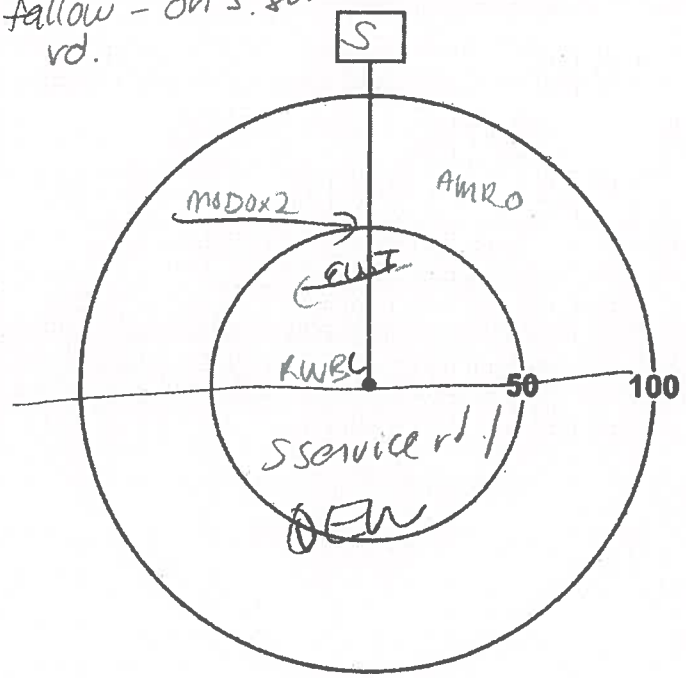
Station: 12 **Feature:** **UTM:** 0610406/4785845

Start Time: 06:05 **End Time:** 06:10 * note hwy noise

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
MODO				2	
AMRO		1			
CUST				1	
RWBL	1				

fallow - on S. service rd.



** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

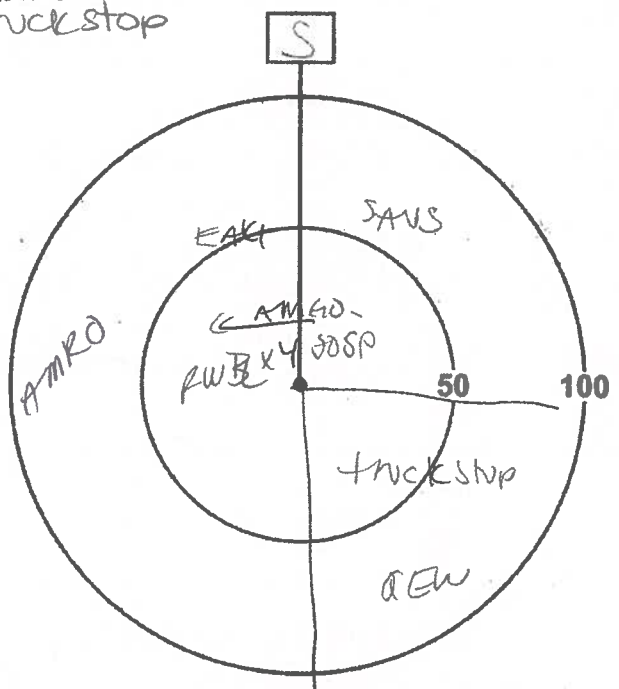
Station: 13 **Feature:** **UTM:** 0610234 4785771

Start Time: 06:14 **End Time:** 06:19

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
EAKI		1			
SAVS		1			
AMGO				1	
SOSP	1				
RWBL	4				
AMRO		1			

- fallow @truckstop



** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Page ___ of ___

Signature: _____ (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature: _____ (Project Manager)

REV: 2011-05-04 / FORM 020

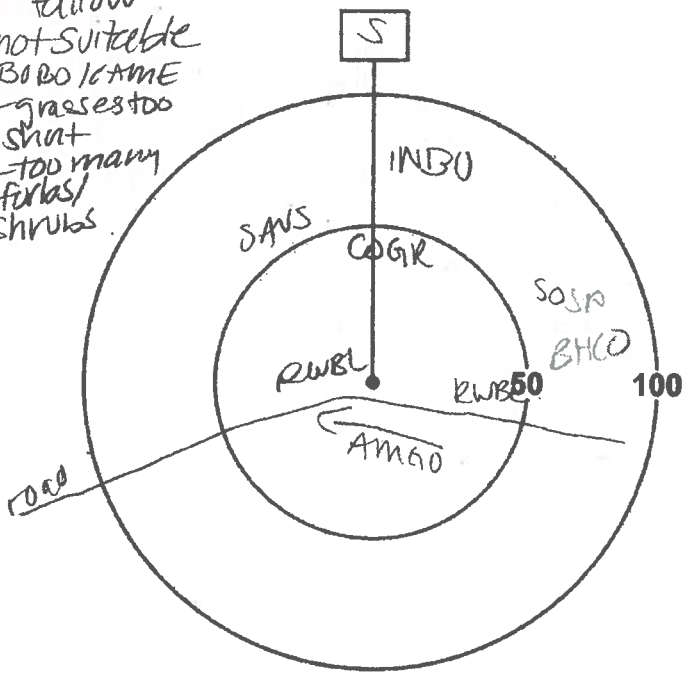
Station: 14 **Feature:** **UTM:** 610037 / 4785737

Start Time: 06:25 **End Time:** 06:30

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
INBU		1			
SAVS		1			
COGR	1				
RWBL	2				
AMGO				1	
BHCO		1			

fallow not suitable BOBO/CAME grasses too short too many forbs/ shrubs



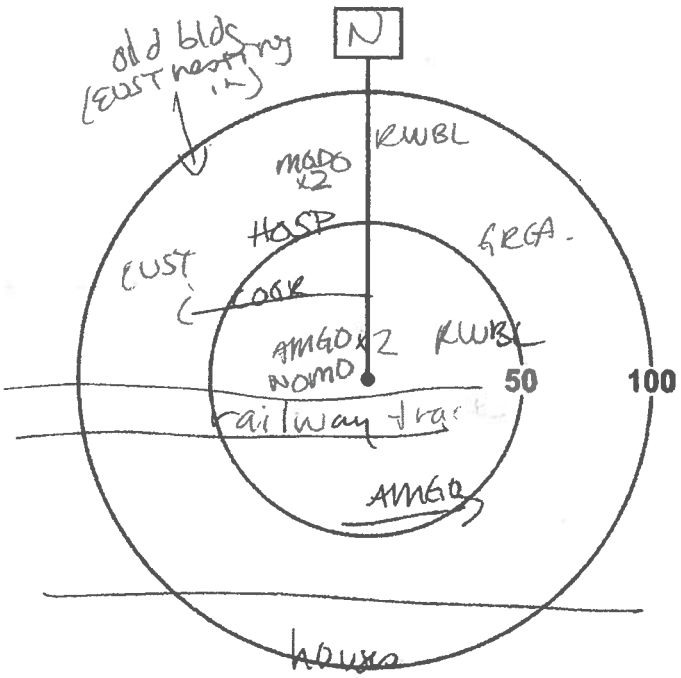
* *Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Station: 16 **Feature:** **UTM:** 0609860 4785605

Start Time: 06:38 **End Time:** 06:42

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
MODO		2			
RWBL	1	1			
HOSP		1			
EUST		1			
COGR				1	
AMGO	2			1	
NOMO	1				
GRCA		1			



* *Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Signature: (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐

Signature: (Project Manager)

