Hanlon Creek Business Park
Environmental Implementation Report
2009

Prepared for:

City of Guelph
Economic Development & Tourism Services
City Hall, 59 Carden Street
Guelph, ON

Project No. 726 Date: February 2009

NATURAL RESOURCE SOLUTIONS INC.
Aquatic, Terrestrial and Wetland Biologists

Hanlon Creek Business Park
Environmental Implementation Report

Project Team:

Staff	Role
David Stephenson	Project Manager, Senior Biologist, Certified Arborist
Tara Brenton	Terrestrial/Wetland Biologist
Brett Woodman	Terrestrial/Wetland Biologist, Certified Arborist
Susan Coleman-Smith	Terrestrial/Wetland Biologist
Jessica Grealey	Terrestrial/Wetland Biologist
Jessica McEachren	Terrestrial/Wetland Biologist
Robin Boles	Terrestrial/Wetland Biologist
Andrew Ryckman	Terrestrial/Wetland Biologist
Phil Anderson	Aquatic Biologist
Andrew Schiedel	Aquatic Biologist
Dave Green	Aquatic Biologist
Robert Steele	Aquatic Biologist
Gerry Schaus	G.I.S.
Shawn MacDonald	G.I.S.
Laurie Dennis	G.I.S.
Nathan Badger	G.I.S.

Report submitted on February 9, 2009

David Stephenson, Project Manager

Head Office: 50 Westmount Rd. N., Unit 230, Waterloo, Ontario, N2L 2R5 **Tel:** (519) 725-2227 **Fax:** (519) 725-2575 **Web:** www.nrsi.on.ca
Sault Ste. Marie: 111 Elgin Street, Unit 201, Sault Ste. Marie, Ontario, P6A 6L6 **Tel:** (705) 253-0620 **Fax:** (705) 253-0670 **Email:** info@nrsi.on.ca

TABLE OF CONTENTS

List of Tables

List of Figures

List of Appendices

1.0 Introduction

1.1 Report Overview

The Environmental Implementation Report (EIR) components have been integrated from a number of sources. The components arise from the following:

- Draft Plan Settlement Conditions, including the Ontario Municipal Board (OMB)
- recommendations from the Consolidated Environmental Impact Statement (EIS) (NRSI 2004),
- comments from the Environmental Advisory Committee on the EIS,
- comments from Shannon Smith supported by EAC (at the time the City's Environmental Planner),
- as well as Grand River Conservation Authority (GRCA) comments.

Many of these requirements overlap with components of the standard plan development and review process.

This EIR also incorporates information arising from review comments on previous draft EIR's prepared in January and June, 2008. Comments were received from staff of the City of Guelph, GRCA, EAC, Public Liaison Committee (PLC), and members of the public. The first draft of the EIR was provided to the City on January 6, 2008, and an introduction to the EIR was presented to EAC on January 30, 2008. This introductory session focused on providing an overview of the content and structure of the EIR relative to the Terms of Reference. A number of questions, comments and concerns were expressed by EAC members and a follow-up memo was provided dated February 12, 2008. This follow-up memo and the details of the EIR were discussed with EAC on February 13, 2008.

The EIR was also provided to members of the PLC. A detailed discussion of the comments, questions and concerns from PLC members occurred on February 20, 2008.

A revised EIR was submitted to GRCA, City staff, EAC and PLC members in June 2008 for further review. A number of new items were introduced in the June 2008 version (i.e. thermal modeling, restoration planting plans). A new set of questions, comments and concerns arose from this report.

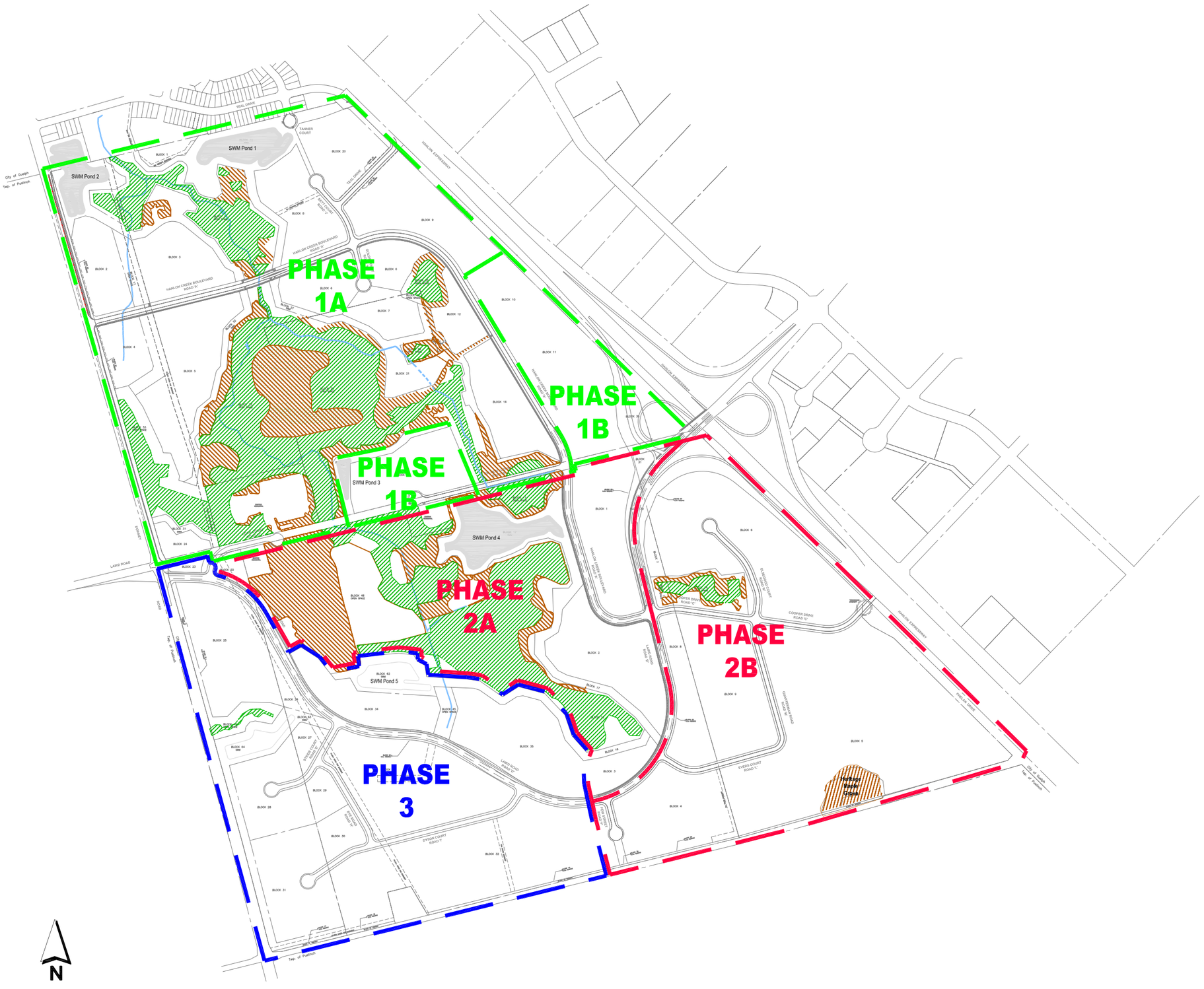
The current EIR is a result of the integration of the comments provided to date. Considerable information and associated reports are appended to this report. It was found that many of the questions and comments on previous versions of the EIR related to the level of detail in the figures. As a result, it was concluded that detailed figures would be needed to satisfy these questions, and these have been appended to this EIR. Also included in the appendices are tabular lists of the comments received to date.

1.2 Study Area

In 1993, The City of Guelph annexed 1,489 ha of land along its south and eastern boundary with the Township of Puslinch. A portion of this land was then designated by the City as Corporate Business Park and Industrial lands (called the 'Hanlon Creek Business Park'). The study area for this project is comprised of the lands between Downey Road and the Hanlon Expressway, and between Forestell Road and the south end of the Kortright subdivision along Teal Drive. The lands fall within Part Lots 16, 17, 18, 19, and 20 Concession 4 and Part Lots 16, 17, 18 and 19 Concession 5 in the former Geographic Township of Puslinch (now the City of Guelph). The lands are a mix of agricultural fields, meadow, woodland, forest and Provincially Significant Wetlands consisting of swamp, marsh and thicket.

The creek, wetlands and forested uplands in the study area are part of the much larger Hanlon Creek watershed. This watershed contains Provincially Significant Wetlands (Hanlon Swamp, Hall's Pond Wetland), Environmentally Significant Areas (Speed River ESA, Hanlon Swamp ESA, Hall's Pond Wetland ESA), Areas of Natural and Scientific Interest (Paris-Galt-Moffat Moraine ANSI) and other unclassified natural areas. The central wetlands in the study area are part of the Hanlon Swamp Wetland Complex and therefore are considered provincially significant. In addition, a small wetland in the southwestern portion of the Business Park, next to Downey Road, is part of the provincially significant Speed River Wetland Complex.

This area encompasses a headwater tributary of Hanlon Creek. The tributary within the study areas was designated as Tributary A in the Hanlon Creek Watershed study.



Hanlon Creek Business Park
City of Guelph

Environmental Implementation Report

February 2009
Project 0726
Universal Transverse Mercator - NAD83
Scale 1:10000 @ (11x17")

NATURAL RESOURCE SOLUTIONS INC.
Aquatic, Terrestrial and Wetland Biologists

Legend

- Phase I
- Phase II
- Phase III
- Existing Upland Woodlot
- Provincially Significant Wetland
- Watercourse

Base layers from AECOM received January 21, 2009 (X-prlegal, X-prroad).

Figure 1

Study Area and Phase Layout

NRSI_0726_Hanlon_PhaseKeyMap_06Feb09_GCS.dwg

1.3 Terms of Reference

Terms of Reference for the EIR were prepared and presented to the GRCA as well as the City of Guelph EAC committee. These Terms of Reference were supported at the July 11, 2007 meeting of EAC, as well as by the GRCA (see Appendix I).

1.4 Modifications to the Terms of Reference

The content of this EIR deviates slightly from the July 2007 Terms of Reference, as follows:

Development details for lands within the HCBP are required to complete the analyses of potential impacts, mitigation, restoration etc. Preparation of these details is varying depending on the landownership and their specific timelines. The detailed development plans etc. for much of the land within the Business Park are available, but the development details for the western-most lands south of Laird Road are not available at the time of preparing this report. Due to landownership patterns, the HCBP has been divided into three main phases (see Figure 1). Phase I includes lands north of Laird Road, while Phase II includes lands south of Laird Road in the east. The development details for these two phases are available, and the EIR includes analysis of these portions of the HCBP. Phase III includes the lands for which development details are not available. The Phase III components of the Terms of Reference are therefore not included in this EIR.

The components that are exclusively found within Phase III that are not addressed in this report are:

- Analysis of tree loss and development of restoration details for the portion of woodlot south of Laird Road that is impacted by Road D
- Analysis of tree retention including trees associated with the Crawley house
- Analysis of retention of small wetlands in Phase III
- Restoration plans for areas within Phase III including storm pond #5 and #6
- Refinement of the characterization details provided in the Consolidated EIS (NRSI 2004) of Tributary A that is adjacent to Pond 5

It is anticipated that at some point in the future an addendum to this EIR will be prepared to address the Phase III analysis.

In the January 2008 draft EIR, details on the Road A crossing of Tributary A and the thermal assessment of the stormwater management ponds were not included. The June 2008 draft EIR included an event-based thermal assessment of the SWM ponds, however, in order to fully satisfy OMB Condition 12, a continuous in-time model was developed. This current EIR includes details on the Road A crossing of Tributary A as well as the continuous in-time thermal modeling assessment.

1.5 Report Structure

The EIR is divided into sections as follows:

- **Section 1** includes a detailed description of the historic background of the EIR, as well as a summary of the natural heritage components of the study area.
- **Section 2** includes details on field work and findings from the tree inventory conducted throughout the study area.
- **Section 3** focuses on the tree inventory around the Heritage Maple Grove and discusses the development of the recommended boundary. Management recommendation and mitigation measures that pertain to the Heritage Maple Grove are detailed in Section 3 as well.
- **Section 4** provides a recommended street tree planting plan as per City planting requirements and planting guidelines.
- **Section 5** discusses buffer designs and restoration planting plans for stormwater management ponds, berms, buffers, riparian and open areas. Restoration plans for the study area are appended to this report.
- **Section 6** includes details on planting requirements and restoration monitoring. Section 6 also outlines tree conservation and replacement and guidelines for seed collection and plant rescue.
- **Section 7** characterizes the small wetlands and addresses the potential for their retention.
- **Section 8** outlines recommendation**s for res**toration of Laird Road. A restoration plan for Laird Road is appended to this report.
- **Section 9** presents the pedestrian and open space trail system proposed throughout the study area. Details on each type of trail (multi-use, off-road) are provided in this section as well.

- **Section 10** details the monitoring recommendations arising from the OMB conditions of Draft Plan approval and the Terms of Reference. Future monitoring recommendations and contingency plans are provided in Section 10 as well. The EIR provides detailed information on recharge targets, a monitoring program that assesses the performance of stormwater management facilities and post-development recharge infiltration rates on a block-by-block basis. Additional monitoring that arose from the OMB conditions of Draft Plan approval, such as tree preservation plans, buffer and woodlot restoration, pedestrian and open space trail system and wetland analysis are also discussed.
- **Section 11** outlines the City of Guelph Property Demarcation Policy (2006) and how it pertains to the business park. Fencing requirements are discussed and a detailed fencing plan is appended to this report.
- **Section 12** provides detail about the realignment and new culvert crossing of the Downey Watercourse as well as the new culvert crossing at Tributary A/Road A. Existing aquatic conditions associated with these areas, proposed undertaking and mitigation measures are detailed. Recommended restoration plans for Downey Watercourse and Tributary A/Road crossing are appended to this report. Ecological connectivity and wildlife movement are discussed as well.
- **Section 13** provides a summary of the Hydrogeology Report prepared by Banks Groundwater Engineering (2008) which outlines the on-going detailed monitoring of groundwater levels and updated characterization of the hydrogeological conditions within the study area.
- **Section 14** summarizes the 2009 Hanlon Creek Business Park Stormwater Management Report Ponds 1, 2, 3 and 4 prepared by AECOM (previously Totten Sims Hubicki (TSH)). Details regarding the Downey Road stormwater pipe are provided in Section 14.
- **Section 15** provides a detailed summary of the thermal impacts associated with the SWM ponds as seen from the continuous model analysis.
- **Section 16** provides details regarding the servicing features (watermains and sanitary sewers) within the proposed development
- **Section 17** provides a list of site plan recommendations, such as sediment and erosion control, dust suppression and snow storage based on the proposed development.

A comprehensive list of bird and amphibian species observed by NRSI within the study area has been appended to this report (see Appendix II and III). Bird species observed have been compared to the Grand River Conservation Authorities 'Grand River bird Checklist' (GRCA 2008) to determine the number of priority species within the study area.

The EIR is prepared as part of a package for submission and review, and although excerpts from these companion documents are included in the EIR, the reader is referred to these associated appended documents for further details.

1.6 Project Phasing

At the time of preparing the EIR, the design of the Hanlon Creek Business Park has been detailed starting with initial clearing and grubbing to the construction of the roads in Phase I and II. Lot-level development, building permits, etc. are not known at this time, but will be required for site plan. As such, the following overview of project phasing focuses on the initial site preparation works.

The timing of the works will be initiated through a tendering process. The schedule of project components must consider the following construction windows:

- Migratory Birds Convention Act (Canadian Wildlife Service 1994) - construction activities can only be constructed in accordance with the Migratory Birds Convention Act. The timing of the peak breeding season for the study area is between May 9 and July 23, although this should be held as a general guideline. Birds are known to nest prior to and after these dates, depending on site conditions and other factors.
- The amphibian breeding season spans from April to June. Therefore, amphibian species will be provided protection from construction activities for most of their breeding season.
- To avoid impact on the coldwater system and associated fish species, any construction activities associated with creeks or aquatic areas (i.e. culvert and road installation) must be conducted between July 1st and September 30th.

- Cleanout/remediation of stormwater management ponds must respect the amphibian breeding season (April to June) and hibernation period for herpetofauna species (late summer).

The on-site works will commence in spring/early summer 2009. Based on the above timing constraints, the following project components timelines will occur:

May – December 2009

Tasks will include installation of sediment and erosion control measures, and site clearing. All works listed below will be preceded by appropriate permits, site inspections, as well as installation of sediment and erosion control measures, tree protection fencing, etc.

Clearing and Grubbing – Phase I,	Includes installation of sediment & erosion control measures, tree protective fencing, removal of trees indicated for removal
Clearing and Grubbing – Phase II	Includes installation of sediment & erosion control measures, tree protective fencing, removal of trees indicated for removal
Earthworks – Phase I, ,	Includes stormwater management facilities, swales
Earthworks – Phase II,	Includes stormwater management facilities, swales
Downey Sewer and Watermain	Includes extension of sewer and watermain along Downey Road right-of-way
Downey Roadworks	Includes section from Teal Drive to Laird Road, grading the road base, bringing in the road granulars, constructing the curbs and paving
Tributary A Watermain Crossing	Includes installation of watermain associated with construction of Road A

The following activities will occur and are those that can proceed based on completion of the applicable above tasks (i.e. clearing of vegetation), or are not affected by the bird or coldwater stream windows.

Sanitary Sewer Installation	Installation associated with roads and will occur in phases: North Limit to Road A, Road A to Laird Road, Road A – Downey to Road J, Laird Road to Road D, Road C, Road D
Watermain Installation associated with roads	Installation will occur in phases: Road C, Road A from Road D to Laird, Road D
Hanlon Watermain and Utility Crossing,	Includes directional boring/tunneling to get watermain and utilities under Hanlon Expressway
Storm Sewer Installation – Phase I and II, likely in November and early December	Installation associated with roads

Roadworks – Phase I, commencing in November to end of December 2008, April – May 2010	Includes roads within Phase I (i.e. north of Laird), grading the road base, bringing in the road granulars, constructing the curbs and paving
Roadworks – Phase II, commencing in April 2010 to May 2010	Includes roads within Phase II, grading the road base, bringing in the road granulars, constructing the curbs and paving

May – September 2010

Tasks that will occur in May to September 2010 are associated with Laird Road, including works that must occur relative to the coldwater stream window (July – mid-Sept). The Road A crossing of Tributary A will occur at this time.

Laird Road Watermain, likely in May/August	Includes installation of watermain along Laird Road within the roadbed.
Laird Road Watermain, Tributary A and A1 Crossings, in July (to respect coldwater construction window)	Includes crossing of Tributary A will occur within the road bedding at the existing culvert. A second crossing of a culvert associated with the agricultural ditch at upstream of Tributary A1
Laird Road Sanitary Sewer, likely May	Includes installation of sanitary sewer within road right-of-way
Laird Roadworks, likely July/August	Includes any required works to repair from above works, such as regrading the road base, bringing in the road granulars, constructing the curbs and paving
Road A – Tributary A Culvert	Includes installation of Tributary A crossing of Road A as per GRCA/DFO permits

Building Permit Stage

Following the road construction described above, building permits may be issued by the City. As such, lot-level works would have timelines that for the most part follow the above project components. Once the subdivision has been registered, the issuance of

building permits will be dependent upon an approved site plan. In some cases the existing blocks may be too large for a prospective purchaser and severed. In this case a building permit would be dependent upon site plan approval.

Grading

Grading plans prepared by AECOM for Phase I are split into separate categories; Interim and Ultimate. Interim grading plans are required for tender submission in 2009 and works to be undertaken early spring/summer 2009. The tender will include works associated with road building within Phase I and II, as well as stormwater management facilities (ponds, swales). Site specific lot-level grading details are not provided within the Interim plans.

Ultimate plans provide detailed grading associated within the development Blocks. The plans document the lot-level grading that will be realized as individual lots are built out.

Ultimate grading plans have been used for the analysis of tree retention/removal.

1.7 Background

In 2000, an Environmental Impact Study (EIS) for the proposed development of the Hanlon Creek Business Park was prepared by a team led by AECOM (previously Totten Sims Hubicki Associates). The EIS provided refined characterization of natural features and functions within the area, as well as information and analyses pertaining to hydrology and hydrogeology, servicing, heritage, etc. The EIS included a conceptual layout for the business park, including road network and lotting, and assessed the potential impacts of the undertaking. The EIS was subsequently reviewed and approved by the GRCA (see November 9, 2000 letter from Natolochny to Al Hearne) as well as the City of Guelph and EAC Committee (see minutes of October 11, 2000).

Subsequent to completion of the EIS, further on-site investigations were completed, including review of vegetation boundaries and characterization by staff of the GRCA, on-site staking of the wetland boundary and the dripline of the deciduous woodlot south of Laird Road, review of the staked boundaries by staff of the GRCA, and surveying of the staked boundaries. Staff of the GRCA (Wayne MacMillan) prepared a follow-up memo in October 2000, which provided recommendations regarding buffers that were

consistent with those proposed in the original 2000 EIS. A brief Addendum letter report was prepared by AECOM in April 2001 which documented these refinements.

In 2002, the City of Guelph commissioned the firm of Green Scheels Pidgeon (GSP) to complete the subdivision land use and road layout design. As well, AECOM was retained to complete a servicing and preliminary servicing design for the Hanlon Creek Business Park.

A Second Addendum to the EIS was prepared in November 2002 based on the detailed characterization of the natural features documented in the EIS (with updates) and refinements to the layout of the undertaking. The treatment of the natural features, especially the buffers, remained consistent with the original EIS.

Additional refinements to our understanding of site conditions occurred including completion of a study of local hydrogeology completed by Waterloo Hydrogeologic (2004) entitled "*Hanlon Creek Business Park Hydrogeological Study*". In addition, further refinements of the proposed servicing of the lands was completed by AECOM and documented in a February 2004 report entitled "*Hanlon Creek Business Park Servicing Report*". Modifications to the Draft Plan of Subdivision prepared by Green Scheels Pidgeon (2004) ensued. These changes and refinements to the proposed business park layout and subsequent information generated by other team members warranted a review and update of the EIS conclusions. This review and update to the report was detailed in the Third Addendum (February 2004).

The Third Addendum was circulated to staff of the GRCA, City of Guelph and presented to EAC in May 2004. A series of review comments were provided on this addendum, many of which related to the difficulties in following the analyses and agreements documented in the various EIS addenda. As a result, the consolidated EIS was prepared in November 2004.

Following review of the EIS, conditions of Draft Plan approval were set out by the Ontario Municipal Board (OMB) in June, 2006. Condition #12 of the Draft Plan approval requires that the Developer shall prepare an Environmental Implementation Report (EIR) based on terms of reference approved by the City and Grand River Conservation Authority (GRCA).

A brief summary of the evolution of the addenda and associated studies is provided in Table 1. This summary clarifies that original approaches to identifying and protecting the key (central) natural features and associated buffers have been maintained throughout over 7 years of study and design for the subject lands.

Table 1. Summary of Hanlon Creek Business Park Report History

Document Title	Content	Associated Documents	Natural Heritage System & Constraints	Wetlands	Buffers
Totten Sims Hubicki Associates et al. 2000. Hanlon Creek Business Park Environmental Impact Study. (August 2000).	EIS provided refined characterization of natural features and functions within the area, as well as information and analyses pertaining to hydrology and hydrogeology, servicing, heritage, etc. The EIS included a conceptual layout for the business park, including road network and lotting and assessed the potential impacts of the undertaking.	N/A	A three-tier constraint system was proposed that included features in which no development would occur, limited development areas and potential development areas. The NHS was based on protection of the central natural 'core' with some bulking up these features. Smaller, isolated wetlands were recommended for secondary consideration.	At the time of preparing the 2000 EIS, the wetlands associated with the study area had not been formally evaluated using the MNR Wetland Evaluation System. The EIS included a detailed analysis of the wetlands and recommended which wetland areas to be included in complex. Procedure was reviewed by staff of the MNR and accepted.	Buffers were recommended based on an iterative approach. Refinements to buffers recommended in the Hanlon Creek Watershed were detailed. Conclusions regarding buffers were reviewed and accepted (see Addenda #1). Staff of the GRCA participated in the EIS study in which buffers widths were examined and recommended.
Totten Sims Hubicki Associates. 2001. Hanlon West Business Park Environmental Impact Study. Addendum.	Further on-site investigations were completed including, review of vegetation boundaries and characterization by staff of the GRCA, on-site staking of the wetland boundary and the dripline of the deciduous woodlot south of Laird Road, review of the staked boundaries by staff of the GRCA and surveying of the staked boundaries.	GRCA. 2000. Memo from Wayne MacMillan re October 23, 2000 Site Visit.	This Addendum did not change the NHS and constraint level approach in the 2000 EIS.	The boundaries of the wetland were staked and reviewed by staff of GRCA. Staff of the GRCA agreed to the recommendations regarding treatment of the smaller wetlands vis-à-vis the large central natural area.	The GRCA provided a memo recommending buffers consistent with those recommended in the 2000 EIS.