Station: 15 **Feature:** **UTM:** 610049 / 4785387

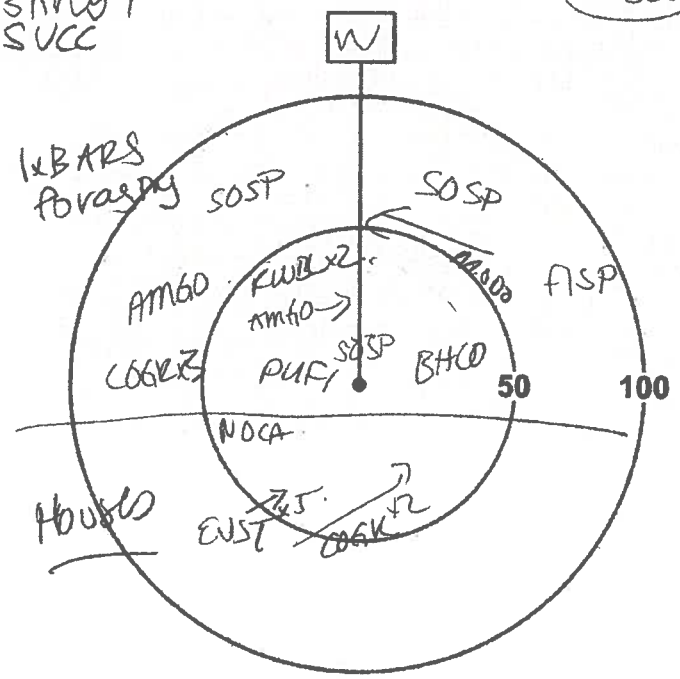
Start Time: 06:50 **End Time:** 06:55

1 BARS obs

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

shrub / SUCC

Species	<50m	50-100m	>100m	Flyovers	Height*
BARS			1		
SOSP	1	2			
AMGO	1	1			
COGR		3		2	
BHCO	1				
PUFI	1				
RWBL	2				
NOCA	1				
EUST	5				



** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Station: 8 **Feature:** **UTM:** 610065 / 4785097

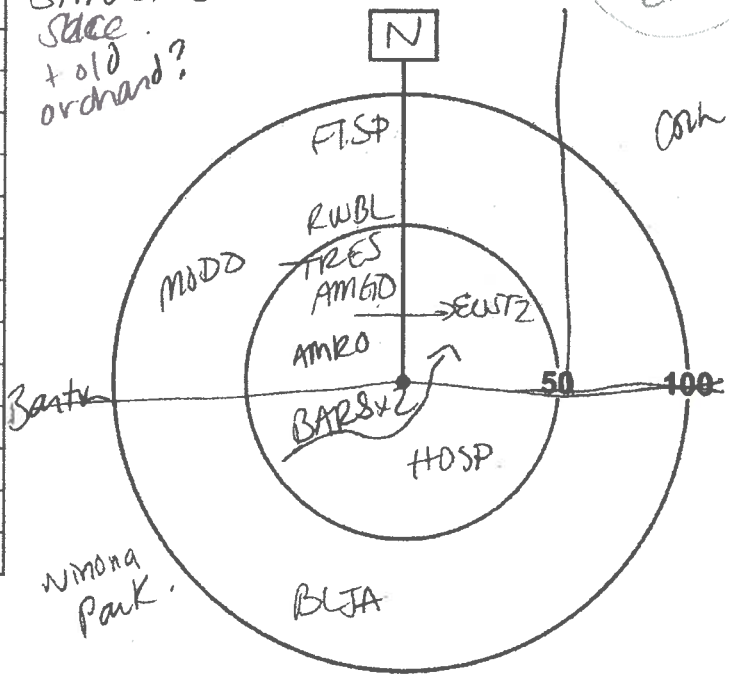
Start Time: 07:04 **End Time:** 07:09

2 BARS obs

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

shrub/ cow space. + old orchard?

Species	<50m	50-100m	>100m	Flyovers	Height*
FISP		1			
RWBL		1			
TREES	1				
AMGO	1				
AMRO	1				
EUST	2				
BARS				2	
BLJA		1			
HOSP	2				



** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Page ___ of ___

Signature: _____
(Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature: _____
(Project Manager)

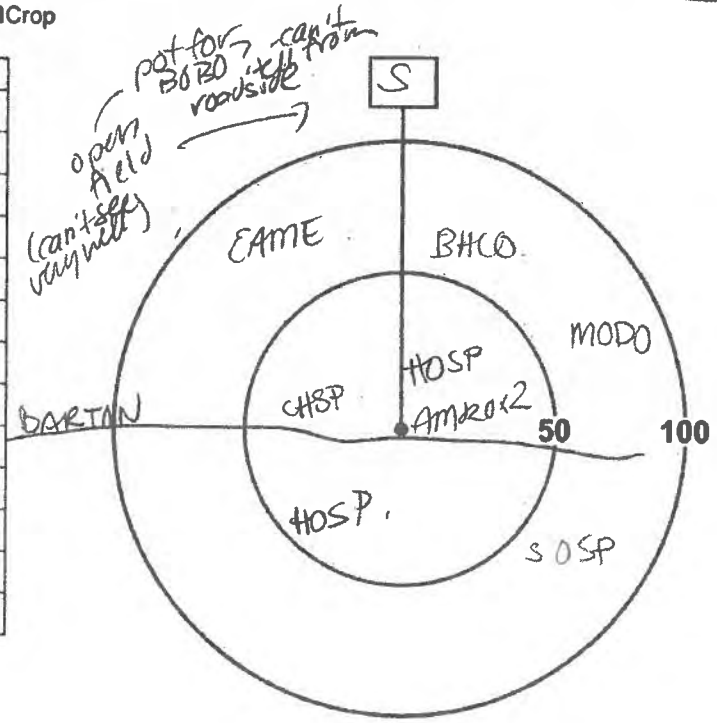
REV: 2011-05-04 / FORM 020

Station: 7 **Feature:** **UTM:** 6092461 / 4785339 *EAME

Start Time: 07:16 **End Time:** 07:21

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
EAME		1			
BHCO		1			
MODO		1			
HOSP	2				
CHSP	1				
AMRO	2				
SOSP		1			



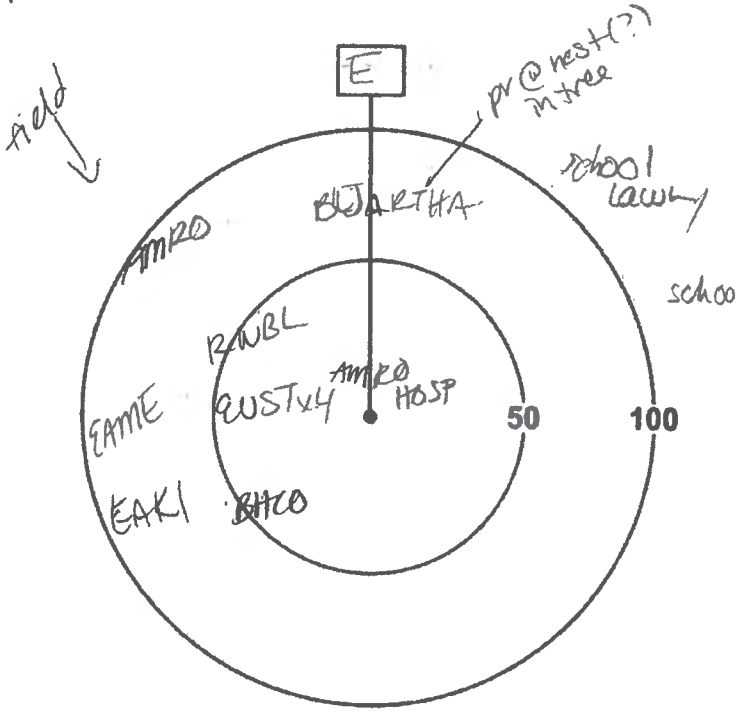
* *Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Station: 4 **Feature:** **UTM:** 0608758 / 4785292

Start Time: 07:27 **End Time:** 07:32

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
AMRO	1	1			
BLJA		1			
RTHA		1			
RWBL	1				
RUST	4				
HOSP	1				
BHCO	1				
EAKI		1			
EAME		1			



* *Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Signature: MKon
(Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature:
(Project Manager)

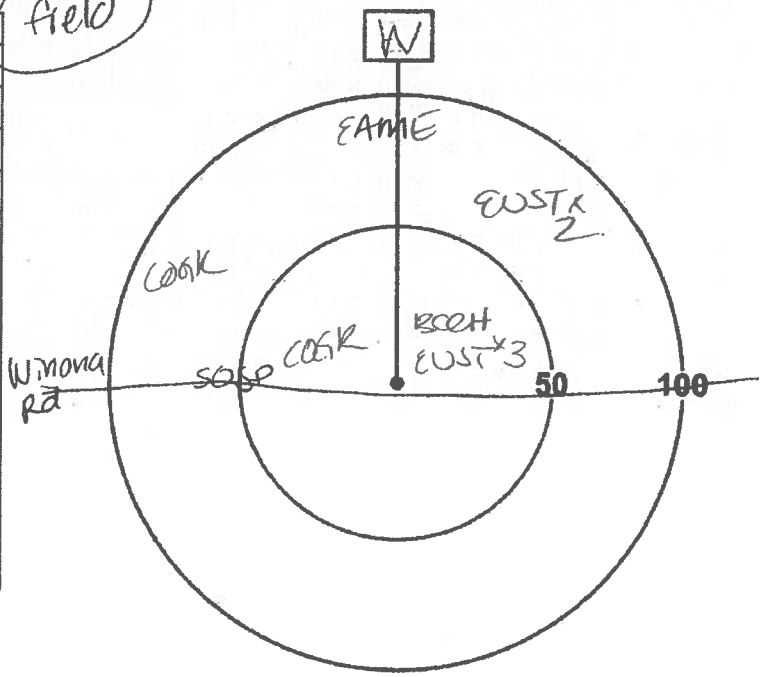
Station: 3 Feature: UTM: 0608816 / 4785156.

Start Time: 07:42 End Time: 07:47

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop open field

Species	<50m	50-100m	>100m	Flyovers	Height*
EAME		1			
EUST	3	2			
BCCH	1				
COGR	1	1			
SOSP		1			

*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep



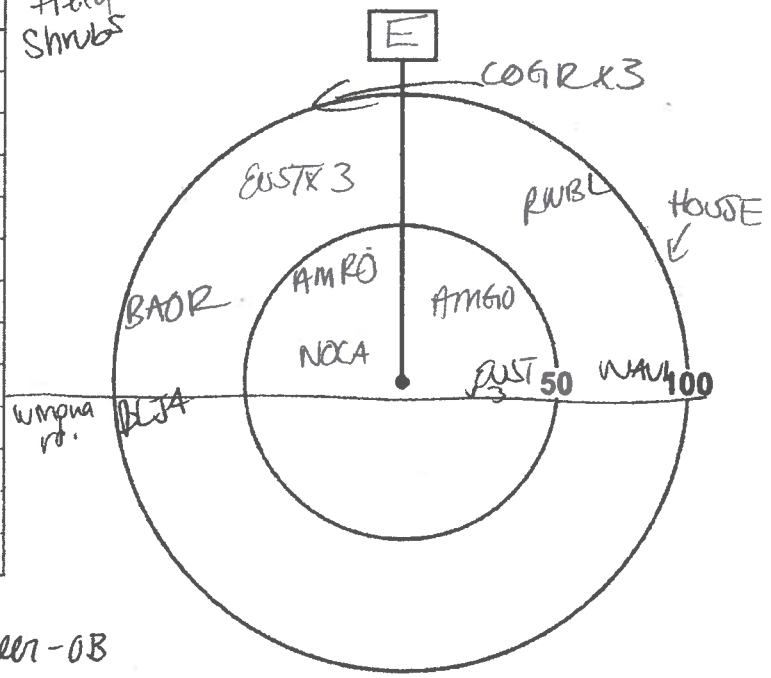
Station: 17 Feature: UTM: 0608784 / 4785104

Start Time: 07:49 End Time: 07:54

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop field & shrubs

Species	<50m	50-100m	>100m	Flyovers	Height*
BAOR		1			
BLJA		1			
AMRO	1				
NOCA	1				
AMGO	1				
EUST	3	3			
RWBL	1				
WAVI		1			
COGR				3	

*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep



- deer - OB

Page ___ of ___

Quality Control: This form is complete ☐ & legible ☐.

Signature: _____ (Field Personnel)

Signature: _____ (Project Manager)

REV: 2011-05-04 / FORM 020

Station: 5 **Feature:** . **UTM:** 0608294 4785534

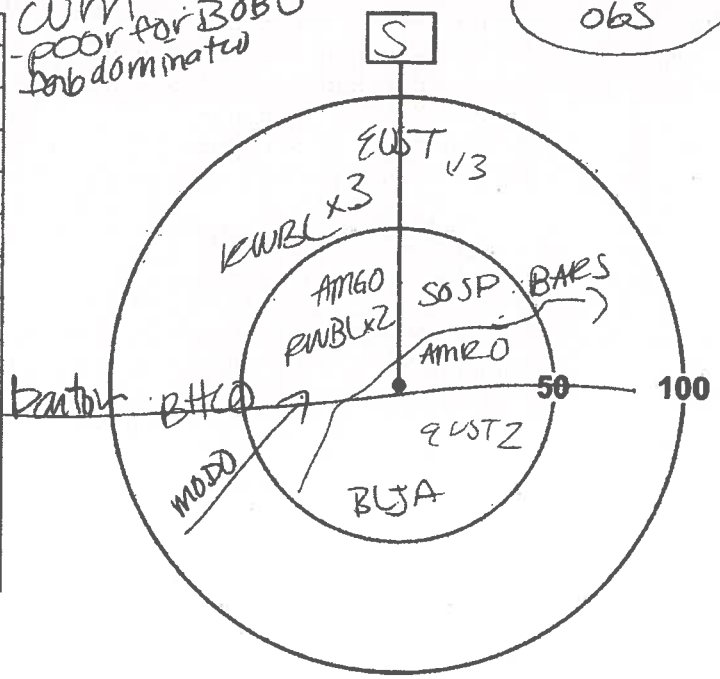
Start Time: 08:35 **End Time:** 08:40

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
EUST	2	3			
BARS				1	
RWBL	2	3			
AMGO	1				
SOSP	1				
AMRO	1				
MODO				1	
BHCO		1			
BLJA	1				

cwm poor for BOBO - pooor dominated

+1 BARS OGS



*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Station: 6 **Feature:** **UTM:**