Totten Sims Hubicki Associates and Natural Resource Solutions Inc. 2002. Hanlon Creek Business Park Environmental Impact Study Addendum #2.	Green Scheels Pidgeon (GSP) completed the subdivision land use and road layout design. Totten Sims Hubicki Associates completed servicing and preliminary servicing design. Addendum included assessment of the potential impacts of the undertaking (esp. those features that differed from original EIS).	Green Scheels Pidgeon. 2002. Hanlon Creek Business Park Draft Plan of Subdivision. (July 16, 2002) Paradigm Limited. 2002. Hanlon Creek Business Park Traffic Impact Study Totten Sims Hubicki Associates. 2002. Hanlon Creek Business Park Preliminary Servicing and Stormwater Management Report (September 2002).	This Addendum did not change the NHS and constraint level approach in the 2000 EIS.	This Addendum was based on the wetland approach proposed in the original EIS and agreed to in Addendum #1.	This Addendum and associated studies/plans were based on the buffers proposed in the 2000 EIS.
Natural Resource Solutions Inc. 2004. Hanlon Creek Business Park Environmental Impact Study Addendum #3.	Additional refinements to understanding of site conditions including completion of study of local hydrogeology. Further refinements of the proposed servicing of the lands were completed. Modifications to the Draft Plan of Subdivision. These changes and refinements to the proposed business park layout and subsequent information generated by other team members warranted a review and update of the EIS and Addenda impact analysis conclusions	Green Scheels Pidgeon. 2004. Hanlon Creek Business Park Draft Plan of Subdivision. (February 2004) Paradigm Limited .2004. Hanlon Creek Business Park Traffic Impact Study Totten Sims Hubicki Associates. 2004. Hanlon Creek Business Park Servicing Report (November 2003). Waterloo Hydrogeologic, Inc.	This Addendum did not change the NHS and constraint level approach in the 2000 EIS.	This Addendum was based on the wetland approach proposed in the original EIS and agreed to in Addendum #1	This Addendum and associated studies/plans were based on the buffers proposed in the 2000 EIS

		2004. Hanlon Creek Business Park Hydrogeological Study (November 2003).			
Natural Resource Solutions Inc. 2004. Hanlon Creek Business Park Consolidated Environmental Impact Study.	A series of review comments were provided on Addendum #3, many of which related to the difficulties in following the analyses and agreements documented in the various EIS addenda. As a result it was agreed that a Consolidated EIS would be prepared.	GSP Group. 2004. Hanlon Creek Business Park Draft Plan of Subdivision. (September 2004) Paradigm Limited .2004. Hanlon Creek Business Park Traffic Impact Study Totten Sims Hubicki Associates. 2004. Hanlon Creek Business Park Servicing Report (November 2004). Waterloo Hydrogeologic, Inc. 2004. Hanlon Creek Business Park Hydrogeological Study (September 2004).	The Consolidated EIS did not change the NHS and constraint level approach in the 2000 EIS.	The Consolidated EIS was based on the wetland approach proposed in the original EIS and agreed to in Addendum #1.	The Consolidated EIS and associated studies/plans were based on the buffer 'smoothing' plan prepared and provided to the GRCA on June 22, 2004.

1.8 Natural Heritage of the Hanlon Creek Business Park

The following overview of the natural heritage components of the Hanlon Creek Business Park is excerpted from the 2004 Consolidated EIS (NRSI 2004). This section is intended to provide an overview of the natural features and functions within the HCBP and to provide an ecological context for the components of the EIR. For additional detail, the reader is referred to the complete EIS.

The Hanlon Creek Watershed Plan identified a number of important natural features and functions within the study area and recommended measures for their retention. Specific recommendations contained within the Watershed Plan that had a bearing on constraint identification are as follows:

- recommended preservation of Tributary A wetland complex
- recommended use of buffer areas
- restoration of a primary ecological linkage from Tributary A to the lower Hanlon Creek valley
- preservation of the headwater woodlands and wetlands on Tributary A
- restoration of a secondary ecological linkage from Tributary A from the lower Hanlon Creek
- restoration of a secondary ecological linkage from Tributary A to the Speed River

Section 2.3.2 of the Watershed Plan identified the following overall goal:

"*To restore, protect and enhance water quality and associated aquatic resources and supplies*", specifically:

- less nutrients
- minimize erosion and sedimentation
- maintain and restore vegetative canopy
- use of BMPs to restore, rehabilitate or enhance water quality
- ensure baseflow function of stormwater management facilities
- implement selected habitat improvement (i.e. improve channel morphology)
- removal of selected debris obstructions

The recommendations of the Watershed Plan were reviewed for guidance, and site specific analyses were completed to provide a greater level of detail to guide land use decisions. The identification of enhancement and protection measures (such as setbacks) was iterative, taking into account not only the characteristics of the natural features, but also the nature of the proposed undertaking.

It was recommended that emphasis be placed on preserving the central area of wetlands and woods and that this central area would be 'bulked up' in terms of enhancements. The central core area was identified based on the following:

- included a diversity of habitat types including mature and immature communities, such as the main wetland and upland wooded stands,
- supported connectivity between the wetland and upland habitat blocks by a combination of direct linkages as well as by proximity. The identification of this interconnected core offset the limited connectivity available for these habitats to other habitats located outside the study area. Key to this was the recommendation in the EIS for the closure of Laird Road through the central natural area.
- included a range of open country habitats including open fields, thicket and immature treed areas
- provided for setbacks/buffers from the creek
- included setbacks around the perimeter of the core (see below).

Outlying features were typically considered of secondary importance in this regard.

The approach to identifying constraints to development within the study area was based on a balance of recommendations contained within the Hanlon Creek Watershed Plan, as well as site-specific conclusions regarding the character and function of natural resources in the study area. This approach also considered potential enhancement opportunities within the area.

Based on the Watershed Plan as well as the findings of the present study, the following key points were used to direct the identification of constraints and enhancement opportunities:

Terrestrial and Wetland Habitats

Overview:

- the study area contains a portion of the provincially significant Hanlon Creek Swamp Complex as well as a small portion of the provincially significant Speed River Wetland Complex
- the high diversity of biological habitat types in the watershed has resulted in a high diversity of wildlife and plant species. This high diversity coupled with the large areas of natural habitat and natural corridors provides habitat for some rare plant and wildlife species. The natural habitats within the study area are not as large as, and are somewhat isolated from the remainder of natural habitats in the Hanlon watershed.

Limitations

The following current characteristics of the natural features in the study area create limitations to the quality, function or sustainability of the natural resources in the area:

- discontinuities in habitat linkages
- historic drainage of the wetlands
- limited amount of early succession upland habitats
- small isolated wetland pockets
- fragmentation of habitats from roads and fields
- lack of large wooded blocks

Rehabilitation and Enhancement Opportunities:

- restoration of discontinuities in habitat linkages with plantings, especially woody riparian vegetation (see discussion below for aquatic resources)
- maintenance of groundwater balance into wetlands
- identification and preservation of vegetated setbacks from the wetlands where warranted
- examination of feasibility of restoring continuity of habitats (’bulking up’ central core habitats)

Aquatic Habitats

Overview:

- documented brook trout spawning occurs in east branch of Hanlon Creek, north of Laird Road
- areas south of Laird Road presently unsuitable for brook trout and limited baseflow, and degraded water quality provides limited fish habitat

Limitations:

The following current conditions appear to limit aquatic habitat quality:

- fragmentation of aquatic habitats
- degraded water quality
- presence of on-line pond
- areas lacking riparian cover
- historic construction of drainage ditches and straightening of creek
- flow obstructions at Laird Road and horse trail crossing appear to create impediments to flow and result in creation of extensive marsh areas with ill-defined channels

Rehabilitation and Enhancement Opportunities:

- improve the connectivity of habitat to encourage fish movement
- improve water quality with respect to nutrient and pesticide/fertilizer inputs
- remove on-line pond
- re-establish riparian canopy
- improve habitat diversity by 'naturalizing' artificially modified reaches of channel
- review the debris and culvert obstructions with possible removal

A Natural Heritage System was developed in the EIS to include aquatic, wetland and terrestrial features consisting of:

- central wetland areas are small wetland areas that are part of the complex (see discussion below)
- mature upland woods
- all perennial watercourses
- upland immature treed areas, and
- setbacks from wetlands, woodlands and watercourse (see discussion below on Setbacks).

Enhancement/Recharge Areas

As part of the development of the concept plan in the EIS, a number of factors were considered, including the opportunities to enhance existing natural features and linkages, as well as groundwater recharge. Open areas associated with the central portions of the natural area were recommended for retention as successional habitats. These areas were seen to provide additional habitat diversity as well as potential linkages between other wooded and wetland habitats. The enhancement areas were in some cases found surrounded (or almost surrounded) by wetland and woodlands, and development of these small inclusions was not recommended. In other cases, the enhancement areas were located along the outside edges of setbacks. These included areas where wooded edges extended beyond the setbacks recommended for wetlands, as well as in areas where additional setback could be beneficial to provide trail linkages, smooth out setback boundaries, etc. The enhancement areas were also seen as areas for potential groundwater recharge.

The preparation of the November 2004 Draft Plan and Servicing Plans were the culmination of a detailed process of discussions and analyses of a range of issues. The approach to identifying and delineating Constraint Areas, discussed above, was aimed at avoiding direct impacts from development on important natural features. The designation of the constraint levels was used to guide the layout of the development in such a way that direct displacement of natural features is minimized.

The construction of the new roadway (Road A) will require a crossing of the creek. The proposed location allows for an efficient treatment of the crossing and online pond since both can be dealt with at the same time. By way of the crossing design, the online pond will be removed and the channel restored.

The current alignment of the intermittent drainage way in the northwest corner of the study area (running diagonally from Downey Road), crosses proposed lots and is proposed to be re-aligned to follow closer to Downey Road. The discharge of this channel is proposed to bypass the stormwater conveyance channel and discharge directly to the existing channel within the protected area. This channel will convey ‘clean’ runoff from Block 47 (open space block that is part of retained natural area) and the agricultural lands west of Downey Road, making it unnecessary to route discharge through the stormwater management facility. This mimics the current discharge location

of the flows and also avoids discharge of these possibly salt-laden flows further upstream where more sensitive trout habitat occurs (or could be restored).

A number of isolated wetland areas have been identified that were not included in the complex by the Ministry of Natural Resources. Although not recommended for inclusion into the wetland complex, it was recommended that the wetland pockets be kept as potential landscaping features wherever possible. It is anticipated that the majority of the isolated wetland pockets will be removed because of grading issues. The actual grading of the Blocks will be reviewed at Site Plan Approval to determine if any more of the isolated wetland can be protected during and after development.

During the preparation of the conceptual plan in the EIS, one guiding objective was the retention of the main natural area and to investigate the feasibility of closing Laird Road. The intent of this closing was to allow for the ultimate removal of the roadbed and restoration of the creek in the vicinity of the road culvert. Based on further analysis, it was concluded that the existing residential lots found on Laird Road would remain and would therefore require road access. Therefore the Draft Plan shows the section of Laird Road between the two existing residences as closed, but not removed. To ensure that Laird Road remains suitable for emergency access, City staff has confirmed that upon closure, the Ontario Building Standards require that the road remain 6m wide. The road surface will be maintained as asphalt along this area to ensure that it has load bearing capabilities for emergency vehicles and utility services. The infrequent traffic along this area will allow for herbaceous plants species to establish on areas adjacent to the roadbed. Mobile wildlife are anticipated to readily cross this feature.

Typical sediment control measures are anticipated for this development with no impacts anticipated to natural features. Setbacks between the rear lot lines and the wetland edges or watercourse has been established at 15 to 30m (greater in some cases), and therefore it is not expected that runoff would reach these natural areas. The slopes in the area are generally flat and are not anticipated to create significant erosion concerns. In cases where stormwater management facilities are located within the setback, sediment and erosion control measures will be required in this area to ensure that no runoff to the wetlands or creek occurs. 'No touch' zones have been identified and will be used. These consist of a minimum of 10m around wetland limits or 1m outside the

dripline of upland woodlands or fringes (whichever is greatest). A 5m setback from wetland limits will be implemented where stormwater management ponds are situated.

The proposed development is not anticipated to have a significant impact on groundwater or surface water flow patterns and volumes. Assuming that recommendations with respect to sediment control and infiltration opportunities are maximized, no impacts on the wetlands or creek are anticipated.

Existing water quality in the creek has been found to have high levels of nutrients and pesticides from agricultural sources. The recommendations for stormwater management quality have been provided to enhance this existing condition. Implementation of these measures in conjunction with vegetated setbacks from the wetlands and creek and establishment of vegetated landscapes associated with lots are anticipated to improve current degraded water quality.

Runoff entering the ponds will have been directed to flow over considerable lengths of vegetated swale. Access has been provided to each pond and monitoring will be required to ensure pond function as well as contaminant levels. Maintenance of the ponds, for example removal of excess/contaminated sediments, will be triggered by this monitoring. The placement of the stormwater management ponds can provide vegetated features that can be incorporated into the neighbouring natural areas to potentially 'bulk up' an existing narrowed area.

The proposed grading and the updated stormwater management pond locations require that a series of ditches be constructed along the rear of many of the lots. These plans show the ditches along virtually all wetland areas. These drainage ways will prevent lot runoff from entering the wetland directly and will convey the runoff along these shallowly sloped and vegetated ditches to stormwater management ponds.

The ditches have been laid out to avoid intrusions into the wetlands. The stormwater conveyance channels are located outside of the 'no touch' zone, eliminating intrusion into the surrounding wetlands. The 'no touch' zones recommended for use (i.e. 5m from wetlands and 1m from upland driplines) have been used in the layout of these swales.

Based on these designs, it is not anticipated that the construction and operation of the proposed swales will influence the soil moisture within the neighbouring wetlands. It is anticipated that the long runs of some of the flows in these swales will allow for maximum contact with vegetation as well as some infiltration of flows into the soils.

A system of authorized trails has been recommended that can also be used to focus any pedestrian use of the natural areas onto properly constructed, laid out and maintained trails. Plantings of native trees and shrubs will be used to discourage human intrusion into sensitive areas (for example along the watercourse banks).

2.0 Tree Inventory and Preservation Plan

The EIR provides the details of the Tree Conservation Plan for hedgerows and other treed areas, including some of the identified Open Space blocks in Phases I and II of the HCBP. The GIS-based tree data and mapping have been used in conjunction with CAD design plans generated by the engineering team (layout of features, grading, etc), to identify tree retention and removal. As discussed in Section 14.3, the ultimate grading plans have been used to identify the trees that will require removal due to cut and fill. The layout of features such as roadways and stormwater management facilities was also used to assess tree retention. Where possible, trees recommended for retention have been identified and measures to protect these trees have been identified. Refer to Section 5.5 for details regarding the recommended compensation plan.

As per the 2004 EIS, no forest edges were proposed to be impacted by the development (except for a small portion of the woodlot south of Laird Road – for Road D). Impacts on the woodlot edge south of Laird Road will be analyzed as part of Phase III. As well, the analysis of trees associated with the Crawley heritage house will be included as part of Phase III. The tree inventory of the Heritage Maple Grove adjacent to Forestell Road is discussed separately in this report (see Section 3).

The need for the tree assessment arose from the following sources:

Source: Draft Plan Conditions (Settlement)

> *"Conditions to be met prior to grading and site alteration (and entered into subdivision agreement prior to registration)*
>
> *3. That the Developer complete a tree inventory and conservation plan, satisfactory to the City Engineer in accordance with City of Guelph Bylaw (1986)-12229 prior to any grading or construction on the site. Unless recommended for removal, due to health, condition and/or hazard potential by a Certified arborist, in good standing with the International Society of Arboriculture, the three existing maple trees located in proximity to the Crawley heritage house on Block 33, as well as the lilac shrubs surrounding the farm house will be preserved as part of the tree conservation plan immediately to the north of Forestell Road, comprise approximately 19 trees. The single hop hornbeam tree (Ostrya virginiana) will be preserved with a tree protection zone that will extend one metre past the drip-line of the tree. To the extent that the approved tree inventory and conservation plan provides for the removal of any of the remaining trees other than the hop hornbeam tree, replacement trees shall be planted at appropriate locations." (Engineering)*

Source: Memo from Shannon Smith to Al Hearne (April 27, 2004) [note: EAC Supported Ms Smith's recommendations to be addressed as part of the EIR]

> *"Tree Conservation and Replacement Plan necessary for removal of hedgerows (can be submitted as part of the EIR)"*

2.1 Field Work

A comprehensive tree inventory was completed by NRSI certified arborists, terrestrial biologists and GIS technicians during the months of July through November 2007 and March 26 and April 14, 2008. All individual trees and hedgerow trees with a 10cm or greater diameter at breast height (dbh) were included in the inventory. Tree species, dbh, canopy radius, health, and hazard rating were recorded for each tree and hedgerow. Each individual tree and hedgerow was given a number and their location was taken for mapping purposes using a GPS Trimble Unit. The location of each tree and hedgerow for Phase I is shown in Appendix IV. Phase II trees and hedgerows are shown in Appendix V.

2.2 Summary of Findings

Phase I

A total of 468 individual trees and 33 hedgerows (containing approximately 381 trees) were surveyed in the Phase I study area. The trees included those located outside of the Open Space blocks, as well as trees associated with the Summerville residence (in the northeast corner of Phase I that was recently acquired by the City, as well as trees associated with the cooling trench outlet from stormwater pond 3 (the cooling trench outlet is described further in Section 14.0).

It is anticipated that 390 of these individual trees will be removed during Phase I, 52% of which are in fair condition or worse. Of the 78 individual trees that are anticipated to remain, 51% are in good condition or better. The clearing of hedgerows will result in approximately 321 more trees being removed. Three hedgerows will be removed, resulting in approximately 14 trees being retained. Some hedgerows are anticipated to be only partially removed, resulting in a further reduction of up to 46 trees. A summary of the tree inventory findings is provided in the comprehensive tree inventory table below (Table 2).

Phase II

A total of 738 individual trees and 28 hedgerows (containing approximately 378 trees) were surveyed in the Phase II study area. The trees included those located outside of the Open Space blocks, as well as trees associated with the cooling trench outlet from stormwater pond 4 (the cooling trench outlet is described further in Section 14.0).

It is anticipated that 545 of these individual trees will be removed in Phase II, 51% of which are in fair condition or worse. Of the 193 individual trees that are anticipated to remain, 57% are in good condition or better. The clearing of hedgerows will result in approximately 355 more trees being removed. Some hedgerows are anticipated to be only partially removed, resulting in a further reduction of up to 23 trees. A summary of the tree inventory findings is provided in the comprehensive tree inventory table below (Table 2).

Table 2. Summary of Tree Inventory Results

	Individual Trees													Hedge-rows	
					Hazard Level			Overall Condition							
	# of Trees	Total Crown Radius (m)	Total Dbh (cm)	Avg. Dbh (cm)	% Low	% Medium	% High	% Excellent	% Very Good	% Good	% Fair	% Poor	% Very Poor	# of Hedgerows	Approx. # of Trees
Phase I															
To be removed	390	1,373.0	12,098	31.0	57	32	11	2	0	46	32	13	6	25	321
To be retained	78	298.7	2,918	37.4	47	45	8	0	0	51	33	13	3	3	14
To be partially retained	-	-	-	-	-	-	-	-	-	-	-	-	-	5	46
Total	***468***	***1,671.7***	***15,015***	***32.1***	***56***	***34***	***10***	***2***	***0***	***47***	***32***	***13***	***6***	***33***	***381***
Phase II															
To be removed	545	2,577.9	15,535	28.5	48	34	18	3	0	46	32	15	4	26	355
To be retained	193	763.0	4,791	24.8	63	31	6	3	0	54	37	4	2	0	0
To be partially retained	-	-	-	-	-	-	-	-	-	-	-	-	-	2	23
Total	***738***	***3,340.9***	***20,326***	***27.5***	***51***	***33***	***15***	***3***	***0***	***48***	***34***	***12***	***3***	***28***	***378***

2.3 Tree Protection Plan

In addition to sediment and erosion control fencing (i.e. silt fence), tree protection fencing in the form of heavy-duty paige-wire will be installed beyond the dripline of retained trees. Signage indicating the purpose of protection fencing will be attached to the paige-wire fencing every 100 to 150m.

Tree protection fencing locations correspond to the placement of sediment and erosion control paige-wire fencing throughout Phase I and II. Fencing locations are shown on Drawing 22490-01-E13 (back pocket of EIR).

3.0 Heritage Maple Grove

The Hanlon Heritage Maple Grove is located near the southeast corner of Phase II of the Business Park, along the north side of Forestell Road. A study of the maple grove was conducted by Bruce Kershner in 2006, and 19 mature, old growth trees were identified. Definitions and characteristics of old-growth forests are specific to different old-growth tree species, making general definitions of old-growth forests very difficult. The Old Growth Policy Advisory Committee (1994) has established a versatile definition for old-growth forests.

> ”*Old growth ecosystems are characterized by the presence of old trees and their associated plants, animals and ecological processes. They show little or no evidence of human disturbance.”*

This definition has been further expanded in an attempt to create more specific definitions for a variety of different forest associations in Ontario. Sugar maple (*Acer saccharinum*) is known to reach an age of old-growth within southern Ontario. Age of old-growth onset for sugar maple, as described by Uhlig et al. (2001) is 120 yrs., with the capability of lasting more than 200 years. Forest associations of sugar maple often include the presence of ironwood (*Ostrya virginiana*), however this species has not been classified with a specific old-growth age of onset due to its characteristic of being short-lived (Uhlig et. al. 2001).

Following review of Kershner’s report and the 2004 EIS (NRSI 2004), draft plan approval conditions pertaining to the Heritage Maple Grove were set out by the Ontario Municipal Board (OMB) in June 2006. The OMB requested that the following conditions be addressed in an Environmental Implementation Report:

> i) that the Developer complete a tree inventory and conservation plan**,** satisfactory to the City Engineer in accordance with City of Guelph Bylaw (1986)-12229 prior to any grading or construction on the site, and,
>
> ii) the single hop hornbeam tree (*Ostrya virginiana*) be preserved with a tree protection zone that will extend one metre past the dripline of the tree.

iii) To the extent that the approved tree inventory and conservation plan provides for the removal of any of the remaining trees other than the hop hornbeam tree, replacement trees shall be planted at appropriate locations.

3.1 Field Work

Field surveys were conducted in the Heritage Maple Grove by Natural Resource Solutions Inc. certified arborists and biologists on July 25, 31, August 15, 16 and 30 and October 5, 2007. Trees ≥10cm diameter at breast height (dbh) were assessed by a certified arborist and surveyed using a GPS Trimble Unit.

From these surveys, 21 large, mature trees and 274 'other' trees were identified. Sugar maple is the dominant large tree species, making up 16 out of the 21 trees identified. Four of the trees surveyed were selected and cored using an increment core to determine age. The age of three sugar maples (Tree 1018, 1019 and 1020), and one cottonwood (*Populus deltoides*) (Tree 1002) were determined:

Tree 1002: approx. 39 years
Tree 1018: approx. 260 years
Tree 1019: approx. 192 years
Tree 1020: approx. 106 years

The area within the maple grove is open grown with well –spaced trees dominated by sugar maple and black cherry (*Prunus serotina*). The remaining canopy is comprised of species such as white elm (*Ulmus americana*), trembling aspen (*Populus tremuloides*), American beech (*Fagus grandifolia*), silver maple (*Acer saccharinum*), basswood (*Tilia americana*) and ironwood.

Common buckthorn (*Rhamnus cathartica*) and black cherry dominate the understorey and shrub layers of the maple grove, making much of the area quite dense. No portions of the stand currently have a closed canopy. Trees within the maple heritage grove are currently situated along the top of a knoll, making them quite resistant to surrounding winds.

A list of trees surveyed and their associated hazard/condition ratings can be seen in Appendix VI. Trees surveyed and their location within the Heritage Maple Grove can be seen in Figure 2.

3.2 Management Recommendations

A management strategy and proposed boundary (development limit) around the Heritage Maple Grove has been developed based on information gathered by NRSI during field surveys. Management recommendations as well as the proposed boundary are based on the following criteria:

- Tree species present (i.e. significance, 'old growth', native/non-native)
- Tree location
- Current condition of trees present (i.e. health and hazard rating)
- Existing topography
- Area required to maintain ecological integrity
- Retention of 'old growth' trees where possible

Tree removal and/or tree retention recommendations have been based on the above conditions. The location and health of the old growth trees throughout the small grove were the primary driving force behind the proposed boundary. Since the majority of the grove is on higher elevated knolls, and future development around the grove will require substantial re-grading, topography was also considered. The condition of trees adjacent to the 'old growth' trees was also considered when developing the proposed boundary. The boundary has been developed to maintain most of the 'old growth' trees as well as 'other' associated trees.