Start Time: 08 45 **End Time:** 08:50

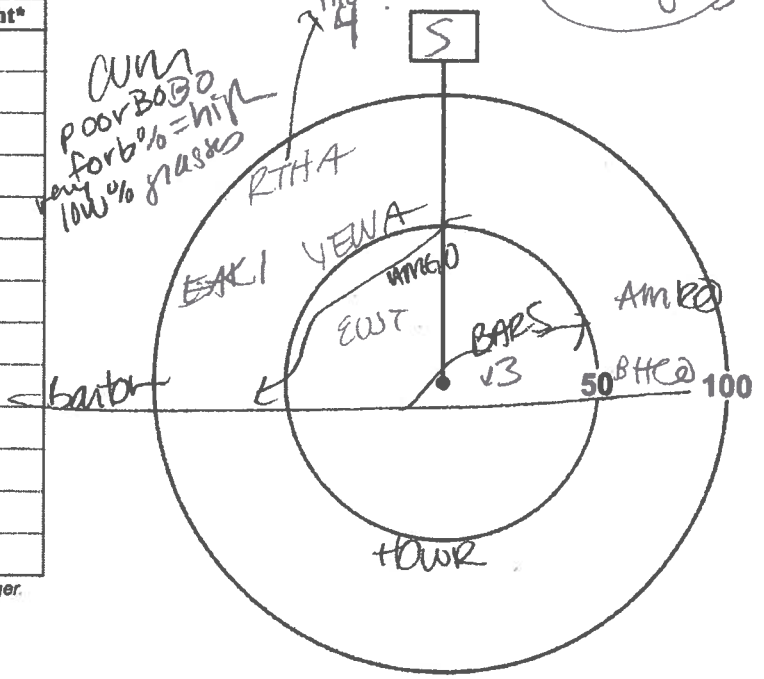
Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
RTHA		1			
YEWA		1			
EAKI		1			
AMGO				1	
EUST	1				
BARS				3	
AMRO		1			
BHCO		1			

likely same male from stn 4

+3 BARS foraging

cwm poor BOBO for b/c % = high % grass



*Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

· cabbage white + Sulphur butterflies

Signature: (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature: (Project Manager)

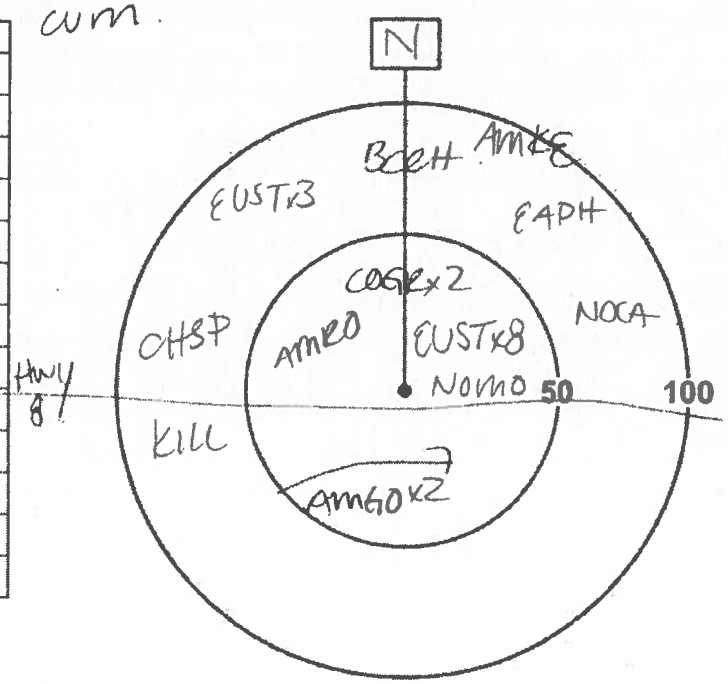
Station: 2 **Feature:** **UTM:** 608484 4784922

Start Time: 08:10 **End Time:** 08:15

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
EUST	8	3			
BCEH		1			
AMKE		1			
EAPH		1			
NOCA		1			
NOMO	1				
COGR	2				
AMRO	1				
KILL		1			
AMGO				2	

cum.



** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

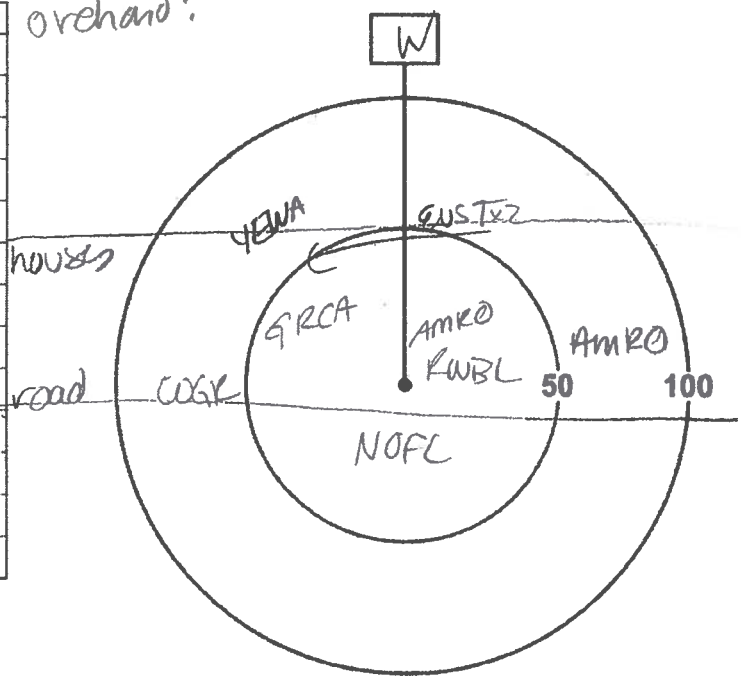
Station: 1 **Feature:** **UTM:** 607994 4785266

Start Time: 08:20 **End Time:** 08:25

Habitat: ❑Forest / ❑Swamp / ❑Marsh / ❑Hay / ❑Pasture / ❑Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
NOFL	1				
GRCA	1				
AMRO	1	1			
RWBL	1				
COGR		1			
VENA		1			
EUST				2	

overhead?



** Height of blade sweep will vary from project to project; check with project manager.*
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Page ___ of ___

Quality Control: This form is complete ❑ & legible ❑.

Signature: _____ (Field Personnel)

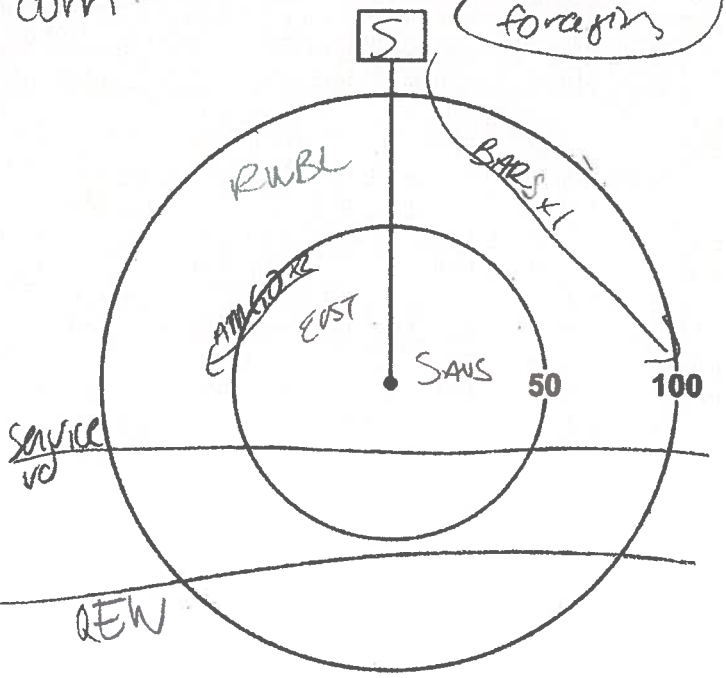
Signature: _____ (Project Manager)

Station: 18 Feature: UTM: 0610787 4785550

Start Time: 09:00 End Time: 09:05

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
RWBL		1			
BARS				1	
EAST	1				
AMGO				2	
SAVS	1				



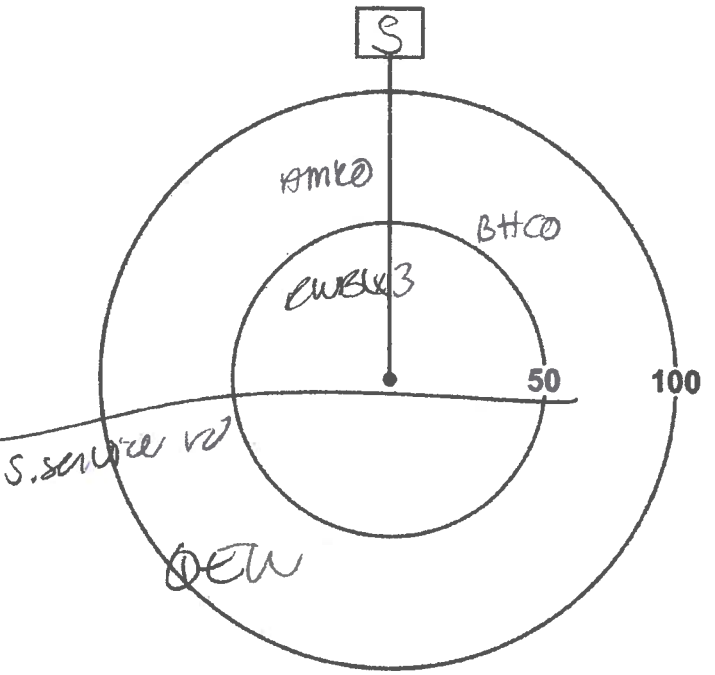
* Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Station: 19 Feature: UTM: 0611228 4785587

Start Time: 09:10 End Time: 09:15

Habitat: ☐Forest / ☐Swamp / ☐Marsh / ☐Hay / ☐Pasture / ☐Crop

Species	<50m	50-100m	>100m	Flyovers	Height*
AMRO		1			
BHCO		1			
RWBL	3				



* Height of blade sweep will vary from project to project; check with project manager.
O-On ground; A-Below height of blade sweep; B-At height of blade sweep;
C-Above height of blade sweep; D-Well above height of blade sweep

Signature: (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature: (Project Manager)

REV: 2011-05-04 / FORM 020

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, ON
Canada N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Bobolink and Eastern Meadowlark Breeding Survey Form

Project Number: 160950443 Project Name: Scube parcels

Date: July 12, 2012 Field Personnel: D. Graham

Weather Conditions:	TEMP (°C):	WIND:	CLOUD:	PPT:	PPT (in last 24 hrs):
	16-25	0-1	10%	None	None

Please mark transect location on map and indicate areas of species observations on map.

stn Transect No.: 3 Habitat:

Start Time: 5:45 End Time: 5:55

Start Point UTM: 608483, 4784921 End Point UTM: sand

Species	Tally
Bobolink	Ø
Eastern Meadowlark	Ø

station Transect No.: 16 Habitat:

Start Time: 8:35 End Time: 8:40

Start Point UTM: 608784 4785104 End Point UTM:

Species	Tally
Bobolink	3 (Flyovers)
Eastern Meadowlark	Ø

Pg. ___ of ___

Signature: _____ (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature: _____ (Project Manager)

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, ON
Canada N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Stantec

Bobolink and Eastern Meadowlark Breeding Survey Form

Project Number: 160950443 Project Name: HAMILTON – SCUBE

Date: JULY 4 2012 Field Personnel: MICHAEL OLIVEIRA

Weather Conditions:	TEMP (°C):	WIND:	CLOUD:	PPT:	PPT (in last 24 hrs):
	20°C	1-2	50%	Ø	Ø

Please mark transect location on map and indicate areas of species observations on map.

Transect No.: PT. #3 **Habitat:** OPEN FIELD

Start Time: 06:15 **End Time:** 06:25

Start Point UTM: **End Point UTM:**

Species	Tally
Bobolink	Ø
Eastern Meadowlark	Ø

Transect No.: **Habitat:**

Start Time: **End Time:**

Start Point UTM: **End Point UTM:**

Species	Tally
Bobolink	
Eastern Meadowlark	

Signature: (Field Personnel)

Quality Control: This form is complete ☐ & legible ☐.

Signature: (Project Manager)

Stantec Consulting Ltd.
1 – 70 Southgate Drive
Guelph, ON
Canada N1G 4P5
Tel: (519) 836-6050
Fax: (519) 836-2493

Bobolink and Eastern Meadowlark Breeding Survey Form

Project Number: 60950443
Project Name: Hamilton- Winona / SWBE
Date: June 26 2012
Field Personnel: N. KOPYSH

Weather Conditions:	TEMP (°C):	WIND:	CLOUD:	PPT:	PPT (in last 24 hrs):
	18°C.	0-1	20%	Ø	Ø

Please mark transect location on map and indicate areas of species observations on map.

Pt. location
~~Transect~~ No.: 3
Habitat: open field.
Start Time: 07:55
End Time: 08:05
Start Point UTM:
End Point UTM:

Species	Tally
Bobolink	Ø
Eastern Meadowlark	1
*access by roadside only	

Pt. location
~~Transect~~ No.: 7
Habitat: open field (can't see well)
Start Time: 7^16
End Time: 7^21
Start Point UTM: 6092461, 4785339
End Point UTM:

Species	Tally
Bobolink	Ø
Eastern Meadowlark	1

-all other habitat in study area = marginal = CUM (forb dominated) or shrub/succ,
- field at stn 7 not well visible from road - potential?

Pg. ___ of ___

Quality Control: This form is complete ☐ & legible ☐.

Signature: _____ (Field Personnel)

Signature: _____ (Project Manager)

Pt. location

~~Transect No.~~: 4 Habitat: Field

Start Time: 727 End Time: 732

Start Point UTM: 608758, 4785292 End Point UTM:

Species	Tally
Bobolink	∅
Eastern Meadowlark	1

Pt. location

~~Transect No.~~: 3 Habitat: Open field

Start Time: 742 End Time: 747

Start Point UTM: 608816, 4785156 End Point UTM:

Species	Tally
Bobolink	∅
Eastern Meadowlark	1

Transect No.: Habitat:

Start Time: End Time:

Start Point UTM: End Point UTM:

Species	Tally
Bobolink	
Eastern Meadowlark	

Pg. ___ of ___

Signature: _____ (Field Personnel)

Quality Control: This form is complete ❑ & legible ❑.

Signature: _____ (Project Manager)

Chimney Assessment Form

Page 1

Scube.

July 12, 2012 10:05 AM

Observer Details

Name	Phone Number	Email Address
D. Graham	( )	

Street Address	City	Prov.	Postal Code

Building Details

Street Address	City	Prov.	Postal Code
24 Victoria	Wingham	On.	

Owner Name	Phone Number	Email Address
	( )	

Type of building (please check one):

- [x] House
- [ ] Church
- [ ] Store
- [ ] Lowrise Apartment
- [ ] School
- [ ] Factory
- [ ] Highrise Apartment
- [ ] Hospital
- [ ] Other, please specify: _____

Chimney Details

Site Name: 1

Chimney Code: SC-W1

GPS coordinates (DD.dddd):

Lat. 43.785637 ° N

Long. 81.609801 ° W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

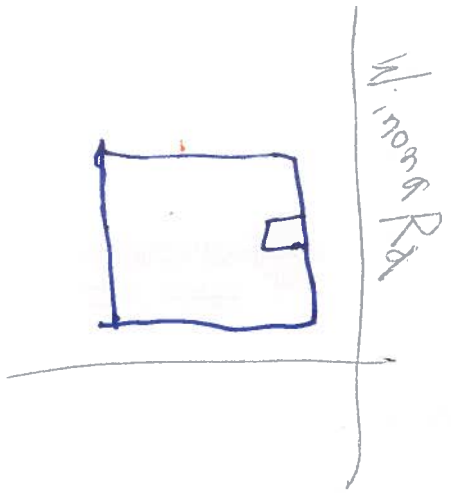
Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

Chimney material (please check one):

- [x] Brick
- [ ] Stucco
- [ ] Concrete
- [ ] Stone
- [ ] Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.