The extent of the Heritage Maple Grove was compared to the extent recommended by Kershner (2006). The area of the grove, including a buffer of ≥5m from the larger trees and vegetated 3:1 slope, is approximately 2.2ha. This compares to an area recommended by Kershner of 2.9ha. Conceptual cross sections through the grove have been produced based on current topographic information as well as the proposed extent of the grove and 3:1 slopes (Figure 3). The proposed 3:1 slopes correspond in some cases to current grades that are in this range, and therefore do not impact the health of the grove. Originally, 2 'old growth' trees were left outside of the proposed 2.2ha boundary, tree 1001 (sugar maple with a 128cm dbh, high hazard and very poor

condition due to extreme rotting in main stem) and tree 1010 (American beech with 70cm dbh, medium hazard in fair condition). Tree 1001 was located on the east side of the Heritage Maple Grove boundary. Although outside of the recommended boundary, this tree was within the road allowance. In 2008, this tree fell down. Figure 2 represents NRSI's recommended boundary (development limit) around the Heritage Maple Grove. The large ironwood (tree 1012) identified in previous studies, is situated on the top of a hill, approximately 10-15m from Forestell Road. Retention of mature, 'old growth' sugar maples surrounding the ironwood will provide adequate protection to "*one of the largest and oldest known ironwoods in the region and in Ontario*" (Kershner 2006).

Since the grove is currently growing on lands that are higher in elevation, on well-drained soils, no change in soil moisture regime within the stand is anticipated.

Vernal pools that may provide habitat for amphibian and salamander species are located in the grove (Scheifele 2006). The vernal pools within the Heritage Maple Grove are being protected as they are located within the recommended boundary around the grove; however, additional amphibian monitoring within the grove is recommended as part of the annual Terrestrial and Wetland Monitoring program to monitor species within these ponds.

3.3 Slope Restoration

A planting plan for the 3:1 slope surrounding the Heritage Maple Grove has been developed and is detailed in Section 5.6 and Restoration Planting Plan L-21 (back pocket of EIR).

3.4 Mitigation Measures

Following review and discussions pertaining to the Heritage Maple Grove and its significance within the City of Guelph, it was determined that the lands would be dedicated to the City, under Public ownership. Protection will be provided to the grove by ensuring that no development activities occur within the recommended boundary. The City requests that the developer remove any hazard trees, erect paige wire fence on posts around the entire block, provide a fence gate for access/maintenance and provide signage to identify ownership and significance of the trees (City of Guelph March 2008).

The following recommendations are provided to ensure that any potential impacts to the maple grove are minimized:

- Sediment and erosion control measures must be installed prior to, and maintained during construction.
- In order to maximize the retention of trees and other areas of vegetation, the following recommendations are provided:
    - Trees and other areas of vegetation to be retained must be identified and delineated with temporary fencing located beyond the dripline of trees, to ensure that vehicle movement or material storage does not disrupt vegetation (especially tree root zones).
    - Any limbs or roots to be retained which are damaged during construction must be pruned using appropriate arboricultural techniques.
- Maintenance of machinery during construction must occur at a designated location away from the heritage grove and its associated buffer (vegetation slope).
- Any areas of bare soil that arise must be graded and re-vegetated as soon as possible to avoid gullying and erosion (seed mix must be applied to cleared/graded areas within 90 days).
- No storage of equipment, materials or fill is to occur within the Heritage Grove or its associated buffer (vegetation slope).
- During the installation of the construction limit fencing, any hazard trees must be identified by a Certified Arborist and removed as warranted.
- The City insists on a program of buckthorn removal in this area.

A number of the trees in this area overlap with the right-of-way of Forestell Road. Any widening or work on this road is to consider the potential impacts to these trees.

Figure 2

Hanlon Creek Business Park

Heritage Maple Grove

NATURAL RESOURCE SOLUTIONS INC.
Aquatic, Terrestrial and Wetland Biologists

February 2009
Project: NRSI-0726D
Scale: 1:1,000 at 11 x 17"
UTM Zone 17 NAD83

BLOCK 37

Tree 1001
no longer standing

Forestell Road

Legend

- 3:1 Vegetated Slope
- 1m from Ironwood Dripline (OMB Condition #3)
- Kershner's Recommended Boundary
- Limit of Heritage Maple Grove
- High Hazard
- Medium Hazard
- Low Hazard
- Other Tree

Note: Symbol Size Represents Crown Radius

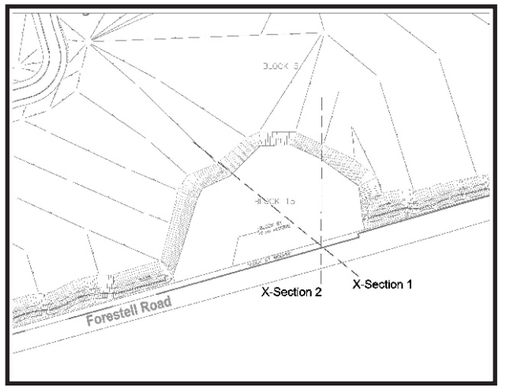
0 5 10 20 30 40 50 Meters

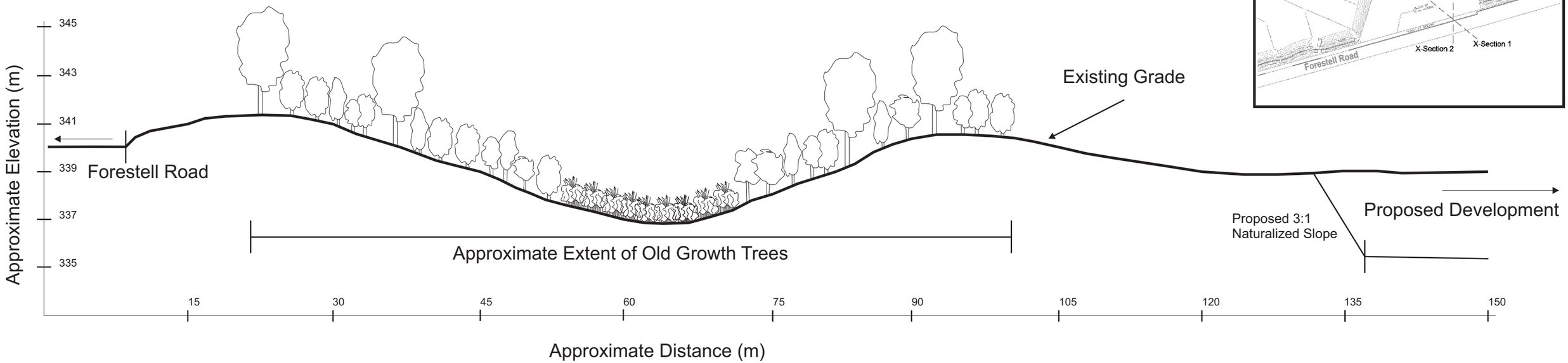
563800 563850 563900 563950 564000 564050 564100 564150 564200

4814750 4814700 4814650 4814600 4814550

NRSI_0726D_HeritageMapleGrove_23Feb09_SWM

Heritage Maple Grove
Cross Section 1





Cross Section 2

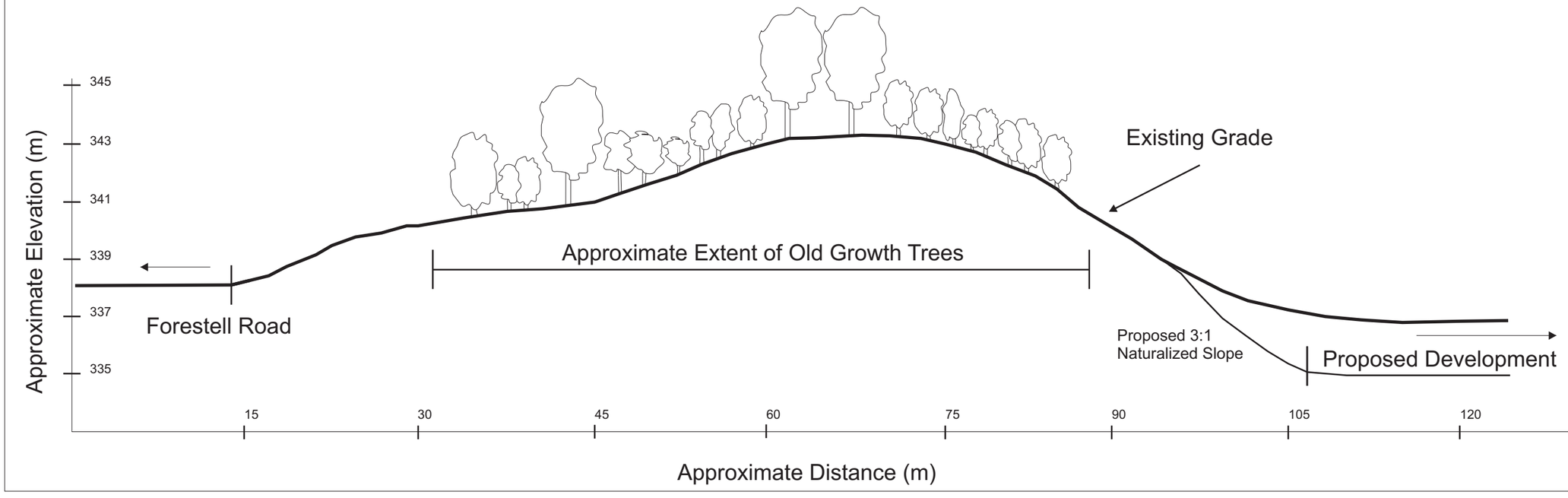


FIGURE 3

NRSI_726K_HeritageMapleGrove_05Feb09_SWM

4.0 Street Tree Planting

A proposed street tree planting plan, providing tree species, recommended spacing and approximate numbers, is requested by City staff at the EIR stage. The following criteria, as set out by City staff, were followed to develop a viable street tree planting plan:

- implementation of native, non-invasive tree species that complement the surrounding natural features
- no ash species, due to the risk of introducing the emerald ash borer (*Agrilus planipennis*)
- salt and drought tolerant tree species
- avoid use of fruiting trees, such as crabapple (*Malus spp*.) along sidewalks
- trees should be 4m off-set from lamp posts (this level of detail will be provided at the Site Plan stage)
- special attention to location and height of trees in proximity to utilities

It is recommended that street trees be planted at least 10-12m off-centre to provide adequate room for growth and ≥60mm caliper trees be planted to ensure survivability in more harsh street conditions. Tree species should be alternated to eliminate homogeneity along each street. A setback of at least 1.5m from driveways is recommended as well as 9.1m x 9.1m sight line triangle on road corners/intersections (City of Hamilton 2007). Various tree species have been chosen to complement the surrounding landscape and increase species diversity, in turn increasing resistance to various blights/diseases etc. Table 3 summarizes tree species that are recommended for street tree planting within the Hanlon Creek Business Park.

Species have been reviewed and approved by City staff and were chosen based on their size, salt/drought tolerance, native status, spring/summer and fall foliage.

Table 3. Recommended Street Tree Species

Common Name	Scientific Name	Avg. Height (m)	Avg. DBH (cm)	Foliage	Comments
Bur Oak	*Quercus macrocarpa*	15	60	Foliage is green in spring and summer and becomes yellow green in autumn.	• Moderately shade tolerant. • Tolerant to urban conditions. • Tolerates poor soil conditions and wide pH ranges.
Common Hackberry	*Celtis occidentalis*	12-25	30-60	Foliage is dark green in spring and summer and yellow-green in autumn.	• Grows on a variety of soils, very adaptable. • Moderately shade tolerant. • Used in landscaping as substitute for elm species as it withstands city conditions well. • Fast growing • Host species for hackberry butterfly and tawny emperor butterfly.
Black Cherry	*Prunus serotina*	22	60	Foliage is dark green and lustrous above, paler below in spring and summer. Leaves are yellow to orange in autumn. Fragrant white flowers that bloom in May.	• Grows well on a variety of soils • Highly tolerant of salt and drought conditions • Seeds and leaves important food source for songbirds, mammals, moths and butterfly larvae.
Red Oak	*Quercus rubra*	20-27	30-90	Dull green and smooth above and yellowish-green below in spring and summer. Russet to dark red in autumn.	• Tolerant of air pollution. • Transplants relatively easily because of absence of significant taproot.
Red Maple	*Acer rubrum*	13-25	60	Foliage light green in spring and summer and bright red in autumn.	• Excellent street tree. • Thrives on a great variety of soils and sites. • Moderately shade tolerant.

Source:
City of Hamilton. 2007. Street Tree Planting Program.
http://www.myhamilton.ca/myhamilton/CityandGovernment/CityDepartments/PublicWorks/Parks/Forestry/StreetTreePlantingProgram/tree-library.htm

Farrar, J.L. Trees in Canada. Markham, Ontario: Fitzhenry & Whiteside Limited, 1995.

4.1 Planting Guidelines

The following planting guidelines should be adhered to during the installation of street trees:

- receiving hole should be at least 1.5 times wider than root ball
- top of root ball should be approximately 1 inch above the adjacent grade
- receiving hole should be back-filled with topsoil
- all caliper trees are to be double staked with minimum 7 foot metal t-posts and rubber tree ties. The stakes are to be driven into the ground beyond the wire basket (root zone).
- all trees are to be mulched after planting with 100mm of shredded cedar mulch. Trees are to be mulched from near but not up to the trunk and to the edge of the canopy dripline. No sod should be planted within the canopy or mulched area at base of trees.

4.2 Street Tree Layout

Phase I

There are approximately 2450m of road, excluding cul-du-sac bulbs, included in the proposed road layout for Phase I. Based on the above recommendation of 10-12m off-centre spacing for each tree species, there should be approximately 408-490 trees planted along the major roadways within Phase I.

Phase II

Phase II includes approximately 2580m of road, excluding cul-du sac bulbs. Based on this layout, there should be approximately 475-570 trees planted 10-12m off-centre along the major roadways.

Phase III

As the current road layout is not anticipated to change, the road layout through Phase III will be approximately 2050m in length, resulting in 342-410 street trees spaced 10-12m off-centre.

5.0 Buffer Design and Restoration Plantings

In the Consolidated Environmental Impact Study (NRSI 2004), it was recommended that enhancement plantings along the edges of the central natural area be provided as part of the EIR, to act as vegetative buffers and provide a number of other benefits. A provision of habitat types have been included in the restoration areas that include both active and passive restoration (i.e. open meadows, wetlands and woodlands). Overall, the restoration/buffer planting areas within Phase I and II will comprise approximately 32ha of land and provide a number of enhancement opportunities, such as:

- Enhancement of existing habitat linkages through re-vegetation of existing habitat breaks, widening the existing core natural area and providing restoration plantings that correspond to the existing native vegetation. This focuses on the creation of, or supplementing existing wooded riparian habitats associated with the creek.
- Increased shading of portions of the creek which are currently exposed to sunlight.
- Provision of buffers and setbacks to enhance wetland, aquatic and terrestrial habitats. Natural succession and plantings can be used to create native vegetation zones around some of the retained wetland and woodland areas, as well as along the creek.
- Bulking up of natural features (i.e. wetlands, woodlands and riparian areas)
- Provision of natural regeneration areas, such as cultural meadows and agricultural fields, providing naturalized habitat for foraging as well as nesting, etc. for species that prefer open areas.
- Habitat enhancement by means of removing a number of non-native species (Manitoba maple, common buckthorn and Norway maple) and replacing with native species such as sugar maple, bur oak and nannyberry.

Based on the existing characteristics of the natural features and the proposed plan of development, a series of enhancement planting approaches were conceptually identified in the Consolidated EIS (NRSI 2004). It was recommended that detailed planting plans be provided at the EIR stage. The goal behind the restoration planting plans included in this report was to create naturalized buffer and enhancement areas with the use of hardy, native species indigenous to the Guelph/Wellington County area. Species recommended will encourage natural succession, while preventing the growth of weedy,

non-native species. As the planting areas become increasingly established, other native species from the surrounding natural features will begin to move in, creating a habitat rich in diversity. Due to the fact that many of the plantings are generally proposed for graded areas, the hardy, early successional species, as set out in the restoration planting plans are necessary for increased planting success. Figure 4 provides a 'Key Plan' for passive and active restoration proposed throughout the study area. Planting plans for Phase I and II have been prepared and compiled into one package (see Restoration Planting Plans in back pocket of EIR).

Hanlon Creek Business Park
City of Guelph

Environmental Implementation Report
Restoration and Planting Plan

February 2009
Project 0726
Universal Transverse Mercator - NAD83
Scale 1:8000 @ (11x17")

NATURAL RESOURCE SOLUTIONS INC.
Aquatic, Terrestrial and Wetland Biologists

Legend

Restoration / Retention Areas

- Open Meadow Restoration
- Naturalized Stormwater Management Area
- Graded Slope Restoration
- North Facing Woodlot Edge Buffer Restoration
- South Facing Woodlot Edge Buffer Restoration
- Wetland / Meadow Marsh Buffer Restoration
- New Woodlot Edge Restoration
- Forestell Road and Heritage Maple Grove Restoration
- Laird Road Restoration
- Riparian Restoration
- Block 2, 3, 9 and 10 Restoration
- Natural Regeneration
- Stormwater Management Pond
- Existing Upland Woodlot
- Provincially Significant Wetland
- Trees / Hedgerows to be Retained

- Phase I
- Phase II
- Phase III
- Watercourse

Removal Areas

- Trees / Hedgerows to be Removed
- Small Non-provincially Significant Wetlands

Base layers from AECOM received January 21, 2009 (X-prlegal, X-prroad).

Figure 4

Key Plan

NRSI_0726_Hanlon_RestorationPosterMap_26Feb09_GCS.dwg

5.1 Stormwater Management Ponds

The planting plans for the four stormwater management ponds in Phases I and II adhere to the Design Principles for Storm Water Management (City of Guelph 1996). Additionally the design has incorporated many components from the Ministry of the Environment (MOE) Stormwater Management Planning and Design Manual (MOE 2003). For example the ponds are divided into four planting zones that are reflective of water levels: shallow water, shoreline fringe, floodline fringe, and upland. Through the designation of these zones, a wider array of appropriate native plant diversity is prescribed. Below is an overview of some of the considerations that determined plant placements, selections and densities.

Firstly, all species prescribed in the planting plans are native and not regionally rare in Wellington County (Riley 1989). Also, as requested by City staff, specific species have been avoided including all species of ash (*Fraxinus spp.*) in recognition of the continuing spread of emerald ash borer (EAB). Many of the species used are also recommended for use in stormwater facilities by different sources ranging from the MOE Guidelines, the Toronto Region Conservation Authority (2004), to various native plant growers.

The specific placement of trees and shrubs has been designed to aesthetically buffer existing land uses from the proposed stormwater facilities. Specifically, plantings are concentrated adjacent to existing residences, along roadways and along the proposed Road D.

Access to the forebays has been discouraged through shrub plantings excluding the maintenance access routes. The shrub beds have been designed for three of the zones associated with stormwater management ponds (Upland, Floodline Fringe, and Shoreline Fringe). Within each of these zones, according to the City of Guelph guidelines, the required shrub planting density is 1 shrub per 4 squares metres (which is equal to 2.0m off-centre) based on a maximum of 5:1 slopes. This plan proposes shrub beds be planted at 1.5m off-centre.

The guidelines also stipulate that the areas above the 5 year storm level be planted. The 5 year storm level corresponds with the contour line that divides the Shoreline Fringe from the Floodline Fringe on the stormwater management plans (see Restoration

Planting Plan L-02, L-04, L-12, L-13 and L-14 in back pocket of EIR). These plans have incorporated tree and shrub plantings in the Shoreline Fringe, as well as the Floodline Fringe and Upland. Woody plant material (trees and shrubs) should be planted in a manner that provides at least a 3m clearance on either side of access roads for maintenance purposes.

As a mitigative measure to ensure there is little to no impact on stream temperature from the stormwater ponds, where feasible, tree, shrub and herbaceous plantings have been recommended along the cooling trenches.

While the Guidelines make no mention of herbaceous plantings or seeding, specific seed mixes have been created for the five different zones including the extensive Shallow Water zones and stormwater management swales. In order to provide the greatest long-term potential cover of a diverse mix of appropriate native species, the plans call for the seed mixes to be applied using a seed drill so as to eliminate the need for expensive topsoil or mulch. This technique allows for the seeds to be placed at exact required depths below the soil surface to allow for maximum germination. This technique is extremely cost effective when compared with the alternatives of planting potted stock, or applying seed in a Terra-seed application (blown on in fine mulch). Topsoil from on-site grading activities will be located along the berms and areas around the stormwater management ponds. Woody plantings, shrubs and trees will be located in areas containing topsoil.

Finally, in recognition of the high quality natural areas that are being retained in the Hanlon Business Park, the planting plans have prescribed seed only for many areas in order to allow for natural re-vegetation of woody species. This will ensure that much of the long-term vegetation will be of local seed stock, and be distributed in a natural, as opposed to a contrived matrix.

Planting plans recommended for the stormwater management ponds within Phase I and II (SWM Pond 1-4) are found in the back pocket of this report (L-02, L-04, L-12, L-13 and L-14).

5.2 Berms

Block 2, 3, 9 and 10

A zoning by-law specific to the Hanlon Creek Business Park states that "*the developer construct a minimum 2m high landscaped berm abutting Blocks 2, 3, 9 and 10 to satisfaction of Director of Planning and Development Services, prior to registration of any phase of development including blocks abutting the berm*.'' Planting plans that satisfy the Director of Planning and Development Services have been prepared. The planting plans have been designed to increase aesthetic appeal of the berm, while providing a visual barrier comprised of native deciduous and coniferous species for neighbouring residences. Recommended plantings for Block 2, 3, 9 and 10 are provided in restoration planting plan L-02, L-03 and L-04 (back pocket of EIR).

Forestell Road Berm Restoration

In accordance with Row 11, Table 7.3 of the zoning by-law, "*a buffer strip should be provided for lots which abut Forestell Road. The buffer strip required for properties abutting Forestell Road shall be a minimum of 14m in width and shall consist of a landscaped berm a minimum height of 2m. Landscaping shall include coniferous trees planted at 3m centre intervals. Landscape material shall be a minimum of 6cm caliper for deciduous trees and 2m in height for coniferous trees. Where there is existing tree or shrub growth, the existing planting may provide the required buffer strip*."

Where topography and drainage permits, a 2m high landscaped berm will be constructed along Forestell Road to provide a buffer to the industrial lands. Planting plans that include native tree, shrub and herbaceous species have been proposed for this area. Planting of dense vegetation along the berm will help provide a visual barrier between the neighbouring residences and the proposed development. The proposed planting plan fulfills the zoning by-law requirement with the use of coniferous tree species, while the shrub and herbaceous species plantings correspond to and complement the existing vegetation. Detailed planting plans for the Forestell Berm are included in planting plan L-19, L-20, L-21 and L-22 (back pocket of EIR).

5.3 Buffers between Trails/Swales and Natural Areas

The Consolidated EIS (NRSI 2004) recommended enhancement plantings in areas between trails and adjacent natural areas (see Figure 4). The objective to planting these

areas is to create a dense barrier or screen, providing additional protection to the natural areas. To ensure species compatibility/tolerance etc. three different planting strategies for buffer areas have been prescribed that correspond to the adjacent vegetation types (see Figure 4).

- North facing woodlot edge
- South facing woodlot edge, and
- Wetland edge

Detailed planting plans and associated planting tables for the above mentioned buffer areas are included in the restoration planting plans included in the back pocket of this report.

5.4 Graded Areas

In order to avoid unnecessary sediment, erosion and dust control issues, areas not built upon within 90 days of being cleared and/or graded must be seeded. The seed mix should be applied using a seed drill so as to eliminate the need for expensive topsoil or mulch. The following herbaceous native seed mix is recommended for cleared and graded areas:

Table 4. Herbaceous Seed Mix for Cleared and Graded Areas

Plant Form	Species Code	Scientific Name	Common Name
Grass	Ed	*Elymus canadensis*	Canada wild-rye
	Ds	*Danthonia spicata*	Poverty oats-grass
Herbaceous	Sc	*Solidago nemoralis*	Gray goldenrod
	Sa	*Symphyotrichum novae-angliae*	New England aster

5.5 Open Meadow Areas

The Consolidated EIS (NRSI 2004) identified and recommended enhancement plantings or naturalization of open meadow areas within the Hanlon Business Park. These areas are seen to provide additional habitat diversity as well as potential linkages between other wooded and wetland habitats.