If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- [ ] Cap
- [ ] Terra Cotta Liner
- [x] Animal Guard
- [ ] Spark Protector
- [x] Metal Liner
- [ ] Other, please specify: _____

Surrounding habitat (please check one):

- [ ] Residential
- [ ] Industrial
- [ ] Commercial
- [ ] Natural
- [x] Other, please specify: Rural

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- [ ] Round → Diameter (cm): _____
- [x] Square → Width (cm): _____
- [ ] Rectangular → Width (cm): 40 Length (cm): 40

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

Chimney height above roofline (m): 2 m	Number of Flues: 1	Colour of Chimney: Brown

Total Chimney Height (m) = 1 (Number of stories in building) × 3 m (approx height of one story) + 2 (Height above roofline (m)) = 5 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada Ontario Region / Environnement Canada Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

Observer Details

Name	Phone Number ( )	Email Address	
Street Address	City	Prov.	Postal Code

Building Details

Street Address 1220 Barton	City	Prov.	Postal Code
Owner Name	Phone Number ( )	Email Address	

Type of building (please check one):

- [x] House
- [ ] Church
- [ ] Store
- [ ] Lowrise Apartment
- [ ] School
- [ ] Factory
- [ ] Highrise Apartment
- [ ] Hospital
- [ ] Other, please specify: _____

Chimney Details

Site Name: 2

Chimney Code: SC-B-2

GPS coordinates (DD.dddd):

Lat. 4785309 ° N

Long. 609379 ° W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

Chimney material (please check one):

- [x] Brick
- [ ] Stucco
- [ ] Concrete
- [ ] Stone
- [ ] Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.

If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- [ ] Cap
- [x] Terra Cotta Liner
- [ ] Animal Guard
- [ ] Spark Protector
- [ ] Metal Liner
- [ ] Other, please specify: _____

Surrounding habitat (please check one):

- [x] Residential / Rural
- [ ] Industrial
- [ ] Commercial
- [ ] Natural
- [ ] Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- [ ] Round → Diameter (cm): _____
- [x] Square → Width (cm): _____
- [ ] Rectangular → Width (cm): 40 Length (cm): 40

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

Chimney height above roofline (m): 1	Number of Flues: 1	Colour of Chimney: Beige

Total Chimney Height (m) = 1 (Number of stories in building) × 3 m (approx height of one story) + 1 (Height above roofline (m)) = 4 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve
comprendre apprécier conserver

Canadian co-partner of
un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada / Environnement Canada
Ontario Region / Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

Observer Details

Name	Phone Number ( )	Email Address	
Street Address	City	Prov.	Postal Code

Building Details

Street Address 1182 Barton	City	Prov.	Postal Code
Owner Name	Phone Number ( )	Email Address	

Type of building (please check one):

- [x] House
- [ ] Church
- [ ] Store
- [ ] Lowrise Apartment
- [ ] School
- [ ] Factory
- [ ] Highrise Apartment
- [ ] Hospital
- [ ] Other, please specify: _____

Chimney Details

Site Name: 3

Chimney Code: SC-B-3

GPS coordinates (DD.dddd):

Lat. 4785399 ° N

Long. 609098 ° W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

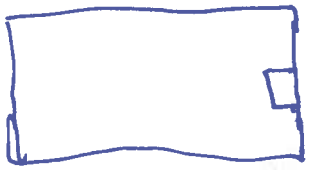
Number of years active (if known):

Chimney material (please check one):

- [x] Brick
- [ ] Stucco
- [ ] Concrete
- [ ] Stone
- [ ] Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.

Barton Rd.



If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- [ ] Cap
- [x] Terra Cotta Liner
- [ ] Animal Guard
- [ ] Spark Protector
- [ ] Metal Liner
- [ ] Other, please specify: _____

Surrounding habitat (please check one):

- [x] Residential / Rural
- [ ] Industrial
- [ ] Commercial
- [ ] Natural
- [ ] Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- [ ] Round → Diameter (cm): _____
- [x] Square → Width (cm): _____
- [ ] Rectangular → Width (cm): 40 Length (cm): 40

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

Chimney height above roofline (m):	1	Number of Flues:	1	Colour of Chimney:	Brown

Total Chimney Height (m) = 2 (Number of stories in building) × 3 m (approx height of one story) + 1 (Height above roofline (m)) = 7 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada / Environnement Canada
Ontario Region / Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

Observer Details

Name	Phone Number ( )	Email Address	
Street Address	City	Prov.	Postal Code

Building Details

Street Address 292 Lewis	City	Prov.	Postal Code
Owner Name	Phone Number ( )	Email Address	

Type of building (please check one):

- [x] House
- [ ] Church
- [ ] Store
- [ ] Lowrise Apartment
- [ ] School
- [ ] Factory
- [ ] Highrise Apartment
- [ ] Hospital
- [ ] Other, please specify: _____

Chimney Details

Site Name: 4

Chimney Code: SC-L-4

GPS coordinates (DD.dddd):

Lat. 4785299 ° N

Long. 6088803 ° W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

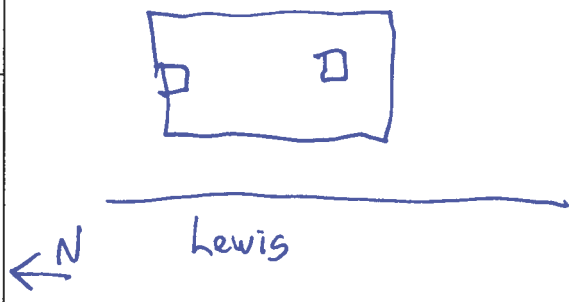
Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

Chimney material (please check one):

- [x] Brick
- [ ] Stucco
- [ ] Concrete
- [ ] Stone
- [ ] Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.



If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- [x] Cap
- [x] Terra Cotta Liner
- [ ] Animal Guard
- [ ] Spark Protector
- [ ] Metal Liner
- [ ] Other, please specify: _____

Surrounding habitat (please check one):

- [x] Residential / rural
- [ ] Industrial
- [ ] Commercial
- [ ] Natural
- [ ] Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- [ ] Round → Diameter (cm): _____
- [x] Square → Width (cm): _____
- [ ] Rectangular → Width (cm): 50 Length (cm): 50

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

Chimney height above roofline (m): 3	Number of Flues: 2	Colour of Chimney: Brown

Total Chimney Height (m) = 1 (Number of stories in building) × 3 m (approx height of one story) + 3 (Height above roofline (m)) = 6m m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None.

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve
comprendre apprécier conserver

Canadian co-partner of
un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada Ontario Region / Environnement Canada Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

Observer Details

Name	Phone Number ( )	Email Address		
Street Address		City	Prov.	Postal Code

Building Details

Street Address 1143 Hwy 8		City	Prov.	Postal Code
Owner Name	Phone Number ( )	Email Address		

Type of building (please check one):

- ☐ House
- ☐ Church
- ☐ Store
- ☐ Lowrise Apartment
- ☐ School
- ☐ Factory
- ☐ Highrise Apartment
- ☐ Hospital
- ☑ Other, please specify: Hotel

Chimney Details

Site Name: 5

Chimney Code: SC-8-5

GPS coordinates (DD.dddd):

Lat. 4784962 °N

Long. 608720 °W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

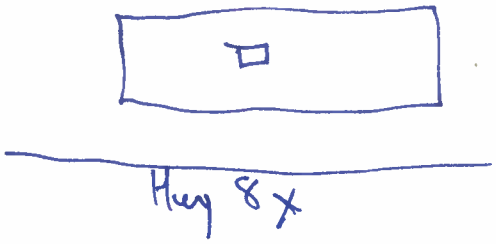
Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

Chimney material (please check one):

- ☑ Brick
- ☐ Stucco
- ☐ Concrete
- ☐ Stone
- ☐ Other, please specify:

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.



If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- ☑ Cap
- ☑ Terra Cotta Liner
- ☐ Animal Guard
- ☐ Spark Protector
- ☐ Metal Liner
- ☐ Other, please specify:

Surrounding habitat (please check one):

- ☑ Residential / rural
- ☐ Industrial
- ☐ Commercial
- ☐ Natural
- ☐ Other, please specify:

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- ☐ Round → Diameter (cm):
- ☑ Square → Width (cm):
- ☐ Rectangular → Width (cm): 40 Length (cm): 40

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

Chimney height above roofline (m): 2	Number of Flues: 1	Colour of Chimney: Brown

Total Chimney Height (m) = 2 (Number of stories in building) × 3 m (approx height of one story) + 2 (Height above roofline (m)) = 8 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada Ontario Region / Environnement Canada Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

Observer Details

Name	Phone Number ( )	Email Address

Street Address	City	Prov.	Postal Code

Building Details

Street Address	City	Prov.	Postal Code
1101 Hwy 8			

Owner Name	Phone Number ( )	Email Address

Type of building (please check one):

- [x] House
- [ ] Church
- [ ] Store
- [ ] Lowrise Apartment
- [ ] School
- [ ] Factory
- [ ] Highrise Apartment
- [ ] Hospital
- [ ] Other, please specify: _____

Chimney Details

Site Name: 6

Chimney Code: SC-8-6

GPS coordinates (DD.dddd):

Lat. 4784905 ° N

Long. 608404 ° W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

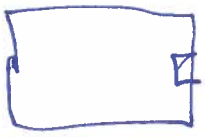
Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

Chimney material (please check one):

- [x] Brick
- [ ] Stucco
- [ ] Concrete
- [ ] Stone
- [ ] Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.



Hwy 8

If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- [x] Cap
- [x] Terra Cotta Liner
- [ ] Animal Guard
- [ ] Spark Protector
- [ ] Metal Liner
- [ ] Other, please specify: _____

Surrounding habitat (please check one):

- [x] Residential (rural)
- [ ] Industrial
- [ ] Commercial
- [ ] Natural
- [ ] Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- [ ] Round → Diameter (cm): _____
- [ ] Square → Width (cm): _____
- [x] Rectangular → Width (cm): 40 Length (cm): 60

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

Chimney height above roofline (m): 0.5	Number of Flues: 1	Colour of Chimney: Brown

Total Chimney Height (m) = 2 (Number of stories in building) × 3 m (approx height of one story) + 0.5 (Height above roofline (m)) = 6.5 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve
comprendre apprécier conserver

Canadian co-partner of
un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

THE ONTARIO TRILLIUM FOUNDATION / LA FONDATION TRILLIUM DE L'ONTARIO

Environment Canada Ontario Region / Environnement Canada Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

Observer Details

Name	Phone Number ( )	Email Address	
Street Address	City	Prov.	Postal Code

Building Details

Street Address 1059 Hwy 8	City	Prov.	Postal Code
Owner Name	Phone Number ( )	Email Address	

Type of building (please check one):

- [x] House
- [ ] Church
- [ ] Store
- [ ] Lowrise Apartment
- [ ] School
- [ ] Factory
- [ ] Highrise Apartment
- [ ] Hospital
- [ ] Other, please specify: _____

Chimney Details

Site Name: S 7

Chimney Code: SC-8-7

GPS coordinates (DD.dddd):

Lat. 47845859 °N

Long. 6088145 °W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

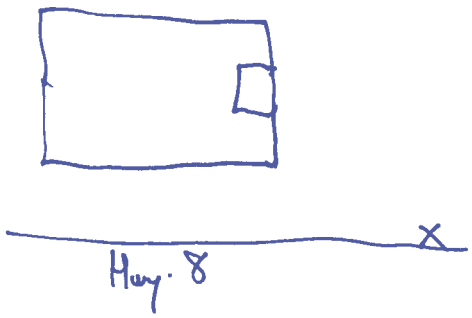
Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

Chimney material (please check one):

- [x] Brick
- [ ] Stucco
- [ ] Concrete
- [ ] Stone
- [ ] Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.



If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- [ ] Cap
- [ ] Terra Cotta Liner
- [ ] Animal Guard
- [ ] Spark Protector
- [ ] Metal Liner
- [ ] Other, please specify: No modifications

Surrounding habitat (please check one):

- [x] Residential (rural)
- [ ] Industrial
- [ ] Commercial
- [ ] Natural
- [ ] Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- [ ] Round → Diameter (cm): _____
- [ ] Square → Width (cm): _____
- [x] Rectangular → Width (cm): 50 Length (cm): 100

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

Chimney height above roofline (m): 3	Number of Flues: 2	Colour of Chimney: Brown

Total Chimney Height (m) = 3 (Number of stories in building) × 3 m (approx height of one story) + 2 (Height above roofline (m)) = 11 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments: None observed. 1st chimney in Scuba parcels that looks suitable for chimney swift.

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada Ontario Region / Environnement Canada Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

Observer Details

Name	Phone Number ( )	Email Address	
Street Address	City	Prov.	Postal Code

Building Details

Street Address 220 Mc Neilly	City	Prov.	Postal Code
Owner Name	Phone Number ( )	Email Address	

Type of building (please check one):

- [x] House
- [ ] Church
- [ ] Store
- [ ] Lowrise Apartment
- [ ] School
- [ ] Factory
- [ ] Highrise Apartment
- [ ] Hospital
- [ ] Other, please specify: _____

Chimney Details

Site Name: 8

Chimney Code: SC-M-8

GPS coordinates (DD.dddd):

Lat. 4784984 ° N

Long. 607878 ° W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

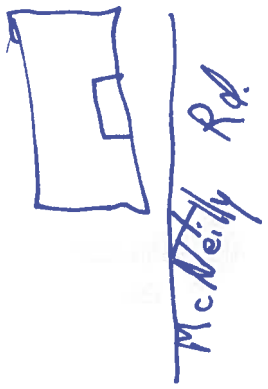
Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

Chimney material (please check one):

- [ ] Brick
- [x] Stucco
- [ ] Concrete
- [ ] Stone
- [ ] Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.



If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- [ ] Cap
- [x] Terra Cotta Liner
- [ ] Animal Guard
- [ ] Spark Protector
- [ ] Metal Liner
- [ ] Other, please specify: _____

Surrounding habitat (please check one):

- [x] Residential / rural
- [ ] Industrial
- [ ] Commercial
- [ ] Natural
- [ ] Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- [ ] Round → Diameter (cm): _____
- [ ] Square → Width (cm): _____
- [x] Rectangular → Width (cm): 150 Length (cm): 30

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

Chimney height above roofline (m):	1	Number of Flues:	4	Colour of Chimney:	Beige

Total Chimney Height (m) = 1 (Number of stories in building) × 3 m (approx height of one story) + 1 (Height above roofline (m)) = 4 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada Ontario Region / Environnement Canada Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

Observer Details

Name	Phone Number ( )	Email Address	
Street Address	City	Prov.	Postal Code

Building Details

Street Address 252 Mc Neilly	City	Prov.	Postal Code
Owner Name	Phone Number ( )	Email Address	

Type of building (please check one):

- [x] House
- [ ] Church
- [ ] Store
- [ ] Lowrise Apartment
- [ ] School
- [ ] Factory
- [ ] Highrise Apartment
- [ ] Hospital
- [ ] Other, please specify: _____

Chimney Details

Site Name: 9

Chimney Code: SC - M - 9

GPS coordinates (DD.dddd):

Lat. 4785167 °N

Long. 607939 °W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

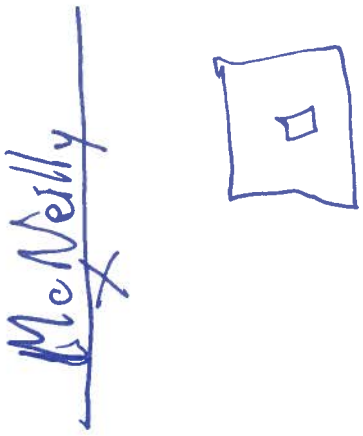
Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

Chimney material (please check one):

- [ ] Brick
- [ ] Stucco
- [x] Concrete
- [ ] Stone
- [ ] Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.