The open meadow areas within Phase I and II are predominantly open, fallow field. Some of the open areas are also comprised of active agricultural field. For restoration purposes, these areas have been divided into open meadow restoration and natural

regeneration (refer to Figure 4). To encourage the establishment of natural areas and habitat linkages throughout the study area, natural regeneration within the open meadow and active agricultural fields is recommended, with exception of the open meadow habitat located in Phase III. In the open meadow habitat within Phase III, it is recommended that an herbaceous seed mix be dispersed throughout the agricultural area. Implementation of a native seed mix will encourage stabilization of existing exposed soils and create meadow habitat for local wildlife. To eradicate non-native species that may be present, it is recommended that the area be tilled and re-planted with a native, open meadow seed mix. The seed mix should be applied using a seed drill so as to eliminate the need for expensive topsoil or mulch. The following table outlines native, open meadow species recommended for the herbaceous seed mix.

Table 5. Herbaceous Seed Mix for Open Meadow Areas

Plant Form	Species Code	Scientific Name	Common Name
Grass	Ed	*Elymus canadensis*	Canada wild-rye
	Ds	*Danthonia spicata*	Poverty oats-grass
Herbaceous	Rh	*Rudbeckia hirta*	Black-eyed Susan
	Ob	*Oenothera biennis*	Hairy yellow evening-primrose
	Sc	*Solidago nemoralis*	Gray goldenrod
	Se	*Symphyotrichum ericoides*	White heath aster
	Sa	*Symphyotrichum novae-angliae*	New England aster
	Mf	*Monarda fistulosa*	Wild bergamot

5.6 Heritage Maple Grove Slope Restoration

A restoration plan along the 3:1 slope surrounding the Heritage Maple Grove has been prepared and is included in restoration planting plan L-21 (back pocket of EIR). The proposed restoration plantings and seed mix aim to provide a naturalized buffer around the grove that is comprised of native species that correspond to the current surrounding areas.

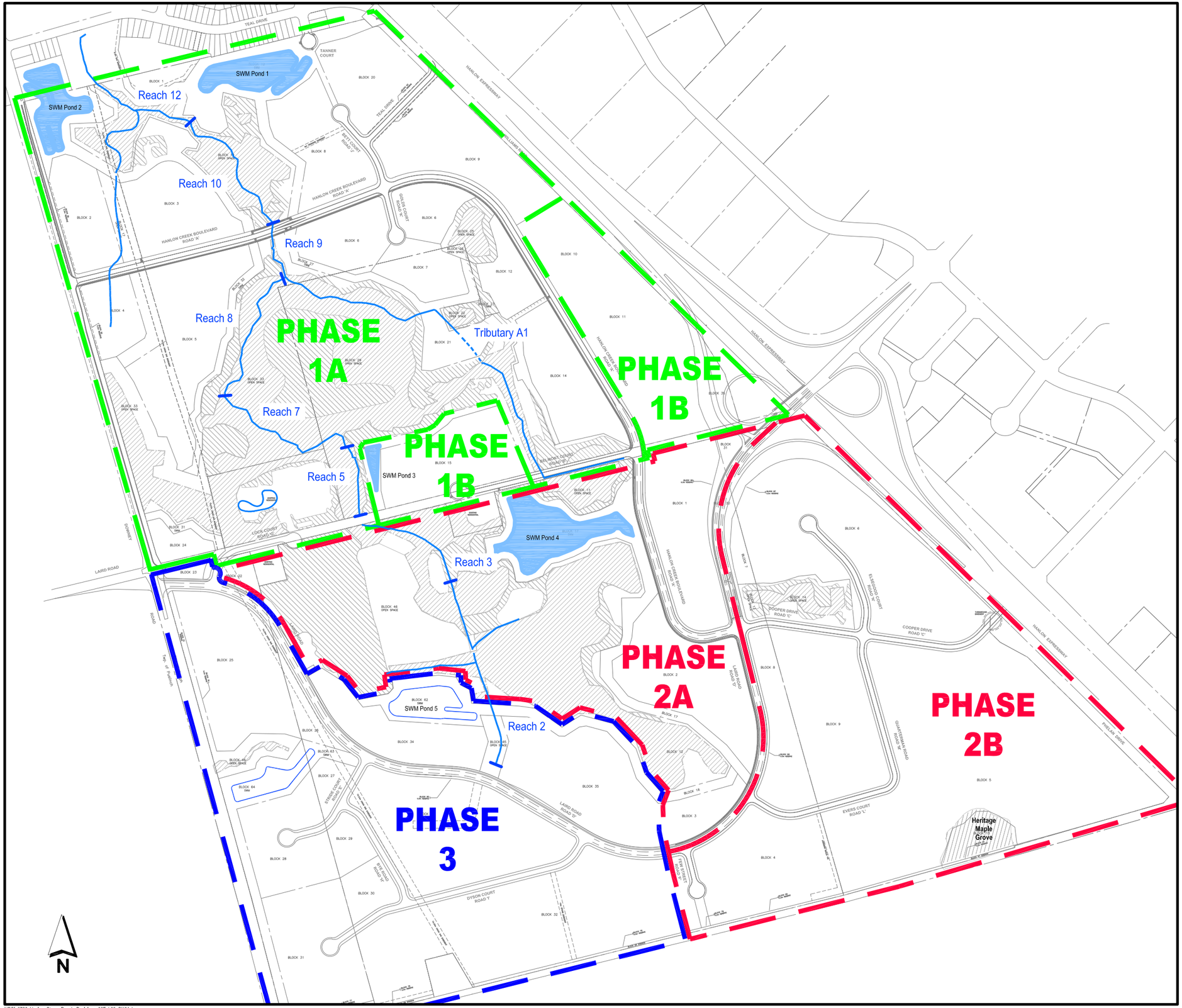
5.7 Laird Road Restoration

Based on plans for the closure of Laird Road and City of Guelph guidelines (see City of Guelph Hanlon Creek Business Park: Old Laird Road Alignment memo, February 11, 2008), restoration opportunities were identified. Some restoration opportunities exist along a narrow corridor, ranging from approximately 0.5 – 4m in width, between the edge of Laird Road and the existing natural features. A restoration planting plan is

proposed along the narrow corridors north and south of Laird Road and is included in the back pocket of this report (L-12). Native tree, shrub and herbaceous/grass species that correspond to the surrounding natural features (wetland/woodlot) were chosen to enhance the proposed buffer area.

5.8 Riparian Restoration

Riparian restoration plans have been prepared that will not only provide additional buffers along most of the riparian reaches within Phase I and II and 'bulk up' the existing natural features, but also decrease creek water temperatures by providing shade through increased canopy cover, to accommodate brook trout habitat (see Section 14.0 for additional information regarding creek cooling). Restoration planting plans for each stream reach (see Figure 5 Stream Reach Lengths), as well as the Downey Watercourse, have been developed and are included in the restoration package included in the back of this report (Stream Reach Lengths – L-03, L-05, L-06, L-12, L-13, L-15 and Downey Watercourse – L-09, L-10). Native plantings for each area were chosen to correspond to and complement the existing natural features. Riparian restoration plantings will begin once on-site works commence. In cases where plantings are recommended in-water and immediately adjacent to water (i.e. Road A, Tributary A crossing), plant installation and associated works must adhere to the cold water timing window (no works between October 1st and June 30th). Additional construction details for the Downey Watercourse are provided in Figure 13 and Drawing 22490-01-E14 (back pocket of EIR).



NRSI_0726_Hanlon_StreamReach_RevIslons_06Feb09_SWM.dwg

Hanlon Creek Business Park
City of Guelph

Environmental Implementation Report
Riparian Restoration

February 2009
Project 0726
Universal Transverse Mercator - NAD83
Scale 1:8000 @ (11x17")

NATURAL RESOURCE SOLUTIONS INC.
Aquatic, Terrestrial and Wetland Biologists

Legend

- Reach Limit
- Watercourse
- Stormwater Management Pond (SWM)
- Existing Upland Woodlot
- Provincially Significant Wetland

Base layers from AECOM received January 21, 2009 (X-prroad, X-prlegal).

Figure 5

Stream Reach Lengths

6.0 Restoration Monitoring

6.1 Restoration Plantings

In accordance with OMB Condition 4, the developer "shall stabilize all disturbed soils within 90 days of being disturbed, control all noxious weeds and keep ground cover to a maximum height of 150mm (6 inches) until the release of the subdivision agreement on the block/lot so disturbed."

A two year warranty is recommended for all proposed planting material throughout the study area (shrubs, trees, herbaceous and grasses). All plants shall be inspected by an appropriate inspector at the end of the guarantee period. Plants which, at that time, are not in healthy vigorous growing condition, to the inspector's approval, shall be replaced at no extra charge. All tree staking is to be removed just prior to final inspection.

Once on-site works commence and restoration plantings have been installed, monitoring plots within the restoration areas identified in Section 5.0 above will be established and monitored by an Environmental Inspector. A specific restoration monitoring plan will be discussed and agreed upon by the GRCA and City at the Site Plan stage. The habitat restoration monitoring will:

- evaluate restoration effectiveness (i.e. planted areas showing a trend toward natural regeneration),
- monitor effectiveness of deer and rodent protection measures associated with tree and shrub plantings,
- document use of restoration areas by wildlife species, such as songbirds and small mammals,
- document invasion of non-native/invasive species,
- monitor presence of beaver activity within riparian and wetland areas
- implement subsequent restoration activities/monitoring (i.e. additional plantings, non-native species removal and additional protective covenants) in response to observed changes in planted areas

6.2 Tree Conservation and Replacement Plan

As part of the conditions of draft plan approval (OMB 2006) a tree inventory and conservation plan was requested (see Section 2.0). It was stated that "*to the extent that the approved tree inventory and conservation plan provides for the removal of any of the remaining trees other than the ironwood tree, replacement trees shall be planted at appropriate locations*" (OMB 2006).

Approximately 1,688 trees are proposed for removal within Phase I and II due to construction and/or high hazard rating. The loss of trees within Phase I and II will contribute 3,951m of crown radius being removed. Overall, the loss of trees within Phase I and II will result in approximately 13.2ha of land. It is anticipated that very few trees will be removed due to construction activities with the preliminary layout of Phase III. A detailed discussion of tree inventory results, as well as tree removal and retention opportunities is found in Section 2.0 and Appendix IV and V. Nearly half of the trees proposed for removal are situated within thin hedgerow communities that provide very little wildlife habitat. To compensate for tree removal and provide additional native wildlife habitat, active and passive restoration and enhancement plans have been developed for various areas throughout the business park, such as woodlot and wetland buffers, stormwater management ponds, open meadow areas, riparian areas and swales (see Section 5.1 to 5.8 and Figure 4). Based on planting plans, as well as the proposed street tree planting plan, it is projected that there will be approximately 2,533 trees and 4,937 shrubs planted throughout Phase I and II. Assuming an average canopy radius of 5m, it is anticipated that the planted trees will provide approximately 20ha of canopy cover. Restoration plantings within Phase I and II will cover approximately 32ha of land. A number of restoration opportunities exist within the preliminary layout for Phase III, such as street trees, buffers, stormwater management ponds, plantings around staging area and woodlot edge impacted by Road D. It is estimated that approximately 575 trees and 615 shrubs can be planted within Phase III.

6.3 Seed Collection/Plant Rescue

EAC and members of the public questioned whether trees, shrubs and herbaceous species situated within the proposed removal areas (i.e. hedgerows, small wetlands to be removed) could act as seed or soil sources for restoration. As outlined in Section 7.0 below, each of the wetlands anticipated for removal have abundant reed canary grass

(*Phalaris arundinacea*), and all but one is dominated by it. This species is regarded as undesirable for restoration given its aggressive growth and less diverse habitat for wildlife. As such, use of the soils from these wetlands is not recommended.

There is opportunity for interested public members to access the property to conduct seed collection/plant rescue work within the small wetlands and other areas that are to be removed. To ensure that rescue work occurs in an appropriate manner and collections occur in the correct location, the City has recommended that Waterloo-Wellington Wildflower Society members be involved in transplant/seed collection of native plants, as they have pertinent knowledge, skills and staff necessary.

The methodology for seed collection and plant transplants varies depending on the species of interest. To ensure that specimens are collected or transplanted in the appropriate manner, it is recommended that standard seed collection and/or transplant guidance documents be followed for each species.

Seed collection/plant rescue must be conducted in a manner that has regard for the timing of construction. For the safety of public involved and construction crews, rescue work should be avoided while lands are actively being cleared and graded. Safety equipment (i.e. hard hats, steel toe boots, safety vests) must be worn while on-site once construction activities have commenced.

Below are recommendations for wildflower rescue (Fosdick 2008):

- Secure written landowner permission before entering any plant-rich properties and carry it while on site.
- Confine rescue work to areas marked for construction
- Be respectful and perform rescue work correctly
- Do not ‘rescue’ any plant species for the purpose of personal profit
- Reduce transplant shock by relocating rescued plants to areas that mimic their natural habitat. Ensure plants have enough water to make it through to the next growing season.
- Gain background information on the plants being collected (i.e. habitat requirements, sun/shade tolerance, fragility, soil preference)

7.0 Analysis of Small Wetland Retention

A number of small wetland areas found within the study area are not contiguous to the central wetland core area. Many of these small wetland areas were not included in historic wetland mapping in the Watershed Plan and the MNR wetland mapping available at the time of preparing the 2000 EIS and early addenda. As part of the 2000 EIS, incorporating these wetland areas within the complex was examined. The wetland areas were reviewed in the field with GRCA staff in 2002. They were also submitted to the MNR for review and subsequently discussed with staff in 2004.

Many of the small isolated wetland areas were not included in the Hanlon Creek Wetland Complex by the Ministry of Natural Resources. It was determined that a majority of the small wetland pockets do not provide significant ecological value and are likely periodically cultivated. As well, most of the isolated areas are less than the minimum size used as a rule of thumb in determining whether to include the areas as part of a larger complex (2.0ha for separate wetland areas and 0.5ha for individual wetland communities). Twelve small wetlands were identified by Natural Resource Solutions Inc. in 2000 that would potentially be removed and/or impacted by the proposed development. As a result of this analysis, and subsequent review by the MNR, a total of four isolated wetlands have been identified as provincially significant (PSW), ensuring protection from development practices. This includes one wetland adjacent to Downey Road (in Block 44 in Phase III) that is part of the Speed River Wetland Complex. Three wetlands (Blocks 43, 49, and 51) are included in Phases I and II and are discussed further below. The isolated wetlands that have not been identified as PSW were surveyed by Natural Resource Solutions Inc. in the fall 2007 and were the focus of further analysis.

7.1 Isolated PSWs in Phase I and II

The following section provides a brief description of the three isolated PSWs in Phase I and II. These wetlands are referred to by block number from the Draft Plan.

Block 43

This wetland is located in Phase II and is bordered by the MTO Laird/Hanlon interchange to the west as well as business park roads to the south (Road C) and east

(Road N). The alignment of the MTO interchange was reviewed as part of the original 2000 EIS and found to be dictated by provincial road standards. Some 2:1 sloping has been extended into the setback around Block 43 in order to achieve the road grades required by the MTO interchange and the surrounding roads. The alignment is close to the western end of the wetland, but a minimum 'no touch' area of 5m is provided from the toe of the proposed fill slope to the wetland. This zone is much larger for much of the remaining western end, ranging up to 20m. The road surface will be from 20m to over 30m from the wetland. Along the east and south sides the 'no touch' zone is greater than 15m, with road surfaces being 30m or greater from the wetland.

The upland vegetation around the wetland in Block 43 is a continuous zone of shrubs, with the exception a few young clumps of trembling aspen, Manitoba maple, crack willow, choke cherry, and black cherry trees. This transition area is flat in most places, with an occasional slight slope (less than 0.5 metres in elevation). Common buckthorn, tartarian honeysuckle (*Lonicera tatarica*), sandbar willow (*Salix exigua*), pussy willow (*Salix discolor*), slender willow (*Salix petiolaris*), black raspberry (*Rubus occidentalis*), nannyberry (*Viburnum lentago*), and red osier dogwood (*Cornus sericea*) are the dominant shrub species. These shrubs are often laden with Virginia creeper (*Parthenocissus inserta*) and riverbank grape vines (*Vitis riparia*), creating limited pockets for growth of herbaceous plants such as woodland strawberry (*Fragaria vesca*), dandelion (*Taraxaxum officinale*), large-leaved avens (*Geum macrophyllum*), coltsfoot (*Tussilago farfara*), horsetails (*Equisetum ssp*.), and enchanter's nightshade (*Circaea quadrisulcata*). The fill slopes associated with the roads will overlap with this shrub dominated area.

No stormwater flows are proposed to be directed to this wetland and the current water regime that is driven by interception with the water table will continue to support this wetland.

Block 49

The isolated wetland in Block 49 will be entirely included in the Open Space area. No stormwater will be directed to this feature. The northern portion of this block is dominated by upland trees. The stormwater swale that is proposed to border the northern end of the wetland has been reviewed and approved as part of the Consolidated EIS which includes 'no touch' zones of 5 m from the wetland and/or 1m

from the dripline. The southern side of this wetland is bordered by an extensive restoration area.

The water regime in the southwest corner of this wetland is influenced by a ruptured tile drain. No changes to this tile are proposed.

Block 51

The swamp wetland in Block 51 is bordered by a fringe of upland trees. Adjacent development includes proposed industrial blocks as well as Road A. The alignment of Road A was reviewed as part of the Consolidated EIS and is based on radii of curvature. The fill is outside the 1m 'no touch' zone from the upland dripline, and over 15m from the wetland boundary at its nearest point.

No stormwater flows are proposed to be directed to this wetland and the current water regime that is driven by interception with the water table will continue to support this wetland.

This isolated feature is connected to the main open space area by an existing treed hedgerow with an associated restoration area totaling 15m in width.

7.2 Non-PSWs in Phase I and II

7.2.1 Field Work

When compared to the Draft Plan of development, 7 wetland communities are situated within Phase I and II of the proposed development (see Figures 6 and 7). Biologists from Natural Resource Solutions Inc. conducted soil surveys within each wetland on October 30, 31 and December 7, 2007 and the ecological land classification (ELC) for each wetland was verified at that time.

7.2.2 Wetland Classification

The following is a description of the seven wetland communities located within the proposed development area. Wetland numbers correspond to those assigned in Totten Sims Hubicki Associates (2000). Refer to Appendix VII for photos of each wetland community.

Wetland 003 - Reed-canary grass Mineral Meadow Marsh (MAM2-2)

This meadow marsh is situated along the north side of Laird Road. Reed canary grass is the dominant species, while red-osier dogwood and purple stemmed aster (*Aster puniceus var. puniceus*) are scattered throughout. A stand of trembling aspen and white cedars (*Thuja occidentalis*) are located along the northern edge of this wetland.

Wetland 004 – Reed-canary grass Mineral Meadow Marsh (MAM2-2)

This small isolated wetland is situated south of Laird Road and is surrounded by fallow field. The wetland is primarily comprised of reed canary grass with two small common buckthorn shrubs. A small stand of trembling aspen is situated along the western perimeter.

Wetland 005 - Reed-canary grass Mineral Meadow Marsh (MAM2-2)

This wetland is situated in close proximity to Wetland 006, adjacent to a small trembling aspen stand. Reed canary grass dominates the community, with some red-osier dogwood, common milkweed (*Asclepias syriaca*) and aster species scattered throughout.

Wetland 006 - Reed-canary grass Mineral Meadow Marsh (MAM2-2)

This mineral meadow marsh is located south of Laird Road in a small depression. Reed canary grass dominates the central portion of the wetland, while crack willow (*Salix fragilis*) and balsam poplar (*Populus balsamifera*) dominate the perimeter. Red-osier dogwood, bittersweet nightshade (*Solanum dulcamara*), riverbank grape and wild cucumber (*Echinocystis lobata*) are present throughout the community.

Wetland 008 – Reed-canary grass Mineral Meadow Marsh (MAM2-2)

The central portion of this wetland is open with a mix of reed canary grass, grasses and bittersweet nightshade. A large crack willow, Bebb's willow (*Salix bebbiana*) and willow shrub species are situated along the slightly elevated wetland perimeter.

Wetland 013 – Reed-Canary Grass Mineral Meadow Marsh (MAM2-2)

This linear wetland is located on the west side of McWilliams Road, north of Laird Road. Reed canary grass is dominant throughout this meadow marsh community. Other species, such as red-osier dogwood, common milkweed and red raspberry (*Rubus idaeus*) are located throughout the area. A few shrub and tree species, consisting of trembling aspen, hawthorn, tartarian honeysuckle, willow and common buckthorn, are sporadically located around the wetland perimeter.

Wetland 014 – Willow Organic Thicket Swamp (SWT3-2)

North of Laird Road, in close proximity to Wetland 008 is a willow swamp thicket, dominated by Bebb's willow. Open areas within the wetland are comprised of reed canary grass. Other species located throughout the community are dark-green bulrush (*Scirpus atrovirens*), Canada goldenrod (*Solidago canadensis*), balsam poplar saplings, common cattail, swamp milkweed (*Asclepias incarnata*) and slender willow.

7.2.3 Wetland Soils

Based on soil cores from each of the small wetlands, silty clay and silty clay loam soils were found to be dominant in 6 out of 7. One wetland was found to be organic in nature, Wetland 014. Refer to Appendix VIII for soils found within each wetland community.

7.3 Retention Opportunities

Wetlands situated within the proposed draft plan of development are found on Figures 6 and 7. Wetlands 9, 10 and 12, as referred to in the Environmental Impact Study (TSH 2000), are situated within Phase III and will require further analysis as development and grading plans become available.

Although not recommended for inclusion in the wetland complex, it was recommended in the Consolidated EIS (NRSI 2004) that wherever possible, the 10 identified wetland pockets be kept as potential landscaping features (Phase I, II and III). These features could be removed if it is not feasible to incorporate them into the lot when developed. Lot level regrading is a significant issue associated with the retention of these wetlands. In order to achieve effective lot drainage and to route stormwater to appropriate

collection and treatment features, some areas of regrading are inevitable. The regrading is less of an issue with maintenance of water balance, since the water regime of these small features is driven by interception with the water table, but the depths of fill on the lands, the need for very steep slopes, and the location of the small wetlands relative to the lot boundaries may severely limit the retention of these wetlands (NRSI 2004).

It was stated in the Consolidated EIS that infiltration targets for the lots may influence the ability to retain these wetlands. Since infiltration is not likely to occur in these depressions, retention of these wetlands on a lot may negatively affect the amount of infiltration (compared to the lot if it had been uniformly filled). In cases where the small wetlands are located close to the lot boundary, these types of features are more likely to have some retention opportunities as they are not at risk from buildings, etc. On specific lots the location of the wetland relative to the building envelope and associated outdoor storage, parking areas etc. will also be a factor limiting the retention of the wetlands.

Figure 6 illustrates the proposed localized grading adjacent to the wetland pockets in Phase I and Figure 7 illustrates the proposed localized grading adjacent to wetland pockets in Phase II. Based on comparisons of the existing grades and locations of the wetlands to the grades required for these lands, none can be saved.

Hanlon Creek Business Park
City of Guelph

Environmental Implementation Report

February 2009
Project 0726
Universal Transverse Mercator - NAD83
Scale 1:5000 @ (11x17")

NATURAL RESOURCE SOLUTIONS INC.
Aquatic, Terrestrial and Wetland Biologists

Legend

- Small Non-provincially Significant Wetlands
- Provincially Significant Wetlands
- Watercourse

Base layers from AECOM received January 21, 2009 (X-prgrading, X-prlegal, X-prroad, X-prtopo-wetlanddesignation).

Figure 6

Wetlands - Phase I

N

NRSI_0726_Hanlon_Wetlands_CooperGrading_06Feb09_GCS.dwg

Hanlon Creek Business Park
City of Guelph

Environmental Implementation Report

February 2009
Project 0726
Universal Transverse Mercator - NAD83
Scale 1:5000 @ (11x17")

NATURAL RESOURCE SOLUTIONS INC.
Aquatic, Terrestrial and Wetland Biologists

Legend

- Small Non-provincially Significant Wetlands
- Provincially Significant Wetlands
- Watercourse

Base layers from AECOM received January 21, 2009 (X-prgrading, X-prlegal, X-prroad, X-prtopo-wetlanddesignation).

Figure 7

Wetlands - Phase II

N

NRSI_0726_Hanlon_Wetlands_CooperGrading_06Feb09_GCS.dwg

8.0 Restoration of Laird Road Right-of-Way

8.1 Proposed Planting and Restoration Plan

During the preparation of the conceptual plan in the EIS, two guiding objectives were the retention of the main natural area and investigation of the feasibility of closing Laird Road. The intent of this closing was to allow for the ultimate removal of the roadbed and restoration of the creek in the vicinity of the road culvert.

Based on further analysis, it was concluded that the existing residential lots found on Laird Road would remain and would therefore require road access. Based on current city requirements, the length of the roadway required to access the existing residence closer to the Hanlon would be beyond a length (300m) that required a second access to this lot. Therefore the Consolidated EIS Draft Plan showed the section of Laird Road between the two existing residences as closed, but not removed. It was proposed that the roadbed would remain with existing culverts, but be topped with turf stone or similar surface treatment to allow for emergency vehicle access. The infrequent traffic along this roadbed will allow for herbaceous plants species to establish on the roadbed, but safety requires that woody species be controlled in the area. It is anticipated that mobile wildlife will readily cross this feature (NRSI 2004).

From the OMB Hanlon Creek Business Park Conditions of Draft Plan approval in June 2006, it was decided that Laird Road shall remain as an open and traveled road in its present location and alignment until both Road D and the MTO grade-separated interchange is constructed and operating in order to directly accommodate the aggregate haul routes to the Hanlon Expressway. The construction of Phase I and II of the HCBP are not anticipated to substantially increase the use of Laird Road through the core natural area, as road connections will route traffic to Laird Road nearer to the Hanlon Expressway. Upon completion of Road D and the MTO grade separated interchange, Laird Road will be closed to local traffic and left as an emergency access for the cul-du-sacs proposed on either end (see Figure 1).

Currently, the vegetation on the north and south side of Laird Road is comprised of agricultural and residential lands, white cedar-hardwood mixed swamp and upland woods. The existing asphalt surface is approximately 7.1m wide with a gravel shoulder along the north and south edge measuring approximately 1.5m and 1.25m, respectively.

To ensure that Laird Road remains suitable for emergency access, City staff has confirmed that upon closure, the Ontario Building Standards require that the travelled surface of the road remain 6m wide. The road surface will be maintained as asphalt along this area to ensure that it has load bearing capabilities for emergency vehicles and utility services. Emergency access roads are maintained to the same standard as residential streets, meaning they are plowed when snow accumulation exceeds 8cm and sanded as required. Road salt is typically not used (City of Guelph 2008). A gated barrier will be situated at the end of each cul-du-sac blocking road access to local vehicle traffic. The barriers will be locked by a padlock, using a standard City-wide key for Emergency Services. Emergency Services suggest that the anchor pin be a straight shaft with a welded steel ring on one end and padlock on the other. In the event that the key does not work, emergency responders will utilize bolt cutters to gain access. The gates will be 3m in width and opposing each other (Appendix IX Laird Road Memo, City of Guelph).

As Laird Road is being maintained for emergency vehicle access, only limited restoration opportunities exist along the road edge (see Section 5.6 and Restoration Planting Plan L-12 in back pocket of EIR)..

An existing culvert is situated beneath Laird Road within the proposed closure area (see L-12). The culvert is approximately 1.2m wide and 1.5m deep. Water flows north through the culvert from Tributary A located south of Laird Road. Debris obstructing potential flow/fish passage was observed historically within the Laird Road culverts, however, based on a site visit by staff of GRCA, AECOM and NRSI, it was agreed that there was no impediment to fish passage noted either from the debris or existing culvert condition; therefore it was confirmed that fish passage will not be impeded. Also, the size of the opening will provide potential wildlife movement during low flow conditions. The culvert size is sufficient to allow for the passage of wildlife species that are known to use culverts for passage (i.e. reptiles, amphibians and small mammals). Large mammals such as deer will not use this culvert. The culvert sizing required to physically accommodate deer passage is significant, and behaviorally, deer are known to prefer to move over roadways. As the existing culvert plays a role in wildlife movement, and the preference of many species is to go over a low-profile road, the construction of additional culverts or alteration along Laird Road is not required. In addition, construction of

additional culverts will be limited as services and utilities (i.e. water, sewer) will be placed in an east/west direction below the surface of Laird Road during the construction phase (see Section 16.0). The presence of wetlands along the base of the road in many locations also limits the locations for additional culverts.

Based on a review in the field with staff of the GRCA, AECOM and NRSI, it was decided that there is not enough room along either side of Laird Road to construct mechanisms that will funnel wildlife through the culverts without impacting the adjacent wetlands; however, mechanisms should be put in place, such as speed limit and wildlife crossing signs while Laird Road remains open.

As stated in Section 5.6, restoration opportunities were identified along the north and south sides of Laird Road based on plans for the closure of Laird Road and City of Guelph guidelines (City of Guelph 2008). Refer to Restoration Planting Plan L-12 (back pocket of EIR) for the restoration planting plans proposed along the narrow corridors north and south of Laird Road. Native tree, shrub and herbaceous/grass species that correspond to the surrounding natural features (wetland/woodlot) were chosen to enhance the proposed buffer area.

9.0 Pedestrian and Open Space Trail System

A Trail Master Plan was prepared by the City of Guelph in 2005. The goal of the Guelph Trail Master Plan was to "*develop a cohesive city wide trail system that will connect people and places through a network that is off-road wherever possible and supported by on-road links where necessary*." A system of authorized trails was recommended in the Consolidated EIS (NRSI 2004) that could be used to focus any pedestrian use of the natural areas onto properly constructed, laid out and maintained trails. Planting of native trees and shrubs was suggested to discourage human intrusion into sensitive areas (for example along the watercourse banks). Based on these recommendations, a trail layout was developed and refined specifically for the Hanlon Business Park (see Figure 8). In accordance with OMB Condition 29, "*the developer shall be responsible for the design and development of the entire Pedestrian Open Space Trail System in-lieu of Parkland Dedication for the entire development, in accordance with the City of Guelph By-law (1989)-13410, as amended by By-law (1990)-13545, or any successor thereof, prior to the issuance of any building permits and to the satisfaction of the Director of Community Services. The developer's financial contribution toward this trail construction shall not exceed the cash-in-lieu of parkland dedication as required by the Planning Act*."

9.1 Trail Layout

The success and maintenance of a public trail system that is associated with natural features is largely reliant upon public education. The misuse of a trail network can lead to encroachment on natural features, dumping and formation of ad-hoc trails. However, with the use of educational signage at trail access points, site boundaries and key internal roadways, along with dense restoration plantings, the impact of a trail network on the surrounding natural features can be greatly reduced. Figure 9 provides an example of the educational signage that may be provided at trail heads and stormwater management ponds. Precise wording for educational signage will be approved by City staff (Park Planner) prior to installation.

The proposed trail layout, as shown in Figure 8, was developed and refined through various discussions between the City, AECOM and NRSI. Stemming from these discussions, the following items were determined:

- SWM Pond access roads would not be shown on the trail map, as they are intended for maintenance purposes.
- Providing access to dead-end trails is not desirable and also not feasible in certain locations as the trails would need to be directed through wetland areas (i.e. north edge of Block 15 and eastern boundary of Block 5)
- Sidewalks elevated from the road surface, rather than on-road bike trails are proposed for the south edge of Block 52, along Downey Road and Road 'D' overpass over the Hanlon Expressway for safety reasons.
- A trail along the southerly limit along the cul-du-sac leading to Forestell Road is not feasible due to grading issues.

9.1.1 Off-road Trails

The off-road trails are designed to follow the natural features throughout the study area. They are predominantly situated within the natural feature buffers and along the stormwater management swales. Swale designs for the study area were created and included in the 2004 Servicing Report. The designs were reviewed and approved of in 2004 for the following reasons; 1) the blocks were designed to allow for sheet drainage from the rear of each property to the conveyance channel. Placing the access road between the conveyance channel and the block would mean that this run-off would have to cross the access road. The access roads would be more susceptible to erosion than the vegetated slope of the conveyance channel and would result in increased maintenance costs and access issues for the City and, 2) there will be a chain link/buffer planting along the rear property line of the blocks. Having access road/trail immediately adjacent to the fence is a safety concern. As a result, trails are proposed along the side of the swales farthest from proposed development. The remaining sections of trail are either located along woodlot features, either beyond or beneath dripline (see Section 9.1.3) or along wetland features. All off-road trails will be constructed as part of the Grading and Drainage Plans.

To minimize the impact of off-road trails on the natural features, the trail surfaces will be 1.5m in width with a limestone screening surface and a 0.15-0.30m clear zone on either side. The clear zone is an area beyond the edge of the trail surface that is clear of obstructions such as protruding objects, boulders, signs, etc. A wood chip surface of 1.5m will be utilized along the section of off-road trail that is situated along a natural

woodlot feature on the south edge of Block 14 (see Section 9.1.3). Limestone screenings will not be utilized along this section as the trail will be situated beneath the woodlot dripline. Figure 10 illustrates cross-sections of trails proposed along the swales associated with wetland or woodland features. It is recommended that all off-road trails be constructed as part of the Grading and Drainage Plans to ensure the least amount of environmental impact.

9.1.2 Multi-Use Trails

Multi-use trails are proposed along roadways throughout the business park. An asphalt surface will be utilized along the multi-use sections of trail.

9.1.3 Off-road Trail on South Edge of Block 14

One section of the off-road trail is situated along a natural woodlot feature on the south edge of Block 14. Currently, the woodlot is adjacent to a fallow field where previous ploughing occurred within 10-15m of the base of the nearest tree species. A 1.5m trail, with a woodchip surface and a 0.15-0.30m clear zone on either side can be situated beneath the dripline without disrupting any of the current vegetation. The off-road trail will be situated outside of the 5m 'no touch' zone of the adjacent wetland boundary. Situating the off-road trail beneath the dripline will avoid tree removal and have little to no impact on surface roots as they will have been disrupted by previous agricultural practices. Special attention should be made to the amount of grading required adjacent to this section of trail as washouts may occur, and lead to an impact on the associated woodlot. It is recommended that a stabilized limestone be utilized in areas where grades are steep (City of Guelph March 2008). Refer to Figure 10 for a cross-section of the proposed trail along the south edge of Block 14.

9.2 Staging Area

A staging area providing access to the off-road trail system is proposed south of Laird, along Road D within the future Phase III (see Figure 8). Upon submission of Phase III, the minor staging area will be comprised of a granular parking lot with 3-5 parking spaces for regular sized vehicles, trail head sign, waste receptacles, a vehicle barrier to the off-road trail and a planted buffer to separate the trail from the parking area.

9.3 Mitigation Measures

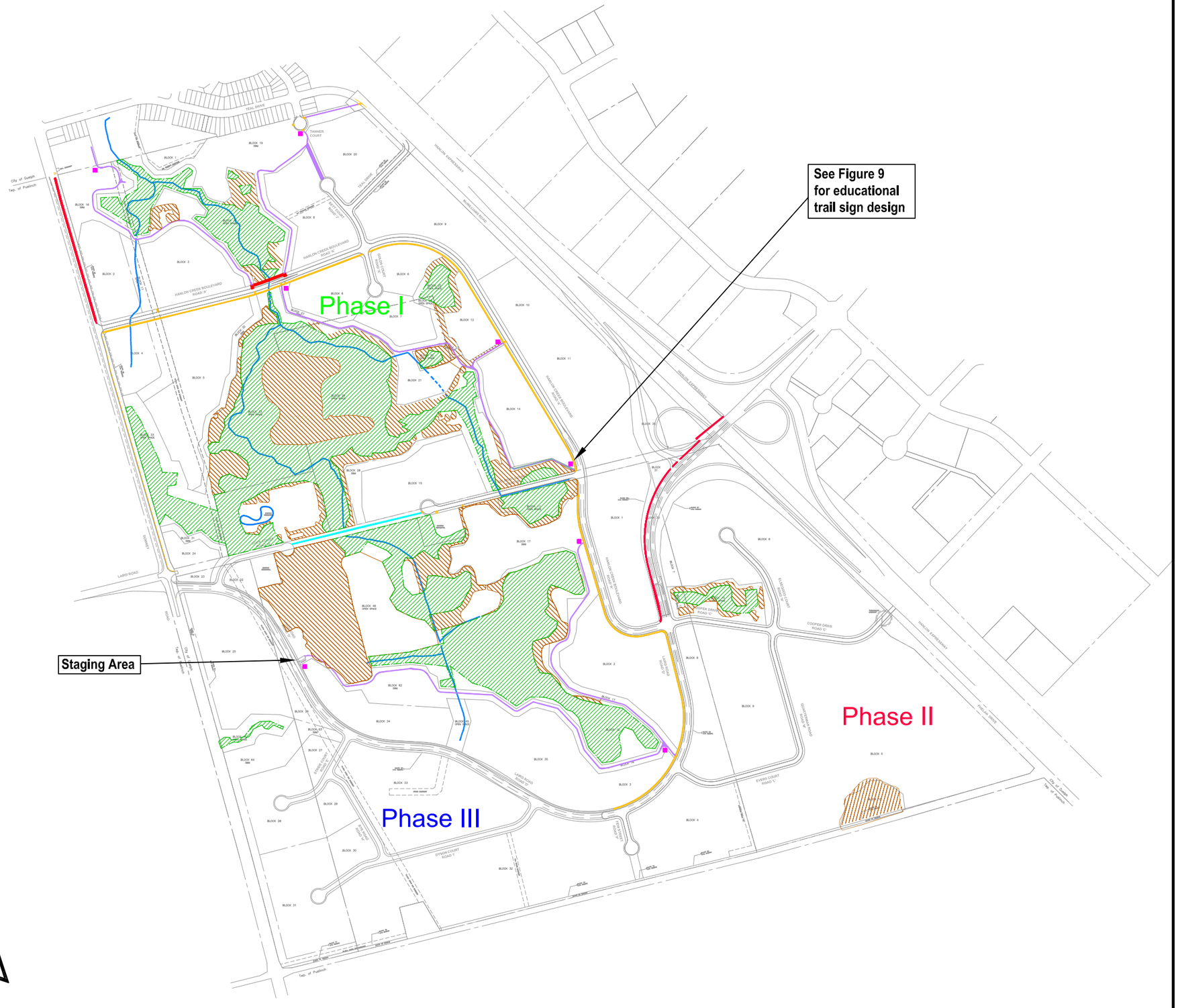
The following recommendations are provided to ensure that any potential impacts from development and trail construction are minimized:

- Sediment and erosion control measures must be installed prior to, and maintained during construction. Areas of bare soil should be re-vegetated as soon as feasible to prevent erosion of soils.
- 'No touch' zones, which consist of a minimum 10m around wetland limits or 1m outside the dripline of upland woodlands or fringes (whichever is greatest), must be implemented along the swale/buffer areas to ensure that natural features are protected from construction processes and regular trail use.
- In areas where off-road trails are located in proximity to wetlands, minor grading must be used to direct surface runoff away from the wetland. This generally consists of the slope of the course leading to a very shallow swale created by a low ridge of topsoil. The vegetated swale is configured to direct surface runoff along the swale back away from the wetland edge.
- Existing areas of natural vegetation are to be retained wherever possible. In order to maximize the retention of trees and other areas of vegetation, the following recommendations are provided:
    - trees and other areas of vegetation to be retained must be identified and delineated with temporary fencing located beyond the dripline of trees, to ensure that vehicle movement or material storage does not disrupt vegetation (especially tree root zones)
    - any limbs or roots of trees to be retained which are damaged during construction must be pruned using appropriate arboricultural techniques.
- Maintenance of machinery during construction must occur at a designated location away from the wetlands or other natural features on-site. Details are provided on the Erosion and Sediment Control Plan Drawing 22490-01-E-13 (back pocket of EIR).
- Any areas of bare soil that arise must be graded and re-vegetated as soon as possible to avoid gullying and erosion (seed mixture must be applied within 90 days of area being cleared and/or graded).
- Restoration and buffer plantings of native woody and herbaceous species along woodlot and wetland edges and riparian areas must be installed in conjunction with trail construction to provide protection to natural features from erosion, as

well as unauthorized entry (especially of vehicles). Refer to Section 5.0 for restoration and buffer planting details.

The ‘no touch’ zone does not apply to the off-road trail situated along the tree dripline, just north of Laird Road. Therefore, construction practices should carefully follow the remaining recommendations stated above.

Monitoring recommendations are provided separately in Section 10.0



Hanlon Creek Business Park
City of Guelph

Environmental Implementation Report

February 2009
Project 0726
Universal Transverse Mercator - NAD83
Scale 1:10000 @ (11x17")

NATURAL RESOURCE SOLUTIONS INC.
Aquatic, Terrestrial and Wetland Biologists

Legend

- Multi-use Trail (Asphalt surface)
- Off-road Trail (Limestone screenings)
- Off-road Bike Trail (Woodchip Surface)
- On-road Bike Trail (Asphalt surface)
- Proposed Sidewalk (Concrete)
- Educational Trail Sign
- Existing Upland Woodlot
- Provincially Significant Wetland
- Watercourse

Base layers from AECOM received January 21, 2009 (X-prlegal, X-prroad)

Figure 8

Pedestrian and Open Space Trail System

NRSI_0726_Hanlon_Trails_06Feb09_GCS.dwg

Hanlon Creek Business Park Stormwater Management Facility and Trail Network

Natural Features

The natural features associated with the Hanlon Creek Business Park include provincially significant wetlands, upland woodlands and meadow habitats. These habitats provide the following important ecological functions:

- Water quality and storage
- Groundwater discharge and recharge
- Biodiversity
- Native seed source
- Habitat for birds, mammals, amphibians, reptiles, insects and fish species

Stormwater Management Facilities

The stormwater management facilities have been integrated with the natural habitats and have been naturalized with plant and seed material that is native to the area. Naturalized buffer zones have been designated between the natural features (i.e. wetland and woodlot) and trail system/stormwater management facilities to protect the adjacent natural features from human impacts and provide important wildlife habitat.

Trail Network

A trail network has also been integrated into the natural habitats and in some cases combined with the stormwater management system. The trail network:

- Provides a valuable recreational amenity to the neighbourhood
- Helps protect the natural areas by concentrating foot and bicycle traffic to designated trails

Protection of Natural Areas

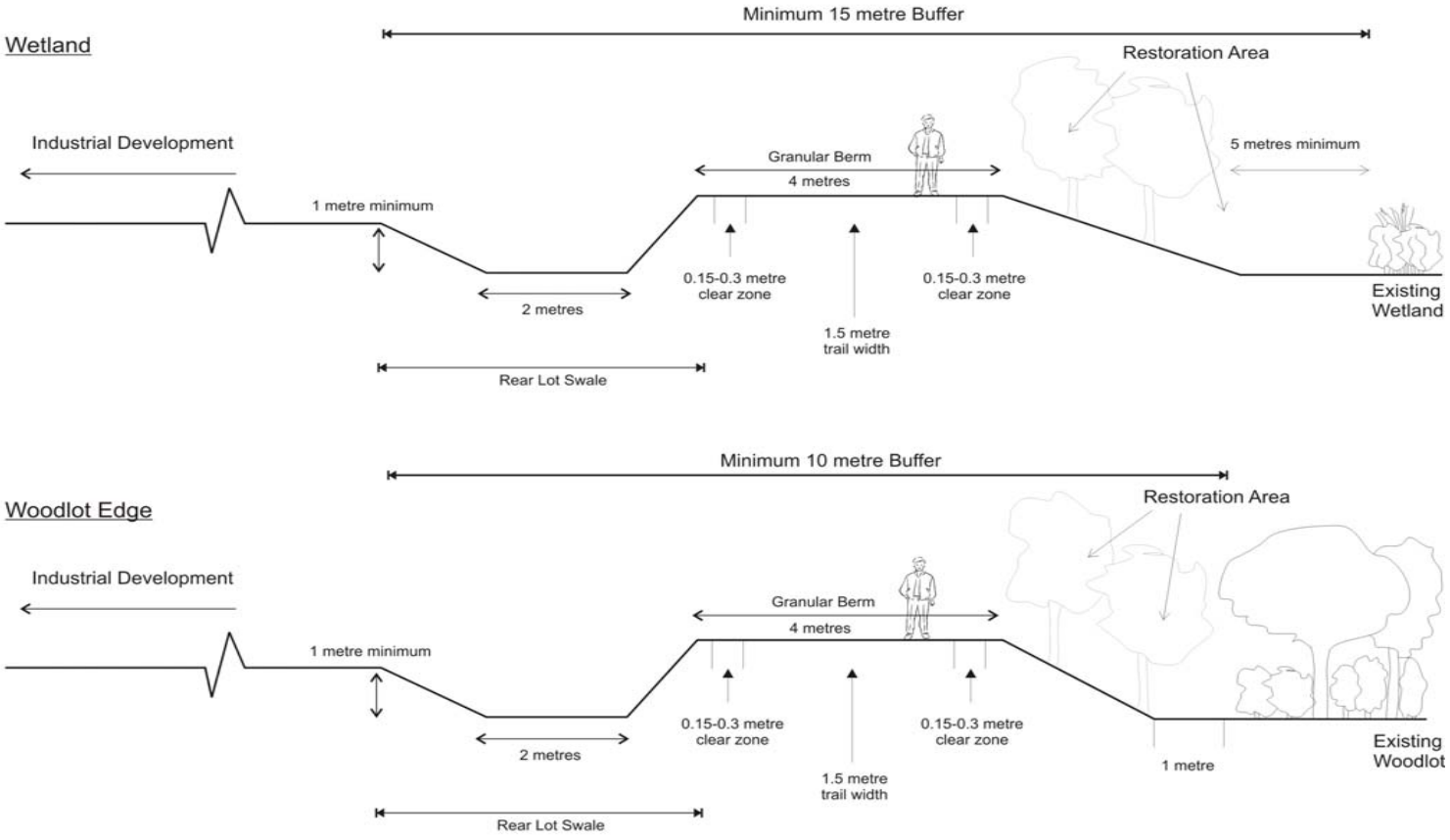
In order to protect the natural features and ensure that they function as intended, the following guidelines must be adhered to:

- Keep your pet leashed and stay on the designated trails
- Refrain from dumping any household and/or industrial waste
- Do not remove any native plant material

Contact Information

For more information regarding Stormwater Management Facilities and Protection of Natural Features, please contact Community Design and Development Services. For more information regarding Trail Networks, please contact the Operations Department at the City of Guelph, or read the City of Guelph's Enviroguide available online at http://www.guelph.ca
<Keyword Search: 'enviroguide'>

Cross Section of Trail Along Swale



NRSI_726K_PedestrianOpenTraill_18Dec07_SWM

Figure 10. Pedestrian and Off-Road Trails Along Natural Features

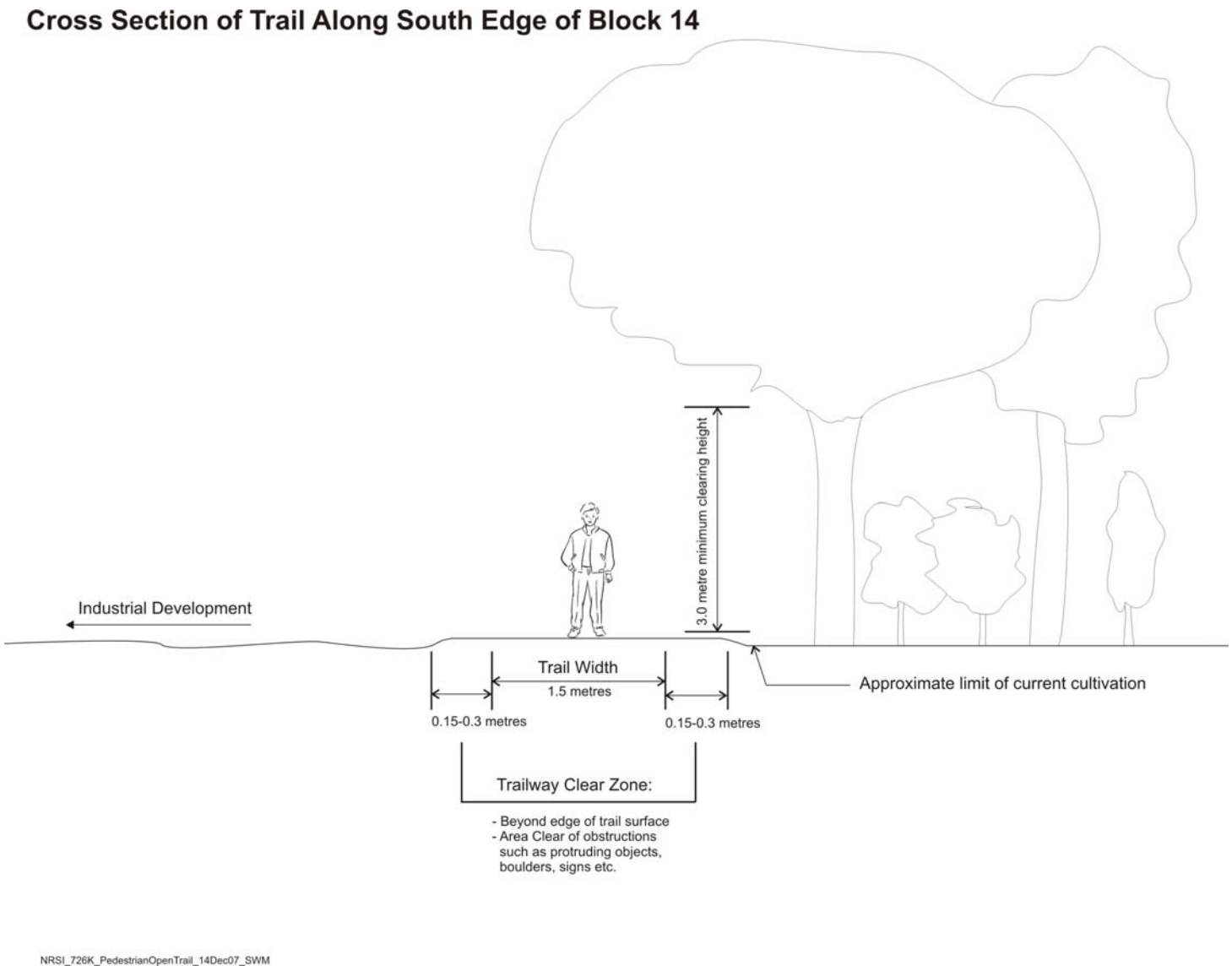


Figure 11. Pedestrian and Off-Road Trail Along South Edge of Block 14

10.0 Monitoring

The monitoring program associated with the Hanlon Creek Business Park is an integration of a series of monitoring requirements arising from the Draft Plan Conditions (OMB 2006), recommendations made in the Consolidated EIS (NRSI 2004), review comments from agencies, as well as the need to monitor the effectiveness of measures arising from the detailed studies and EIR as part of the design, mitigation and restoration of features in the Business Park.