If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- [ ] Cap
- [x] Terra Cotta Liner
- [x] Animal Guard
- [ ] Spark Protector
- [ ] Metal Liner
- [ ] Other, please specify: _____

Surrounding habitat (please check one):

- [x] Residential (rural)
- [ ] Industrial
- [ ] Commercial
- [ ] Natural
- [ ] Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- [ ] Round → Diameter (cm): _____
- [x] Square → Width (cm): _____
- [ ] Rectangular → Width (cm): 40 Length (cm): 40

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

Chimney height above roofline (m): 2	Number of Flues: 1	Colour of Chimney: Grey

Total Chimney Height (m) = 1 (Number of stories in building) × 3 m (approx height of one story) + 2 (Height above roofline (m)) = 5 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada / Environnement Canada
Ontario Region / Région de l'Ontario

McIlwraith Field Naturalists

Chimney Assessment Form

Observer Details

Name	Phone Number ( )	Email Address		
Street Address		City	Prov.	Postal Code

Building Details

Street Address 276 Mc Neilly		City	Prov.	Postal Code
Owner Name	Phone Number ( )	Email Address		

Type of building (please check one):

- ☐ House
- ☐ Church
- ☐ Store
- ☐ Lowrise Apartment
- ☐ School
- ☐ Factory
- ☐ Highrise Apartment
- ☐ Hospital
- ☐ Other, please specify: _____

Chimney Details

Site Name: 10

Chimney Code: SC-M-10

GPS coordinates (DD.dddd):

Lat. 4785345 ° N

Long. 607989 ° W

NOTE: Chimney codes are created using the following scheme:

City Initials - Site Initials - Chimney Number

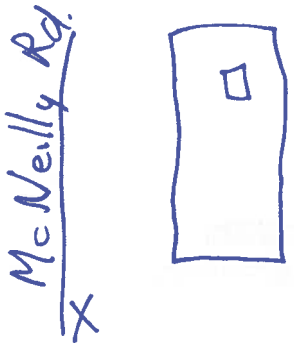
Eg.	City Name	Site Name	No. of Chimneys	Code
	Port Rowan	Public Library	1	PR-PL-1
	London	141 Wortley	2	LO-141-1
				LO-141-2

Number of years active (if known):

Chimney material (please check one):

- ☑ Brick
- ☐ Stucco
- ☐ Concrete
- ☐ Stone
- ☐ Other, please specify: _____

If possible, please draw a picture of the chimney location on the building, including the position where the coordinates were taken.



If the chimney is modified (cap, liner, etc.), please check the appropriate modification:

- ☑ Cap
- ☑ Terra Cotta Liner
- ☑ Animal Guard
- ☐ Spark Protector
- ☐ Metal Liner
- ☐ Other, please specify: _____

Surrounding habitat (please check one):

- ☑ Residential / rural
- ☐ Industrial
- ☐ Commercial
- ☐ Natural
- ☐ Other, please specify: _____

Please select the **SHAPE** of your chimney and provide the appropriate estimated measurements:

- ☐ Round → Diameter (cm): _____
- ☑ Square → Width (cm): _____
- ☐ Rectangular → Width (cm): 40 Length (cm): 40

NOTE: Measurements can sometimes be estimated by counting bricks. Standard bricks have the following measurements: **20cm x 9cm x 6cm (L x W x H)**

Chimney Assessment Form

Chimney height above roofline (m): 0.5	Number of Flues: 1	Colour of Chimney: Brown

Total Chimney Height (m) = 1 (Number of stories in building) × 3 m (approx height of one story) + 0.5 (Height above roofline (m)) = 3.5 m

If swifts are present, are they: ☐ **Nesting** ☐ **Roosting** ☐ **Unknown**

Additional Comments:

None

Created by:

BIRD STUDIES CANADA / ÉTUDES D'OISEAUX CANADA
understand appreciate conserve / comprendre apprécier conserver

Canadian co-partner of / un partenaire canadien de
BirdLife INTERNATIONAL

In partnership with:

Ontario

The Ontario Trillium Foundation / La Fondation Trillium de l'Ontario

Environment Canada / Environnement Canada
Ontario Region / Région de l'Ontario

McIlwraith Field Naturalists

CHSW 160950443 JULY 4, 2012 HAMILTON – SCUBE

TIME:	STATION:	UTM:	# OF SUITABLE CHIMNEYS	# CHSW OBSERVED:	
10:35	(1)	0609819 4785639	Ø	Ø	
10:52	(2)	0609305 4785335	Ø	Ø	
11:08	(3)	0609056 4785414	Ø	Ø	
11:26	(4)	0608835 4785328	Ø	Ø	
11:43	(5)	0608591 4784942	Ø	Ø	BARS (3)
11:58	(6)	0608322 4784897	Ø	Ø	
12:15	(7)	0608135 4784860	Ø	Ø	
12:30	(8)	0607825 4784837	Ø	Ø	
12:45	(9)	0607909 4785077	Ø	Ø	
13:00	(10)	0607970 4785277	Ø	Ø	
13:15	(11)	0608046 4785539	Ø	Ø	
13:30	(12)	0608636 4785483	Ø	Ø	
13:47	(13)	0609256 4784859	Ø	Ø	

OHSW 60950443 Hamilton-SCUBE
June 26 2012

Time	station	UTM	location	# suitable chimneys	# OHSW obs.
09:30	1 Winona Rd Winona Equip	0609819 4785639		none -all = narrow, dum or capped	Ø.
09:45	2 1216 Barton	0609805 / 4785335		none - new housing to north - no chimneys to W - older houses - sml / capped	Ø.
10:00	3 1178 Barton	0609056 / 4785414		none	Ø
10:15	4 school	0608835 4785328		houses across st	Ø.
	(no other stns on Lewis — no other pot. structures — all visible from #4 stn)			none #265 → lrg wide chimney - not visible if access	Ø
10:30	5 1123 Hwy 8	608591 / 4784942		#1123 has long narrow brick chimney @ 3 stacks (not applicable if access)	Ø
10:45	6 memphis fire BBQ	608322 / 4784897		none - capped / sml	Ø.
11:00	7 Thai cuisine 1065 Hwy 8	0608135 / 4784860		? older house - 1059 Hwy 8 narrow long brick - no caps top not visible	Ø
11:15	8 201 McNeilly Rd.	0607825 / 4784837		none Ø	Ø
11:30	9 235 McNeilly Rd	0607909 4785077		Ø	Ø.
11:45	10 263 McNeilly Rd	0607970 4785277		none	Ø.
12:00	11 297 McNeilly (McNeilly / Barton)	0608046 / 4785539		none	Ø

CHSW June 26 2012 Scube

Time	Station	UTM	# suitable chimneys	# CHSW observed
12^{15}	12 (1095 Boston)	608636 4785483	None	∅
12^{30}	13 (1226 Hwy 8)	609256 4784859	None	∅

APPENDIX D:
Correspondence