The specific monitoring components are:

1. Monitoring of hydrogeology, creek flows and temperatures, aquatic biota and wetlands, arising from the Draft Plan Condition #12, to provide baseline information on interactions, as input to the design of stormwater management facilities that discharge to Tributary A, as well as post construction monitoring of performance of the ponds (especially thermal impacts). Monitoring results generated from the terrestrial and aquatic components can be found in Appendix XIII through XVIII.

2. Monitoring arising from the Draft Plan Condition #12, of hydrogeology and wetlands at strategic locations to provide baseline information on spatial distribution and interactions of groundwater/wetlands such that block-level infiltration targets can be assessed.

3. Monitoring of hydrogeology and wetlands in the western portion of lands south of Laird Road (Speed River PSW) to monitor changes in groundwater and wetlands stemming from concerns over potential impacts of the proposed neighbouring Mast-Snyder Gravel Pit.

4. Monitoring arising as conditions from permit applications/review (including the *Fisheries Act* permit) as well as impact predictions specifically arising from recommendations out of the EIR process.

Reviewers of previous EIR drafts identified two additional monitoring requirements:

5. Monitoring of success and naturalization processes of restoration areas within buffers, swales and stormwater management areas, arising from GRCA comments (December 2008) and restoration planting warranty.

6. Monitoring of wildlife movement throughout the Business Park, with a focus on movement and mortality associated with Laird Road and Hanlon Creek Boulevard (Road 'A').

The following monitoring discussion is divided into three phases, pre-construction, during construction and post-construction. Many of the items, especially the three components described above commenced as pre-construction monitoring, and will continue through the during construction and into the post-construction periods. Other monitoring activities will occur only during construction while others will occur post-construction.

10.1 Pre-Construction Monitoring

Pre-construction monitoring focused on monitoring components 1 to 3. This monitoring will continue through construction and follow after construction until 75% of Phase I and 2 are built. Details of this monitoring including triggers and contingency measures are shown in Tables 6 through 9.

Hydrogeological baseline monitoring for components 1-3 is described in detail in the May 2008 Hydrogeology Report (Appendix XII) and summarized in Section 13.0 below.

Further detail on baseline terrestrial, wetland and aquatic monitoring components 2 and 3 are dealt with in Appendix XIII, XIV and XV Pre-Construction Terrestrial and Wetland Monitoring for 2006, 2007 and 2008 as well as Appendix XVI, XVII and XVIII Pre-Construction Aquatic Monitoring Program for 2006, 2007 and 2008.

Aquatic monitoring and terrestrial and wetland monitoring within the Hanlon Creek Business Park was established as a result of recommendations in the Hanlon Creek Business Park Consolidated EIS (NRSI 2004), the Hanlon Creek State of the Watershed Report (PEIL 2004), conditions for the Draft Plan approval as set by the Ontario Municipal Board and comments received from the Environmental Advisory Committee (EAC) meeting on July 11,

2007. The monitoring regime for aquatic, terrestrial and wetland components followed from 2006 to 2008, is consistent with the Hanlon Creek State of the Watershed Report (PEIL 2004). The objective of the monitoring is to track changes that may occur to the terrestrial, wetland and aquatic ecology within the new industrial lands as a result of construction and the stormwater management plan.

In addition to the aquatic biota monitoring (see above), flow and temperature monitoring was conducted to provide input to the thermal assessment. This monitoring is described in the stream temperature impact report appended to the EIR (Appendix X)..

10.2 During Construction Monitoring

The following during construction monitoring programs are required for the Hanlon Creek Business Park based on component 4, 5 and 6 above. As discussed under pre-construction monitoring, the hydrogeological, hydrologic, aquatic, terrestrial and wetland monitoring will occur during construction. In addition, the following monitoring activities will occur:

- Sediment and erosion control measures must be installed prior to, and maintained during construction. Areas of bare soil must be re-vegetated with the recommended seed mix within 90 days of being cleared to prevent erosion of soils.
- Trees and other areas of vegetation to be retained must be identified and delineated with temporary fencing located beyond the dripline of trees, to ensure that vehicle movement or material storage does not disrupt vegetation (especially tree root zones).
- Any limbs or roots to be retained which are damaged during construction must be pruned using appropriate arboricultural techniques.
- Maintenance of machinery during construction must occur at a designated location away from the natural areas on-site. Details are provided on the Erosion and Sediment Control Plan Drawing 22490-01-E13 (back pocket of EIR).
- No storage of equipment, materials or fill is to occur within the natural areas or buffers/setbacks.
- During the installation of the construction limit fencing, any hazard trees must be identified and removed as warranted.

Contingency Measures

Actions to address any of the above-noted items will be identified by the Environmental Inspector and implemented immediately.

10.3 Post-Construction Monitoring

As discussed under pre-construction monitoring, the hydrogeological, hydrologic, aquatic, terrestrial and wetland monitoring will continue until 75% of Phase 1 and 2 are built.

Details of the monitoring programs will be refined based on discussions between the City, Grand River Conservation Authority and the developer. This will include confirming the monitoring protocol and reporting relationships as well as monitoring duration. In terms of monitoring components 5 and 6, the following will be incorporated into the annual terrestrail and wetland monitoring program.

- Monitor ecological function of restoration areas and passive restoration areas (use of open/restored areas by wildlife)
- Monitoring of wildlife movement throughout the Business Park, with focus on movement and mortality associated with Laird Road and Hanlon Creek Boulevard (Road 'A').
- Monitoring of the success and naturalization processes of restoration areas within buffers, swales and stormwater management areas will be conducted.

General Monitoring (i.e. trail network, terrestrial, wetland and aquatic features and restoration areas)

- Follow same protocols as monitoring that arose from components 1-3.
- Open space impacts, such as encroachment, dumping and formation of ad-hoc trails will be monitored and appropriate mitigation measures applied if required.

10.4 Creek Crossing Monitoring

The following are specific monitoring recommendations anticipated from aquatic permitting and creek crossings related to monitoring component 4.

- For crossings deemed to be a HADD, monitoring will be required as a condition of the Fisheries Act permitting for the creek crossings
- Monitoring specifics and timing will be developed by the GRCA and DFO
- Following culvert installation, monitor effectiveness and stability of design as well as habitat and stability conditions seasonally (spring and fall) over two year period.
- Provide reports on stability and effectiveness of design to DFO.

10.5 Stormwater Management and Stream Temperature Monitoring

As detailed in Section 14.0, an adaptive management approach should be adopted to ensure that the stormwater management approach is working and has minimal impacts on water temperatures within the Tributary A system. Monitoring recommendations are detailed in Section 14.0 below.

The stream temperature impact report (AECOM 2009b) provides a description of the temperature monitoring strategy for the SWM facilities, such that a total of 8 loggers are located at the pond inlet, pond outlet, outlet of the cooling trench, varying depths in the wet pool of the pond, and in the creek upstream and downstream of the outlet.

The 2009 stream temperature impact report (AECOM 2009b) recommends monthly download and review of instream temperature monitoring data, applying a two-level approach to triggers for adaptive management. Refer to Section 15.0 for recommended monitoring.

Post-construction monitoring should be carried out until 75% of the development area is built (by area) in Phase I and II, after which the State-of-the Watershed monitoring would take over. The exception is monitoring for the Mast-Snyder Pit, which is tied to the timing of the pit operation and restoration.

Table 6. Monitoring of hydrogeology, creek flows and temperatures, aquatic biota and wetlands to assess thermal impacts of stormwater management ponds 1-5 to potential coldwater habitats

	Component	Description	Trigger/Threshold	Contingency
Flow & Temperature Monitoring	Flow Volume Temperature	This will be the primary monitoring tool for assessing thermal impacts, if any. Brook trout temperature tolerances will be used as thresholds of potential thermal impacts. The temperature impact report (Appendix X) recommends a plan to monitor temperatures at various locations within the SWM facilities and in Tributary A. The SWM facility monitoring will occur on ponds 3 and 4. This will serve to identify the function of each mitigative element in the system (bottom draw, cooling trench, increased vegetative cover). Monitoring will continue to the point when 75% of the development area is built (Phase I and II).	The results of monitoring will be compared to baseline monitoring results with the goal of maintaining or enhancing conditions. Temperature triggers will be based on the maximum temperature targets for brook trout as determined in the temperature impact report (Appendix X). Triggers for maximum stream temperatures will be based on monthly reviews of instream temperature data, and employ a two-stage approach with 22°C and 24°C triggering different levels of response.	The thermal modeling included a series of mitigative measures to ensure that thermal impacts would be avoided (e.g. bottom-draw outlet, shaded cooling trench outlets in contact with cooler groundwater, shaded upstream and downstream creek banks). Augmentation of these measures (esp. vegetative) can be developed as adaptive management measures. Since plantings will take some time to mature and provide optimal shading, alternative plant sizes and densities could be assessed. Other adaptive measures may also be considered. The thermal exceedances of 22°C and 24°C will be treated as follows: 1. Any single temperature exceedance of 22°C should be analyzed in an annual temperature and flow monitoring report, including an investigation of the cause of the exceedance and recommendations for adaptive management measures as warranted. The investigation should consider the frequency, duration and spatial distribution of the exceedance. 2. Any single temperature exceedance of 24°C should trigger an investigation commencing within 2 weeks of the monthly review of data that identified such an exceedance. This investigation should consider the frequency, duration and spatial distribution of the exceedance, seek to identify the cause of the temperature exceedance, and provide recommendations for adaptive management measures as warranted. If adaptive management measures are warranted, the design and implementation of selected measures should be completed as soon as

	Component	Description	Trigger/Threshold	Contingency
				possible. At the latest, the selected measures should be implemented in the year following the exceedance of 24°C.
Hydrogeological Monitoring	Level Temperature Water Quality	This will be a primary input to the thermal modeling. Groundwater temperature monitoring in wetlands will assist in monitoring of potential thermal impacts	Triggers for groundwater temperatures at any monitoring station, but most importantly in the wetlands close to watercourses, would be an increase above previously observed high groundwater temperatures It is anticipated that surface water changes would be more immediate and are therefore identified as the primary trigger.	See above
Fish Community Monitoring and Analysis	Species Numbers Biomass Location	Monitoring of fish communities will be carried out to help determine whether any changes occur in the suitability of the habitat for brook trout. Brook trout are not currently present in Tributary A or Tributary A1 with sufficient numbers or consistency to monitor changes in their population as an indicator. However, other fish are present and the existing community will continue to be monitored.	The monitoring will allow for observation of large changes in fish community size (numbers, biomass), diversity (species) and location (presence/absence of species at stations), which may be useful for interpreting the temperature monitoring results. Specific quantitative triggers are not recommended at this time due to the absence of brook trout and the large natural variability in the pre-development monitoring results. Future results should be reviewed for identification of potential triggers. For example, development of a consistent brook trout population may facilitate valid quantitative comparison.	See above
Benthic Monitoring and Analysis	Species Numbers Location Percent Model Affinity (PMA) index Percent Similar Community (PSC) values % EPTs, and % dominant taxa.	Monitoring of benthic invertebrates to be carried out to help determine whether any changes occur in the suitability of the habitat for brook trout. Parameters will be monitored from system-health perspective, see below.	Specific quantitative triggers are not recommended at this time due to the large natural variability in the pre-development monitoring results. Future results should be reviewed for identification of potential triggers.	See above

	Component	Description	Trigger/Threshold	Contingency
Terrestrial and Wetland Monitoring Annual Vegetation Monitoring Program	Species richness Coefficient of Wetness (CW) Coefficient of Conservatism (CC) Percent cover of plants per plot Number of trees, size, condition Ratio of Native to Non-Native Species Yearly Site Vegetation Inventory Soil Analysis	Species assemblage and distribution within the system does not indicate that temperature-sensitive species are present to act as indicators of potential thermal impacts. Parameters will be monitored from system-health, as well as infiltration target perspective see below.	n/a	n/a
Terrestrial and Wetland Monitoring Amphibian Monitoring	Species Location Abundance	Species assemblage and distribution within the system does not indicate that temperature-sensitive species are present to act as indicators of potential thermal impacts. Parameters will be monitored from system-health perspective, see below.	n/a	n/a
Terrestrial and Wetland Monitoring Breeding Bird Monitoring	Species Breeding evidence Percent of birds breeding	Species assemblage and distribution within the system does not indicate that temperature-sensitive species are present to act as indicators of potential thermal impacts. Parameters will be monitored from system-health perspective, see	n/a	n/a

	Component	Description	Trigger/Threshold	Contingency
		below.		

Table 7. Monitoring of hydrogeology and wetlands to assess spatial distribution and interactions of groundwater/wetlands arising from block-level infiltration

	Component	Description	Trigger/Threshold	Contingency
Temperature Monitoring	Flow Volume Temperature	This will be an input to assessment of surface-groundwater influences on wetland characteristics. Flow monitoring will assist in interpretation of groundwater infiltration – wetland monitoring, but parameters not anticipated to be triggers. Parameters will be monitored for other monitoring foci.	n/a	n/a
Hydrogeological Monitoring	Level Temperature Water Quality*	Groundwater levels will be a primary input to monitoring spatial distribution of infiltration impacts to groundwater/wetlands. Typical changes in above, may be a result of several other potential impacts such as stormwater management, drought etc	Triggers for groundwater elevations at any monitoring station, but most importantly in the wetlands, would be a decline below previously observed low groundwater elevations (e.g. July and November 2007) that cannot be singularly attributed to climate (i.e. medium- to longer-term drought). Monitoring will continue to the point when 75% of the development area is built out (Phase I and II).	Exceedance of triggers may be a result of a number of regional, site wide and/or lot level effects. Initial priority will be to identify and isolate cause of exceedance(s) (possibly by further detailed assessment). Specific contingencies to be developed to address specific cause. May include, but not be limited to, re-analysis of infiltration targets, modification to infiltration measures at lot-level
Fish Community Monitoring and Analysis	Species Numbers Biomass Location	n/a	n/a	n/a
Benthic Monitoring and Analysis	Species Numbers Location	n/a	n/a	n/a

	Component	Description	Trigger/Threshold	Contingency
	Percent Model Affinity (PMA) index Percent Similar Community (PSC) values % EPTs, and % dominant taxa.			
Terrestrial and Wetland Monitoring Annual Vegetation Monitoring Program	Species richness Coefficient of Wetness (CW) Coefficient of Conservatism (CC) Percent cover of plants per plot Number of trees, size, condition Ratio of Native to Non-Native Species Yearly Site Vegetation Inventory Soil Analysis	Species assemblage and distribution, amount of open water and soil characteristics may be sensitive to changes in water regime from groundwater influences. Typical changes in above, may be a result of several other potential impacts such as stormwater management, drought etc.	Triggers would be changes in following parameters greater than baseline variation between and within monitoring stations:: · CW and/or CC indeces · percent cover of species sensitive to water level fluctuations (i.e. sedges) · soil chroma	Exceedance of triggers may be a result of a number of regional, site wide and/or lot level effects. Initial priority will be to identify and isolate cause of exceedance(s) (possibly by further detailed assessment). Specific contingencies to be developed to address specific causes (see above re groundwater). Increase frequency of monitoring until cause is identified and contingencies are applied
Terrestrial and Wetland Monitoring Amphibian Monitoring	Species Location Abundance	In certain wetlands, species assemblages may be sensitive to changes in amount (depth, extent and duration) of open water potentially affected by groundwater infiltration targets. Typical changes in above, may be a result of several	Triggers would be a decline in populations over more than 1 year compared to regional & provincial monitoring trends. The sensitivity of this trigger is considered less than groundwater and vegetation monitoring, and as such is not anticipated to be primary trigger (i.e. other parameters would be anticipated to have changed well before changes to amphibian populations).	n/a

	Component	Description	Trigger/Threshold	Contingency
		other potential impacts such as stormwater management, drought etc		
Terrestrial and Wetland Monitoring Breeding Bird Monitoring	Species Breeding evidence Percent of birds breeding	Species assemblage and distribution within the system does not indicate that sensitive species are present to act as indicators of potential groundwater affects.	n/a	n/a

Table 8. Monitoring of hydrogeology and wetlands to monitor potential impacts of the proposed neighbouring Mast-Snyder Gravel Pit

	Component	Description	Trigger/Threshold	Contingency
Flow & Temperature Monitoring	Flow Volume Temperature	n/a	n/a	n/a
Hydrogeological Monitoring	Level Temperature Water Quality	Groundwater levels will be a primary input to monitoring potential impacts of Mast-Snyder Pit. Results of monitoring at locations on Pit property to be provided to the City by operator/consultants. Typical changes in above, may be a result of several other potential impacts such as stormwater management, drought etc	Triggers for groundwater elevation in the wetland, would be a decline below previously observed low groundwater elevations (e.g. July and November 2007) that cannot be singularly attributed to climate (i.e. medium- to longer-term drought). Specific triggers for groundwater on Pit property have been detailed on Plans, and are part of Settlement between City, County, Township & Pit	Exceedance of triggers may be a result of a number of regional, site wide and/or lot level effects. Initial priority will be to identify and isolate cause of exceedance(s) (possibly by further detailed assessment). Specific contingencies have been developed and are described on Plans that are part of Settlement between City, County, Township & Pit. May include, but not be limited to, re-analysis of infiltration targets, modification to infiltration measures at lot-level, stormwater management pond 6
Fish Community Monitoring and Analysis	Species Numbers Biomass Location	n/a	n/a	n/a

	Component	Description	Trigger/Threshold	Contingency
Benthic Monitoring and Analysis	Species Numbers Location Percent Model Affinity (PMA) index Percent Similar Community (PSC) values % EPTs, and % dominant taxa.	n/a	n/a	n/a
Terrestrial and Wetland Monitoring Annual Vegetation Monitoring Program	Species richness Coefficient of Wetness (CW) Coefficient of Conservatism (CC) Percent cover of plants per plot Number of trees, size, condition Ratio of Native to Non-Native Species Yearly Site Vegetation Inventory Soil Analysis	Species assemblage and distribution, amount of open water and soil characteristics may be sensitive to changes in water regime from groundwater influences. Typical changes in above, may be a result of several other potential impacts such as stormwater management, drought etc. Results of monitoring at locations on Pit property to be provided to the City by operator/consultants. .	Triggers would be changes in following parameters greater than baseline variation between and within monitoring stations, especially compared to wetland monitoring being undertaken on pit property and elsewhere in HCBP: · CW and/or CC indeces · percent cover of species sensitive to water level fluctuations (i.e. sedges) · soil chroma Specific triggers for wetlands on Pit property have been detailed on Plans, and are part of Settlement between City, County, Township & Pit	Specific contingencies have been developed and are described on Plans that are part of Settlement between City, County, Township & Pit Exceedance of triggers may be a result of a number of regional, site wide and/or lot level effects Initial priority will be to identify and isolate cause of exceedance(s) (possibly by further detailed assessment). Specific contingencies to be developed to address specific causes (see above re groundwater). Increase frequency of monitoring until cause is identified and contingencies are applied
Terrestrial and Wetland Monitoring Amphibian Monitoring	Species Location Abundance	In certain wetlands, species assemblages may be sensitive to changes in amount (depth, extent and duration) of open water potentially affected by groundwater infiltration targets.	Triggers would be decline in populations over more than 1 year compared to regional & provincial monitoring trends. The sensitivity of this trigger is considered less than groundwater and vegetation monitoring, and as such is not anticipated to be primary trigger (i.e. other parameters would be anticipated to have	n/a

	Component	Description	Trigger/Threshold	Contingency
		Typical changes in above, may be a result of several other potential impacts such as stormwater management, drought etc	changed well before changes to amphibian populations)	
Terrestrial and Wetland Monitoring Breeding Bird Monitoring	Species Breeding evidence Percent of birds breeding	Species assemblage and distribution within the system does not indicate that sensitive species are present to act as indicators of potential groundwater affects.	n/a	n/a

Table 9. Monitoring of State-of-the-Watershed and system health

	Component	Description	Trigger/Threshold	Contingency
Flow & Temperature Monitoring	Flow Volume Temperature	Monitoring program has been developed to follow monitoring recommended in Hanlon Creek State of the Watershed Monitoring Program (except monitoring frequency and number of stations in the HCBP is much greater than in HCSW). After the 75% build-out timeframe for Phase I and II, the number of stations and frequency of monitoring is anticipated to revert to that described in the HCSW.	Monitoring designed to be provided to the City for incorporation into watershed-level monitoring program. Comparison to watershed-wide monitoring program will be used to identify possible local impacts. Changes in flow and temperatures greater than baseline variation between and within monitoring stations, especially compared to monitoring being undertaken elsewhere in watershed	Local exceedance of triggers (i.e. only within HCBP) may be a result of a number of regional, site wide and/or lot level effects. Initial priority will be to identify and isolate cause of local exceedance(s) (possibly by further detailed assessment).
Hydrogeological Monitoring	Level Temperature Water Quality*	Groundwater levels and water quality will be a primary input to monitoring	See above for triggers associated with groundwater infiltration and thermal impacts.	Local exceedance of triggers (i.e. only within HCBP) may be a result of a number of regional, site wide and/or lot level effects.

	Component	Description	Trigger/Threshold	Contingency
		system health.	Triggers for groundwater quality at a minimum would be a trend towards, or elevated above, on two consecutive sampling periods, the Ontario Drinking Water Standards (ODWS). This is to be reviewed with Guelph Waterworks relative to their Source Water Protection Program. Comparison to watershed-wide monitoring program will be used to identify possible local impacts. Changes in groundwater levels and water quality greater than baseline variation between and within monitoring stations, especially compared to monitoring being undertaken elsewhere in watershed	Initial priority will be to identify and isolate cause of local exceedance(s) (possibly by further detailed assessment). This will trigger a response to evaluate the probable contributing factors and to develop a solution
Fish Community Monitoring and Analysis	Species Numbers Biomass Location	Monitoring program has been developed to follow monitoring recommended in Hanlon Creek State of the Watershed Monitoring Program (except monitoring frequency and number of stations in the HCBP is much greater than in HCSW). After the 75% build-out timeframe for Phase I and II, the number of stations and frequency of monitoring is anticipated to revert to that described in the HCSW.	Monitoring designed to be provided to the City for incorporation into watershed-level monitoring program. Comparison to watershed-wide monitoring program will be used to identify possible local impacts. Changes in species, numbers greater than baseline variation between and within monitoring stations, especially compared to monitoring being undertaken elsewhere in watershed	Local exceedance of triggers (i.e. only within HCBP) may be a result of a number of regional, site wide and/or lot level effects. Initial priority will be to identify and isolate cause of local exceedance(s) (possibly by further detailed assessment).
Benthic Monitoring and Analysis	Species Numbers Location Percent Model Affinity (PMA) index Percent Similar Community (PSC) values % EPTs, and	Monitoring program has been developed to follow monitoring recommended in Hanlon Creek State of the Watershed Monitoring Program (except monitoring frequency and number of stations in the HCBP is much greater than in HCSW).	Monitoring designed to be provided to the City for incorporation into watershed-level monitoring program. Comparison to watershed-wide monitoring program will be used to identify possible local impacts. Changes in species, numbers greater than baseline variation between and within monitoring stations, especially compared to monitoring being	Local exceedance of triggers (i.e. only within HCBP) may be a result of a number of regional, site wide and/or lot level effects. Initial priority will be to identify and isolate cause of local exceedance(s) (possibly by further detailed assessment).

	Component	Description	Trigger/Threshold	Contingency
	% dominant taxa.	After the 75% build-out timeframe for Phase I and II, the number of stations and frequency of monitoring is anticipated to revert to that described in the HCSW.	undertaken elsewhere in watershed	
Terrestrial and Wetland Monitoring Annual Vegetation Monitoring Program	Species richness Coefficient of Wetness (CW) Coefficient of Conservatism (CC) Percent cover of plants per plot Number of trees, size, condition Ratio of Native to Non-Native Species Yearly Site Vegetation Inventory Soil Analysis	Monitoring program has been developed to follow monitoring recommended in Hanlon Creek State of the Watershed Monitoring Program (except monitoring frequency and number of stations in the HCBP is much greater than in HCSW). After the 75% build-out timeframe for Phase I and II, the number of stations and frequency of monitoring is anticipated to revert to that described in the HCSW. Species assemblage and distribution, amount of open water and soil characteristics may be sensitive to changes in water regime from a range of influences.	Monitoring designed to be provided to the City for incorporation into watershed-level monitoring program. Comparison to watershed-wide monitoring program will be used to identify possible local impacts. Changes in species, numbers greater than baseline variation between and within monitoring stations, especially compared to monitoring being undertaken elsewhere in watershed. See above for triggers associated with groundwater infiltration and thermal impacts. Triggers would be changes in following parameters greater than baseline variation between and within monitoring stations, especially compared to wetland monitoring being undertaken on pit property and elsewhere in HCBP: · CW and/or CC indeces · percent cover of species sensitive to water level fluctuations (i.e. sedges) · soil chroma	Local exceedance of triggers (i.e. only within HCBP) may be a result of a number of regional, site wide and/or lot level effects. Initial priority will be to identify and isolate cause of local exceedance(s) (possibly by further detailed assessment). Specific contingencies to be developed to address specific causes (see above re groundwater). Increase frequency of monitoring until cause is identified and contingencies are applied
Terrestrial and Wetland Monitoring Amphibian Monitoring	Species Location Abundance	Monitoring program has been developed to follow monitoring recommended in Hanlon Creek State of the Watershed Monitoring Program (except monitoring frequency and number of stations in the HCBP is	Monitoring designed to be provided to the City for incorporation into watershed-level monitoring program. Comparison to watershed-wide monitoring program will be used to identify possible local impacts. Changes in species, numbers greater than baseline variation between and within monitoring	Local exceedance of triggers (i.e. only within HCBP) may be a result of a number of regional, site wide and/or lot level effects. Initial priority will be to identify and isolate cause of local exceedance(s) (possibly by further detailed assessment).

	Component	Description	Trigger/Threshold	Contingency
		much greater than in HCSW). After the 75% build-out timeframe for Phase I and II, the number of stations and frequency of monitoring is anticipated to revert to that described in the HCSW. In certain wetlands, species assemblages may be sensitive to changes in amount (depth, extent and duration) of open water potentially affected by a range of influences.	stations, especially compared to monitoring being undertaken elsewhere in watershed. Triggers would be decline in populations over more than 1 year compared to regional & provincial monitoring trends.	
Terrestrial and Wetland Monitoring Breeding Bird Monitoring	Species Breeding evidence Percent of birds breeding	Monitoring program has been developed to follow monitoring recommended in Hanlon Creek State of the Watershed Monitoring Program (except monitoring frequency and number of stations in the HCBP is much greater than in HCSW). After the 75% build-out timeframe for Phase I and II, the number of stations and frequency of monitoring is anticipated to revert to that described in the HCSW.	Monitoring designed to be provided to the City for incorporation into watershed-level monitoring program. Comparison to watershed-wide monitoring program will be used to identify possible local impacts. Changes in species, numbers greater than baseline variation between and within monitoring stations, especially compared to monitoring being undertaken elsewhere in watershed	Local exceedance of triggers (i.e. only within HCBP) may be a result of a number of regional, site wide and/or lot level effects. Initial priority will be to identify and isolate cause of local exceedance(s) (possibly by further detailed assessment).

11.0 Property Demarcation

Fencing along various natural heritage features within the study area is recommended as per the City of Guelph Property Demarcation Policy which was approved by City Council on July 2 and 15, 2006. The policy states that the Recreation and Parks Department will co-operate with the demarcation of common property lines between existing public City parks and private property as per the City of Guelph Property Demarcation Policy. To form the basis of future construction plans, the City indicated that a plan indicating the demarcation types and locations for all of the open space and stormwater blocks should be provided at the EIR stage in accordance with the City's Demarcation Policy.

In the Hanlon Creek Business Park, chain link and/or buffer plantings are proposed along rear lot edges, between off-road trails and wetland features, around stormwater management facilities and other natural features that may be impacted by construction or human use. Fencing around stormwater facilities that meet the SWM design principles as set out by the City of Guelph is not required (City of Guelph 1996). The City reserves the right to chain link fence natural heritage features if the buffer plantings are not protecting the natural features to the satisfaction of the City (City of Guelph 1996). A 'living fence' or buffer planting means a "*primarily native, low maintenance, non-invasive plant material that will successfully co-exist with other plants. It is imperative that the plant material not result in a monoculture or threaten the existing ecosystem.*" (City of Guelph 1996) It is not anticipated that the implementation of chain-link fencing along rear property line will have a significant impact on deer movement as the core natural area has a number of open and naturalized areas that will allow movement.

Property demarcation markers (PDM) are to be installed throughout the study area to indicate the relative position of a boundary and serve as a public notice indicator of the use/restriction of publicly owned lands. The PDM is a 4inch (10cm) square plastic marker, 6 feet (1.8m) long, installed vertically 3 feet (0.9m) into the ground. It should be placed generally every 100 feet (30m) or 3 lots, whichever is less (City of Guelph 1996). Property demarcation markers can be ordered and purchased from the City of Guelph Operations Department (contact: 519-837-5628). Figure 12 shows the recommended

property demarcation plan and the restoration planting plans show buffer plantings throughout the business park (back pocket of EIR).

Standard Notes

- Chain link fence to be installed along rear property limit.
- Chain link fence needs to be installed when trails and restoration plantings go in.
- Installation of chain link fence needs to be part of subdivision development agreement.
- Buffer plantings to be installed between trail edge and natural feature (see Section 5.0 for buffer design details).

Hanlon Creek Business Park
City of Guelph

Environmental Implementation Report

February 2009
Project 0726
Universal Transverse Mercator - NAD83
Scale 1:10000 @ (11x17")

NATURAL RESOURCE SOLUTIONS INC.
Aquatic, Terrestrial and Wetland Biologists

Legend

- SWM Pond
- Chain Link Fence along Property Limit (back)
- Paige-wire Fence
- Off-road Trail / Maintenance Access
- Existing Upland Woodlot
- Provincially Significant Wetland
- Watercourse

Base layers from AECOM received January 21, 2009 (X-prlegal, X-prroad)

Figure 12

Property Demarcation Plan

NRSI_0726_Hanlon_PropertyDemarcation_06Feb09_GCS.dwg

12.0 Creek Crossings

The construction of the Hanlon Creek Business Park will see a new road network (Road A), including two culvert crossings of Downey Watercourse. One culvert crossing is of the road itself while the other is a crossing of a stormwater conveyance system and maintenance road. Road A will also include one open box culvert crossing of Tributary A - Hanlon Creek during the 2009 construction season. Currently, one culvert is present on the Downey Watercourse in the vicinity of the proposed SWM Pond 2 conveyance channel and naturalized Downey Watercourse channel intersection. Tributary A has an existing culvert crossing at Laird Road.

Background information was collected from the Ministry of Natural Resources (MNR), Grand River Conservation Authority (GRCA) and from the review of other available information on the aquatic habitat conditions and fisheries information on Tributaries A and A1, as well as the Downey Drain. Most recently, Natural Resource Solutions Inc. completed detailed aquatic monitoring for Tributary A1 and Tributary A in 2006, 2007 and 2008 including fish community and benthic invertebrate community assessments. The information below has been provided to present an overview of existing aquatic habitat conditions and other details necessary for external agency review.

12.1 Existing Aquatic Habitat Conditions

Fish species sampled throughout the watercourse are indicative of cool to warm water habitat though their specific physical habitat preferences are varied. Channel substrates through the majority of the watercourse are dominated by organic material with isolated sections where the bed material consisted of cobble, gravel, and sands. Groundwater influences are present through the length of the watercourse from the extreme headwaters to the online pond (NRSI 2004). The majority of the watercourses within the study area remain in a reasonably natural state; however, upstream of Laird Road, the watercourse appears to have been channelized/straightened with only the slightest of meanders observed.

Tributary A receives significant groundwater inputs from Tributary A1. Numerous fish community assessments have been completed on Hanlon Creek within the study limits

over recent years. The fish community within Tributary A at Road A crossing consists of pumpkinseed (*Lepomis gibbosus*), western blacknose dace (*Rhinichthys obtusus*), brook stickleback (*Culaea inconstans*), central mudminnow (*Umbra limi*), creek chub (*Semotilus atromaculatus*), and white sucker (*Catostomus commersonii*). No trout species were captured until sampling for the 2008 aquatic monitoring resulted in the capture of 4 brook trout in Tributary A upstream of the Road A crossing. These individuals were either juveniles or adults that likely migrated into Tributary A in response to higher flows during the wet summer of 2008 (NRSI 2008).

12.2 Culvert Crossings

As part of the Hanlon Creek Business Park development, three culvert crossing structures must be constructed, one on Tributary A and two on the Downey Watercourse. The order of construction will go as follows:

- realignment of Downey Watercourse;
- construction of downstream culvert structure of Downey Watercourse;
- construction of upstream culvert structure of Downey Watercourse;
- construction of Tributary A culvert structure.

The construction of the Downey Watercourse realignment and culvert structures must take place first to allow access to Tributary A for construction.

12.3 Downey Watercourse

Proposed Undertaking

The current alignment of the intermittent watercourse in the northwest corner of the study area (running diagonally from Downey Road), crosses proposed lots and is proposed to be re-aligned further to the east of Downey Road adjacent to an existing gas easement.

Existing Site Conditions

This intermittent tributary has been assessed for fish community and habitat conditions on numerous occasions. During the site visits (Sept, 6, 2007 and Dec 6, 2007) this tributary was dry with no flow or remnant pools present. The creek appears to be

channelized with little to no meanders present. Substrates consisted of terrestrial grasses and based on discussions between NRSI biologists and the GRCA, it was concluded that the watercourse provides fish habitat. Fish sampling could not be conducted due to dry conditions. Riparian vegetation consists of terrestrial grasses and isolated shrubs along the channel margins and old agricultural fields.

Design Details

Figure 13 shows a comparison of Downey Watercourse existing conditions compared to the proposed channel realignment. The discharge of this watercourse is proposed to bypass the stormwater conveyance channel and discharge directly to the existing channel within the Open Space area. This channel will convey 'clean' runoff from Block 47 (an open space block that is part of the retained natural area) and the agricultural lands west of Downey Road, making it unnecessary to route discharge through the stormwater management facility. This mimics the current discharge location of the flows. The existing channel length of the Downey Watercourse is 434.5m and the new naturalized rock lined channel length will be 505m. The new meandering channel alignment will have a streambed lined with riverstone with side slopes stabilized with a native seed mixture and mulch (Terraseed or equivalent). The watercourse low flow channel bottom will be 500mm wide with a 500mm depth and near vertical side slopes and will be lined with 100mm riverstone with granular "B" infill to a depth of 300mm (Drawing 22490-01-E14).

Two culvert structures will be constructed along this drainage feature. Three CSPs with a 500mm diameter will be installed at each crossing location to convey flow downstream. The CSPs for the Road A crossing will be 50m long, and the CSPs for the stormwater conveyance channel crossing will be 24m long. The middle culvert is designed to be constructed at a lower invert then the two outside culverts. This will allow flow to be maintained during low flow periods while the additional two culverts at higher inverts will provide capacity for higher flow events. Riverstone (100mm to 300mm) lined plunge pools are present at both upstream and downstream ends of the culvert crossings to provide 300mm pool depths below culvert invert and will be constructed to match the existing channel form. Refer to Drawings 22490-01-C02 and 22490-01-C07 (back pocket of EIR) showing representative cross-sections through the culvert crossings.

Hanlon Creek Business Park
City of Guelph

Environmental Implementation Report

February 2009
Project 0726
Universal Transverse Mercator - NAD83
Scale 1:2000 @ (11x17")

NATURAL RESOURCE SOLUTIONS INC.
Aquatic, Terrestrial and Wetland Biologists

Legend

- Existing Upland Woodlot
- Provincially Significant Wetland
- Existing Watercourse
- Proposed Watercourse

Base layers from AECOM received January 21, 2009 (X-prlegal, X-prroad).

Figure 13

Downey Watercourse - Existing and Proposed Conditions

N

NRSI_0726_Hanlon_DowneyRoad_06Feb09_SWM.dwg

Standard Mitigation Measures

1. In-water construction activities will be restricted to the low flow conditions typically experienced during the summer months.
2. No works/in-water works are to take place unless authorized by the GRCA and DFO.
3. Timing of in-water works associated with the channel realignment will be negotiated with GRCA and DFO as the typical coldwater timing restrictions will not allow sufficient time to complete the realignment.
4. All primary erosion and sediment controls to be installed prior to significant earthworks or increased construction activity.
5. Bypass pumping of the intermittent watercourse will be required during flow events. This will require the installation of an upstream coffer dam and conduit piping along the entire length of the proposed realignment. Water flow is to be maintained to downstream reaches and discharged to the watercourse in a controlled manner. Water flow can only be directed into completed and stabilized sections of the realigned channel. Stability is to be determined by the Environmental Monitor and Contract Administrator.
6. Refueling activities will be conducted in an environmentally responsible manner. This includes keeping the fueling operations to a 30m setback from the water's edge, drainage pathway unless otherwise directed by the Environmental Inspector/Contract Administrator. Spill kits and sufficient amount of absorbent material should be available on the fuel or service vehicles.
7. Any spills resulting from refueling operations, hydraulic leaks, maintenance etc. must be reported immediately to the Contact Administrator who will then notify the Spills Action Centre.
8. Dewatering of any excavations, pits or chambers must be done in a controlled manner so as not to discharge turbid water to the receiving watercourse. Dewatering operations shall be directed to areas above ground and could include containment areas constructed with silt fence/straw bales and/or filter bag on existing vegetation. Where larger volumes of water or high turbidity levels are anticipated, the use of containment or defractionation tanks may be required. Suitable containment areas will be identified by the Contract Administrator.

9. The area of disturbance within the channel and on the stream banks must be kept to a minimum. High visibility snow fencing should be installed to restrict heavy equipment traffic in sensitive areas.
10. Stockpile and staging areas must be well removed from the watercourse and contained by appropriate sediment and erosion controls such as silt fencing.
11. Sediment and erosion control measures must be installed, maintained and *modified* as required throughout the construction period. The installed measures must be routinely inspected to ensure that they are functioning as intended.
12. Weather conditions must be monitored to adequately prepare the site for rain events as well as to select appropriate construction windows for the installation of the culvert crossings
13. Re-vegetation of disturbed soils with an appropriate seed mixture must be completed as soon as practical. A nurse crop of annual oats (*Avena sativa*) should be incorporated into the seed mixture for summer or fall application.
14. Streambed elevations shall be re-instated through the trench section to match upstream and downstream streambed elevations.
15. Erosion and sediment control measures are not to be placed in watercourses unless specified in contract or approved by the GRCA/DFO
16. Where channel sections are to be dewatered, a fish salvage and relocation shall be conducted prior to the work area.

Staging Sequence

- Install erosion and sediment controls as shown on Drawings 22490-01-E13 and 22490-01-E14 (back pocket of EIR) prior to construction including sediment controls and the limit of construction or re-grading.
- Set up the diversion pump and pump intake. The intake shall be upstream of the upstream dam. On small, low discharge watercourses, stream features such as a deep pool can be used.
- Due to the ephemeral nature of Downey Watercourse it is not anticipated that a fish salvage/relocation will be required however that will be to the discretion of the onsite environmental monitor.
- In the event the environmental monitor deems a fish salvage as required erect exclusion net and relocate all fish from the dewatering area to

downstream of the construction limits (Scientific Collectors permit must be obtained from the Ministry of Natural Resources)

- Layout pumps and hose/conduit for water bypass operation.
- Install submersible pumps with screened intakes upstream of the coffer dam location.
- Install flow dissipater at downstream limit of bypass pumping to prevent scour.
- Install pea gravel bag cofferdam upstream of construction area. Simultaneously or upon completion of the upstream barrier, the pumps can be initiated while any existing water drains downstream from the isolated section.
- Install downstream pea gravel bag coffer dam at construction limits to contain construction area and prevent back-flooding or movement of fine materials.
- Install dewatering pump within the isolated section (in natural stream feature such as a pool) and discharge water to a filter corral consisting of a filter bag, straw bales, filter cloth and paige wire fence
- Once area has been dewatered and flow (if present) is being maintained to downstream reaches the culvert installation can begin
- Excavate material as required for installation of downstream culvert/servicing and stockpile in designated contained area on site.
- The amount of open excavation for culvert installation is to be kept to a minimum to pre-disturb as little area as possible.
- Perform local dewatering as required and discharge silt laden water to filter corral with silt fence, straw bales and filter bag. Sumps will be dug as required and dewatering pumps encased in clear stone will be installed to intercept any seepage water as well as any ground water encountered during excavation.
- Construct river stone lined plunge pools and install 3 - 50.0m 500mm storm sewers as per design details
- Install 1500mm corrugates steel pip culvert for pond 2 conveyance channel
- Excavate and create new meandering natural channel as per design working upstream.

- Construct and install river stone lined plunge pools at station 0+138.48 and install 3 – 50.0m 500mm storm sewers as per design
- Install 200mm sanitary sewer and 300mm watermain
- Complete final trim work and grading.
- Install rock lining to new channel and stabilize slopes with a native Terraseed mixture or equivalent as detailed in contract plans.
- After stabilization is completed, pre wash the constructed channel.
- Slowly remove upstream diversion and allow water to flow through realigned creek, thus abandoning the by-pass pumping.
- Completely remove diversion cofferdam, restore effected creek area
- Complete plantings as specified
- Remove all excess material from site
- Maintain erosion and sediment control devices until vegetative cover is sufficiently established.

12.4 Tributary A Crossing

Proposed Undertaking

The new culvert structure on Tributary A will be a pre-cast open bottom structure set on pour-in-place footings. The culvert structure will have an overall length of 34.0m, width of 4.0m, and a structure height of 2.0m. Armour stone headwalls have also been included in the culvert design. For the design of Road A at this location, refer to Drawing 22490-01-P02 (back pocket of EIR).

Existing Site Conditions at the Tributary A Structure

Habitat through this section consists of riffles, pools, undercut banks, woody debris, cobble, and vegetation both instream and overhanging terrestrial grasses. The online pond directly downstream of the site is heavily vegetated with emergent aquatic vegetation. Channel substrates through this section consist of cobble, gravel, coarse sand, and silt. Channel widths range from 0.9m to 2.5m though the pond itself is up to 10m wide. Evidence of thick deposits of silt, muck and detritus was observed within the pond which only allows for shallow water conditions. There is an existing ford which crosses through the channel directly upstream of the online pond. Exposed soils provide limited bank stability on both sides of the creek at the laneway crossing. The existing

vegetative buffer to the creek consists of 10m to 20m of herbaceous shrubs and terrestrial grasses. Limited canopy cover is present through this section of channel. Old agricultural fields are present beyond the vegetated buffer.

Design Details

Refer to Drawing 22490-01-C04 (back pocket of EIR) showing representative cross-sections through the culvert crossing.

The culvert will allow for the construction of a low flow channel that has an 800mm wide channel invert, 300mm channel depth below surface of culvert substrate infill, and 1:1 side slopes. This low flow channel will meander slightly through the structure and provide a 'floodplain' width of +/- 2.0m on each side depending on location. The low flow channel will be formed using river run stone mixed with granular "B" material. A plunge pool will be constructed at the downstream end of the culvert to a depth of 0.4m. The existing online pond will be filled and a new meandering channel will be constructed and stabilized with river stone and Terraseed or equivalent.

The channel in the culvert has been designed as a slightly sinuous, low-flow thread with a floodplain to accommodate the flows required and to tie-in to the downstream channel. The purpose of the low-flow channel is to provide for fish passage, provide habitats suitable for benthic invertebrate production and to restrict the creek from spreading the entire width of the culvert during periods of low flow. Such spreading, results in decreased flow depths which could become a barrier to fish migration, as well as sedimentation of fine materials from upstream, which could choke the channel and create a maintenance issue.

The overall length of the new channel segment will consist of a long gentle riffle. The riffle is designed to meet a depth of 300mm at bankfull and a surface width of 800mm wide. Hand placed boulders, cobbles and riffle stone will be placed on 100mm to 300mm river stone and 30% granular "B" infill to form a naturalized channel. Banks are designed to 1:1 side slopes given the nature of the material the channel flows across. A plunge pool lined with 100mm to 300mm river stone mixed with granular "B" to a depth of 400mm will be constructed at the downstream end of the culvert.

The profile along the channel bottom is consistent the entire length of the culvert. There may be slight alterations to the profile at the tie-ins upstream and downstream to accommodate the existing channel; these are to be considered a 'field fit' situation and will be dealt with at the time of construction.

Determination of Fish Habitat Impacts on Tributary A

The proposed Tributary A culvert placement at Road A will result in the physical disruption of the streambed through the structure and a temporary disturbance to fish habitat within the vicinity of the crossing structure during construction. The banks of the channel upstream and downstream of the structure replacement will also be disturbed during the installation of the structure and wingwalls. The existing online pond will be filled and replaced with a natural channel. The vegetation on the existing streambanks is primarily grass with other scattered shrubs and a few trees. In addition to the disturbance to fish and fish habitat anticipated during construction, 34.0m of creek will be covered by the new culvert. The length of Tributary A affected by the proposed construction activities will be approximately 48m. Of the 48m of channel to be affected by construction, 34m will be covered by the culvert. The remaining 14m will be affected by the infilling of the existing online pond and replaced with a meandering natural channel. Of the overall 48m of Tributary A affected, the aquatic habitat value of 36.0m currently consists of an online pond which has been filled by fine material and detritus. The remaining 12.0m of channel length includes the 10.0m of channel to be covered with the culvert and a 2.0m length upstream of the structure which may also be impacted during construction operations. The creation of the low flow channel is designed to provide better fish habitat conditions through the previously ponded channel length as well as improved thermal conditions downstream. This provision for a low flow channel will maintain the current function of the existing flowing channel fish habitat and provide improved habitat opportunities through the placement of larger cobble (>250mm) which will be embedded into the low flow channel to provide strategic cover and feeding habitat for fish utilizing or traversing the structure. It is expected that the mixture of river run and native substrate material will ensure continued or improved benthic invertebrate production and fish movement.

Standard Mitigation Measures

1. In-water construction activities will be restricted to the low flow conditions typically experienced during the summer months. Based on the existing coldwater management within the impact area of Tributary A, the construction window should be from July 1 to September 30.
2. Refueling activities will be conducted in an environmentally responsible manner. This includes keeping the fueling operations to a 30m setback from the water's edge, drainage pathway unless otherwise directed by the Environmental Monitor/Contract Administrator. Spill kits and sufficient amount of absorbent material should be available on the fuel or service vehicles.
3. Any spills resulting from refueling operations, hydraulic leaks, maintenance etc. must be reported immediately to the Contact Administrator who will then notify the Spills Action Centre.
4. Dewatering of any excavations, pits or chambers must be done in a controlled manner so as not to discharge turbid water to the receiving watercourse. Dewatering operations shall be directed to areas above ground and could include containment areas constructed with silt fence/straw bales and/or filter bag on existing vegetation. Where larger volumes of water or high turbidity levels are anticipated, the use of containment or defractionation tanks may be required. Suitable containment areas will be identified by the Contract Administrator.
5. The area of disturbance within the channel and on the stream banks must be kept to a minimum. High visibility snow fencing should be installed to restrict heavy equipment traffic in sensitive areas.
6. Stockpile and staging areas must be well removed from the watercourse and contained by appropriate sediment and erosion controls such as silt fencing.
7. Sediment and erosion control measures must be installed, maintained and *modified* throughout the construction period as required. The installed measures must be routinely inspected to ensure that they are functioning as intended. Disturbed soils should be stabilized immediately with suitable plantings.

8. Weather conditions must be monitored to adequately prepare the site for rain events as well as to select appropriate construction windows for the installation of the culvert crossings
9. Re-vegetation of disturbed soils with an appropriate native seed mixture must be completed as soon as practical. A nurse crop of annual oats (*Avena sativa)* should be incorporated into the seed mixture for summer or fall application.
10. Streambed elevations shall be re-instated through the trench section to match upstream and downstream streambed elevations.
11. Erosion and sediment control measures are not to be placed in watercourses unless specified in contract or approved by the GRCA/DFO.
12. Where channel sections are to be dewatered, a fish salvage and relocation shall be conducted prior to the work area.

Staging Sequence

- Install erosion and sediment controls as detailed in Drawings 22490-01-E13 and 22490-01-E15 (back pocket of EIR).
- The instream work area will be limited to upstream of the culvert crossing construction limits to the construction limits downstream of the existing online pond.
- Set up the diversion pump and pump intake. The intake should be installed on the upstream side of the upstream coffer dam.
- Erect exclusion net and relocate all fish from the dewatering area to downstream of the construction limits (Scientific collectors permit must be obtained from the Ministry of Natural Resources)
- Layout pumps and hose for water bypass operation.
- Install submersible pumps with screened intakes upstream of the coffer dam but downstream of fish exclusion fence.
- Install dissipater area downstream for treatment of discharge from by-pass pumping to prevent scour.
- Install pea gravel bag cofferdam upstream of construction area but downstream of fish exclusion netting. Simultaneously or upon completion of the upstream barrier, the pumps can be initiated and pumping can begin while the water drains from the isolated section.

- Install downstream pea gravel bag coffer dam at construction limits to contain construction area and prevent back-flooding or movement of fine materials.
- Install dewatering pump within the isolated section (in natural stream feature such as a pool) and discharge water to a filter corral consisting of a filter bag, straw bales, filter cloth and paige wire fence
- Once area has been dewatered, excavate bank material to grade and limits as required for installation of 300mm watermain
- Install 300mm watermain to extend and cap well beyond Tributary A channel to minimize impact during continuation of watermain construction after the culvert has been completed.
- Install culvert, headwall, infill the pond and shape downstream channel
- Place and form culvert substrate material prior to the placement of the precast culvert sections
- The amount of open excavation for culvert installation is to be kept to a minimum to pre-disturb as little area as possible. Perform local dewatering as required and discharge silt laden water to filter corral with silt fence, straw bales and filter bag. Sumps will be dug as required and dewatering pumps encased in clear stone will be installed to intercept any seepage water as well as any ground water encountered during excavation.
- If excess amounts of ground water are encountered during construction activities then environmental de-fractionation tanks will be utilized.
- Once the culvert footings have been installed (see culvert staging drawings), construct the low flow channel within the culvert and new natural channel downstream of the culvert
- Complete final trim work and grading.
- Stabilize slopes as detailed in contract plans with a native Terraseed mixture or equivalent.
- After stabilization is completed, pre wash the constructed channel.
- Slowly remove upstream diversion and allow water to flow through realigned creek, thus abandoning the by-pass pumping.

- Completely remove diversion cofferdam, restore effected creek area
- Complete plantings as specified
- Remove all excess material from site
- Leave erosion and sediment control devices in place until vegetative cover is sufficiently established.

12.5 General Operational Constraints

As construction activities in and around water are challenging, with a significant potential for environmental effect, it is recommended that the contractor organize an in-water construction team which will consist of an Environmental Inspector, selected machine operators and general laborers. This team will be responsible for the construction activities within the vicinity of Tributary A and the Downey Watercourse which will include the creation of the low flow channel and installation of the new structures. This will afford the best skill sets and a required level of consistency to the project and minimize the potential for environmental mishaps. The selection of expertise/personnel for the in-water construction team will be to the satisfaction of the GRCA and City.

Sediment and erosion control measures must be installed prior to construction and maintained diligently throughout the construction operations. Maintenance should continue until such time as the disturbed areas are sufficiently stabilized through vegetative growth. There are potential overland flow paths to Tributary A within the potential influence of the construction activities that could carry constructed related sediment to the watercourse. These areas should be identified in advance of construction and receive added protection and scrutiny during inspections particularly during the periods before and after rain events. Sedimentation controls will be installed and maintained along the downstream side of construction activities along Tributary A to prevent any movement of material into the identified wetland and will remain in place until construction is complete and the area has stabilized.

All channel work will be completed in the dry using a coffer dam (or equivalent) and bypass pumping to ensure that the water flow will be maintained continuously downstream of the work area (through all stages of construction) and discharged back

into the channel using a diffuser/dissipater to ensure the returning water does not scour or erode the stream bed or banks.

The contractor will provide general arrangement drawings and staging plans which will detail the bypass methodology proposed and demonstrate that the approach can adequately address the environmental and existing site conditions (varying flow volumes, channel capacities, contingency measures and wet weather response) be integrated effectively into the larger construction operation and be recognized as a priority operation. Appropriate size pumps will be used to maintain flow downstream of the construction area with potential for return periods of 5 years. Additional pumps will be made available as a contingency plan in the event of storm events creating higher flow rates of 10 yr return period.

Fish are to be collected and relocated from the construction area prior to the bypass pumping and subsequent channel dewatering.

Dewatering activities, particularly those employed during the excavation for the culvert footings must be done in a controlled manner so as not to discharge turbid water to the receiving watercourse. Dewatering operations shall be directed to areas above ground and could include containment areas constructed with silt fence/straw bales and/or filter bag on existing vegetation. Suitable containment areas will be identified by the Contract Administrator.

The area of disturbance within the channel and on the stream banks must be kept to a minimum. High visibility snow fencing should be installed to restrict heavy equipment traffic in sensitive areas.

Construction staging must have regard for the environmental aspects of the proposed culvert placement and low flow channel construction. This will ensure that ample time is provided to ensure the timely arrival of required equipment and materials; the appropriate allocation of resources; necessary environmental reviews; and the boundaries established through in-water construction windows. A pre-construction meeting should be held with the contractor's in-water team to discuss all the issues and contingency measures available for difficulties encountered. Informal meetings will be

held routinely to plan the day-to-day operations around site constraints and environmental variables. A construction schedule will be developed for critical operations that will be routinely updated and maintained until the in-water works are completed.

Travel paths, stockpile areas and staging areas, within the vicinity of the culvert installations, will be preplanned and followed. This will include the locating of proper refueling areas well removed (at least 30m) from the channel. Every reasonable attempt will be made to minimize the construction related disturbance to the watercourse and vicinity.

Excess material shall be removed immediately from the channel area and temporarily stockpiled in suitable locations identified by the design drawings and on-site areas approved by an environmental monitor.

The construction operations will include the repair and stabilization of any area disturbed during construction. This includes, but is not limited to, application of sod, topsoil, seed erosion control mats or other suitable slope treatments.

Photographic records of the culvert construction and low flow channel construction will be required from established vantage points and it is recommended that some digital video footage be collected. These will contribute to the information available to satisfy the expected monitoring requirements as determined by GRCA.

As a result of the coldwater designation of Tributary A, an appropriate construction timing window for coldwater systems will be respected. This window will prohibit in-water construction activities between October 1st and June 30th of the construction year unless otherwise specified by MNR.

In order for appropriate access to Tributary A construction timing of Downey Watercourse is scheduled to take place as first priority. Regardless of the Downey Watercourse being managed as a cold or warm water system, it is still governed by the GRCA/DFO as being fish habitat and will be affected by an in-water construction timing window.

12.6 Creek Crossing Restoration

12.6.1 Downey Watercourse

Recommended native grass, herbaceous and shrub species for restoration of the Downey Watercourse are outlined in Table 10 below. Restoration planting plan L-09 and L-10 (back pocket of EIR) represent the proposed planting plan along the Downey Watercourse. As a gas easement runs along the eastern edge of the ditch, it is recommended that only the native grass and herbaceous seed mix be planted along this area.

Table 10. Recommended Species for Downy Watercourse Planting

Common Name	Scientific Name	Max. Height (m)	Location	Size or Stock Type
Fowl manna grass	*Glyceria striata*	1.5	Channel floodplain	seed mix
Canada bluejoint	*Calamagrostis canadensis*	1.5	Channel floodplain	seed mix
Path rush	*Juncus tenuis*	0.6	Channel floodplain	seed mix
Switch grass	*Panicum virgatum*	1.8	Vertical side slopes	seed mix
Virginia wild-rye	*Elymus virginicus*	1.2	Vertical side slopes	seed mix
Panicled aster	*Symphyotrichum lanceolatum*	2	Vertical side slopes	seed mix
Boneset	*Eupatorium perfoliatum*	0.5	Vertical side slopes	seed mix
Grass-leaved goldenrod	*Euthamia graminifolia*	0.5	Vertical side slopes	seed mix
Red-osier dogwood	*Cornus stolonifera*	3	Middle/lower western slope	1G pot
Gray dogwood	*Cornus racemosa*	2.5	Upper western slope	1G pot
Sandbar willow	*Salix exigua*	3-4	Channel floodplain	1G pot
Heart-leaved willow	*Salix eriocephala*	3-4	Lower western slope	1G pot

Shrub Species

All recommended species are small to moderate sized shrubs, not expected to grow taller than 4 or 5 meters. Shrub species listed have been noted to prefer or tolerate full sun and wet to moist moisture conditions. Native dogwood and willow species root well

and are therefore good for stabilizing banks and supplementing bioengineering techniques (Daigle and Havinga 1996).

Ground Cover/ Grasses for Riparian Zones

It is recommended that the bare soil slopes be seeded (with the use of a seed drill designed for native species, such as a Truax seed drill), with the above recommended native grass/herbaceous mixture following the shrub planting. Fowl manna grass, Canada bluejoint and path rush are appropriate species for the moist/wet conditions that may be present within and immediately adjacent to the low flow channel. The remaining grass/herbaceous species listed are noted to establish quickly and provide high-quality riparian cover along stream banks and slopes.

12.6.2 Tributary A Crossing

Table 11 provides a list of plant species recommended for restoration of lands associated with the Tributary A crossing. Two planting zones have been identified based on the nature of construction activities proposed and variable habitat types associated with Tributary A Road A crossing. The zones include road embankment and lands adjacent to the tributary. Refer to restoration planting plan L-05 and L-06 (back pocket of EIR) for a detailed planting plan. Herbaceous/grass species associated with drier conditions have been recommended for areas associated with the road embankment, while species that prefer moist to wet conditions, have been recommended for lands adjacent to the tributary. Salt tolerant species were chosen to ensure that the recommended plantings will be capable of enduring the potentially harsh surroundings (i.e. traffic along Road A, snow removal, road run-off).

Table 11. Recommended Species for Tributary A Crossing

Common Name	Scientific Name	Location	Salt Tolerance	Size or Stock Type
Poverty oats-grass	*Danthonia spicata*	Road embankment	Moderate	seed mix
Canada wild-rye	*Elymus canadensis*	Road embankment	Moderate	seed mix
Black-eyed susan	*Rudbeckia hirta*	Road embankment	Moderate	seed mix
Pearly everlasting	*Anaphalis margaritacea*	Road embankment	Moderate	seed mix
Common strawberry	*Fragaria virginiana*	Road embankment	High	seed mix
Gray goldenrod	*Solidago nemoralis*	Road embankment	Moderate	seed mix
Staghorn sumac	*Rhus typhina*	Road embankment	High	1G pot
Rice cutgrass	*Leersia oryzoides*	Riparian area	Moderate	seed mix
Softstem bulrush	*Scirpus validus*	Riparian area	Moderate	seed mix
Common cattail	*Typha latifolia*	Riparian area	Moderate	seed mix
Blue vervain	*Verbena hastata*	Riparian area	Moderate	seed mix
Square-stemmed monkey flower	*Mimulus ringens*	Riparian area	Moderate	seed mix
Spotted Joe-pye-weed	*Eupatorium maculatum*	Riparian area	Moderate	seed mix
Nannyberry	*Viburnum lentago*	Riparian area	Moderate	2G pot
Pussy willow	*Salix discolor*	Riparian area	High	1G pot
Black willow	*Salix nigra*	Riparian area	Moderate	40mm caliper WB

Ground Cover for Road Embankment and Riparian Zones

During construction activities associated with the installation of the Road A culvert at Tributary A, areas of land adjacent to the tributary will be cleared and/or graded. To ensure slope stability and avoid unnecessary run-off into the tributary, it is recommended that a Terraseed mix comprised of the native herbaceous/grass species outlined in Table 11 above, be applied to all disturbance areas (bare soils).

Trees

It is recommended that large caliper sized trees be planted throughout the area adjacent to the tributary. Large tree stock will provide stability to the disturbed soils as well as increased canopy cover for the tributary.

Terraseed

Terraseed should be applied to all disturbed work areas following the installation of all tree and shrub species.

Spacing

Based on site conditions for both the Downey Watercourse and Tributary A crossing, shrubs should be spaced 1.5m off-centre. Plants should be installed in a non-uniform pattern, with groupings of the same species. On slopes, an even coverage is desired to help stabilize the bank, but not necessarily in a uniform pattern (i.e. not in rows).

Sources of Plant Materials

It is recommended that plants from the same seed zone be used in restoration works. The Native Plant Resource Guide for Ontario (SER-Ontario Chapter) provides a map of seed zones and suppliers for each area.

Planting and Care of Planted Trees and Shrubs and Herbaceous Species

Terraseed

The following recommendations should be adhered to during Terraseed application:

- prior to Terraseed application, plant trees and shrubs
- evenly distribute Terraseed over all disturbed work areas
- do not add mulch around trees and shrubs during planting stage
- ensure that Terraseed is not blown against the tree and shrub stems (Terraseed mulch should be brushed from base of trees and shrubs if found)

The following are brief recommendations that pertain to handling, planting and caring for shrubs and trees during planting.

- bare-root plants are sensitive to drying out, they must be kept moist at all times;
- dig a pit large enough to accommodate the root system, 10cm deeper than the root collar of the plant;
- spread out the roots in the pit, trimming any broken or unduly long roots;
- place the mineral soil over the roots, shaking the plant to allow the soil to sift down over the roots, until the root collar is at the soil surface, place topsoil on top of the mineral soil;

- firmly pack the soil down in the planting zone and shape a shallow basin around the plant, to hold water close to the plants roots;
- water the plant and apply a layer of Terraseed mulch over the planting zone to prevent drying out;
- trees should be well anchored and not require staking, however if a temporary stake is needed, it should be removed after the first growing season to ensure that the tree is not 'choked' by the collar; and
- rodent guards should be installed on young trees.

12.7 Creek Crossing Summary

The construction of the Tributary A crossing structure and constructed low flow channel will provide attributes and conditions that will have a positive benefit to the fish habitat available within this section of Tributary A. These improvements over the existing situation include:

- introduction of a more natural low flow channel through the existing online pond;
- lower water thermal warming effect caused by the online pond by eliminating it and replacing with natural channel;
- high quality river run stone substrate mixed with native streambed material which provide for benthic invertebrate production, and cover habitat provided by small voids and edges;
- removal of the detritus substrates and stabilization of the over widened channel section downstream of the culvert; and
- planting of native shrubs at the inlet and outlet of the new structure.

The new culvert and low flow channel at Tributary A crossing of Road A will provide improved habitat conditions within the immediate vicinity and contribute additional benefits to downstream resources.

The construction of two culvert crossings on the Downey Watercourse provides conveyance of flows to downstream resources. The design layouts of these crossings allow for the conveyance of flow during low minimal flow periods by lowering the invert of the middle 500mm storm sewer by 0.15m. The design will also provide attributes and

conditions that will have a positive benefit to the fish habitat available downstream in Tributary A. These improvements over the existing situation include:

- the construction of a new natural meandering channel replacing the existing channelized watercourse;
- high quality river run stone substrate mixed with native streambed material which provide for benthic invertebrate production, for downstream resources;
- planting of native shrubs at the inlet and outlet of the new structure as well as along the newly constructed Downey Watercourse will afford added thermal buffering.

A detailed monitoring plan will be developed to monitor adjustments of the constructed channel for a period to be determined by the Approvals Agency.

12.8 Ecological Connectivity and Wildlife Movement

The following is a summary of ecological connectivity considerations taken into account in the creek crossing designs. The key consideration was the creation of a 'porous' network of features for wildlife movement, and at the same time encouraging wildlife movements away from interactions with vehicles. This will be achieved through the provision of the diversity of wildlife habitat enhancement, and particularly movement, options.

- The culvert sizing was reviewed to confirm that the size of the opening will be sufficient to provide for a low-flow channel as well as a dry 'bench' on each side for potential use by wildlife during lower flow conditions. The culvert size is sufficient to allow for the passage of wildlife species that are known to use culverts for passage (i.e. reptiles, amphibians and small mammals).

- The inclusion of a continuous creek channel will encourage wildlife that prefer to follow the stream through the culvert. The splash pools at the ends of the culverts that may have been viewed as potential refugia for wildlife entering or leaving the culvert have been removed from the design to provide for continuity of fisheries habitats and minimize warming effects of these pools.

- Large mammals such as deer will not use this culvert, the culvert sizing required to physically accommodate deer passage are significant, and behaviorally deer are known to prefer to move over roadways.

- The size of the culvert and vertical height of the road bed was reviewed. The preference for the design was that the vertical height of the road be minimized to allow for larger wildlife movement over the roadway.

- The 'approaches' to the culverts have been designed to include structures to focus wildlife towards the culvert (i.e. shaping of the embankment and rock work around ends of culvert). This will also tend to encourage small wildlife to use the culvert versus traveling over the road.

- Swales associated with the culverts will provide wildlife connectivity as they are part of the same system. The swales will be planted with a recommended herbaceous seed mix (see restoration planting plans in back pocket of EIR) that will provide native ground cover for small wildlife moving through the area (i.e. amphibians, small mammals).

- The crossing is located on a straight stretch of roadway. This will provide adequate visibility and reaction time for both wildlife and motorists to minimize collisions.

- The current width of natural habitats associated with the creek is variable, but in some cases is quite limited. The proposed landscaping in this area at the narrowest point, including the vegetated swales, will increases the width of this riparian corridor to approximately 100m.

- The width of the crossing (between natural and restored habitats on the up and downstream sides of the culvert), has been kept to minimum within design and safety standards (approximately 40 to 50m). This will encourage short distance movement of aerial wildlife.

With these considerations in the design, maintenance of potential wildlife movement through this area is anticipated. In addition to these wildlife considerations, a number of considerations regarding aquatic habitats were provided:

- Current aquatic habitat conditions to minimize disruption and destruction of critical habitats (e.g. shifting the culvert location to impact marginal habitats in the on-line pond)

- Maintenance of the natural form and function of the channel both in terms of water conveyance and continuity of available fish habitat

- Provision of a low flow channel complete with appropriately sized substrate and channel morphology incorporated in the design

- Effective erosion and sediment controls in and around watercourses

- Restoration of the impacted areas to complement and enhance the existing habitats found as well as inclusion of only appropriate native species

12.9 Monitoring Recommendations

It is anticipated that the creek crossings will be considered a Harmful Alteration, Disruption or Destruction of fish habitat (HADD) under Section 35(2) of the federal *Fisheries Act*. For crossings deemed to be a HADD, monitoring will be required as a condition of the *Fisheries Act* permitting for the creek crossings. The specifics and timing of this monitoring will be developed by the GRCA and DFO. Monitoring after a culvert installation is required and generally includes effectiveness and stability monitoring of the design and looks at habitat and stability conditions seasonally (spring and fall) over a two year period. Reports on the stability and effectiveness of the design will be provided to DFO for their records.

13.0 Hydrogeology

On-going detailed monitoring of groundwater levels and an updated characterization of the hydrogeological conditions across the Hanlon Creek Business Park study area have been conducted by Banks Groundwater Engineering Limited (BGE). The reader is referred to Appendix XII - Hanlon Creek Business Park City of Guelph Environmental Implementation Report – Hydrogeology Report (BGE May 2008).

The bedrock underlying the study area consists of dolostone of the Guelph and Lockport-Amabel Formations, which represent significant regional water supply aquifers in southern Ontario and are capable of supplying high capacity municipal wells. A City of Guelph municipal supply well, known as the Downey Road Well, is located about 0.8km north of the study site northern boundary, in the Amabel aquifer.

The analyses presented in the report confirm the local occurrence and movement of groundwater in relation to the on-site wetlands and Hanlon Creek Tributary A. Included is a presentation and analysis of trends in groundwater elevations over the 2003 to 2008 monitoring period in relation to climate. The horizontal shallow groundwater flow directions are confirmed to be from southeast of the site, arcing towards the site's northern boundary. Over most of the local area, groundwater flows under a downward vertical hydraulic gradient from the overburden to the bedrock, thereby recharging the bedrock aquifer system. The horizontal direction of groundwater flow coincides with the wetlands and creek, indicating that a portion of groundwater is discharging to this surface water system. The analyses also confirm the downward hydraulic gradients (i.e. groundwater recharge conditions) in the upland portions of the site, and upward hydraulic gradients in the vicinity of and within the core wetland complex (i.e. groundwater discharge conditions). Seasonal variations in vertical directions of groundwater flow are also observed in some monitoring well pairs. Groundwater discharge conditions have also been confirmed at the Downey Road PSW.

The interpreted depth to groundwater is presented and evaluated for selected occasions. Under present conditions, in the areas where groundwater may be less than two metres below ground surface, there may be limitations related to lot-level stormwater infiltration facilities. During periods of lower-than-average conditions, represented by the

September 2003 groundwater elevations, it is apparent that areas where this limitation may exist are adjacent to the wetlands and creek. However, during high groundwater elevation periods, such as April 2004, 2007 and 2008, the area where the depth to groundwater is below 2.0m is much larger. During low groundwater elevation periods, such as July 2007, the 2.0m depth contour is significantly smaller.

The greatest range in depths to groundwater occurs around the perimeter locations of the site where groundwater recharge to the medium- to coarse-grained deposits is most significant. It is interpreted that it is in these areas where the groundwater elevations in the spring of 1997 would have been up to 0.5m above those observed in April 2004, April 2007, and April 2008. Therefore, allowance should be made for this potential high groundwater elevation during the design of stormwater infiltration facilities, at the Site Plan Approval stage.

The hydrogeology report also presents an updated analysis of the long-term annual average recharge to the shallow groundwater system, relative to the current varying site conditions. Post-development recharge rate targets, which set target infiltration rates on a block-by-block basis, were determined through a block-by-block groundwater infiltration reassessment, taking into account the spatial distribution of infiltration with special attention to the effects of depressional topography. The block-by-block recharge targets to be met by the developers demonstrate how infiltration will be maintained throughout all phases of the development. Following the determination of the recharge targets, with an accuracy of +/- 10 percent that had been acknowledged during OMB negotiations, a preliminary analysis was completed by each current developer to evaluate the potential to meet these targets. Each developer confirmed the potential to meet these targets on a block-by-block basis, within the stated range of accuracy. It will be the developer's responsibility to demonstrate, using a water balance analysis, how the recharge targets will be met through the Site Plan Approval process, with the designs to be completed by a Professional Engineer. Grading and importing of fill must be included in this analysis, such that imported or transferred finer-grained soils do not negatively impact groundwater recharge during and following the development of each block. The requirement of a water budget analysis was included as a Draft Plan Condition 50 A, and the City of Guelph will further enforce this requirement as a condition in the Subdivision Agreement with all developers.

The following is a condensed version of the conclusions and recommendations presented in the hydrogeology report that are relevant to the Conditions of Draft Plan Approval:

Water Budget

- Post-development recharge rate targets have been established on a block-by-block basis through a block-by-block groundwater infiltration reassessment.
- Areas where depth to groundwater may be less that 2m during some period of the year have been identified, which may limit the installation and operation of lot-level stormwater management infiltration systems.
- An allowance should be made for the seasonally high water table, during the design of stormwater infiltration facilities, at the Site Plan Approval stage.
- It is the developer's responsibility to demonstrate, using a water balance analysis, how the recharge targets will be met through the Site Plan Approval process. Grading and importing of fill must be included in this analysis, such that imported or transferred finer-grained soils do not negatively impact groundwater recharge during and following the development of each block.

Groundwater Protection

- Protection of groundwater resources must consider potential changes to quantity and quality. Actions recommended for groundwater protection should occur during and post-development. It is expected that Spill Prevention and Contingency Plans will be required for all industries located within the HCBP site, in accordance with Ontario Regulation 224/07, which came into force on September 1, 2008. This Regulation defines the requirements of such plans and to whom this Regulation applies.
- Monitoring well stations located within the planned grading areas of the HCBP site must be properly abandoned in advance of grading by a licensed Water Well Technician, in accordance with Ontario Regulation 903, as recently amended, of the Ontario Water Resources Act. Similarly, any domestic wells located within the lands must be properly abandoned and to the satisfaction of the City Engineer.
- As part of the City of Guelph Source Water Protection Planning process, the proposed land uses within the HCBP should be considered relative to protection of the Downey Road municipal well drinking water source.

13.1 Monitoring Recommendations

A long-term groundwater monitoring program is required to assess any changes in groundwater quality and quantity during and post-construction of the site, and to assess the performance of stormwater management facilities. In some cases, existing monitoring wells can be maintained, with minor modifications or improvements, for continued monitoring. Several monitors must be replaced following grading and development of selected blocks. The proposed locations for long-term monitoring of groundwater levels and quality are presented in Figure 18 of the Hydrogeology Report (see Appendix XII). This figure depicts existing monitors that are expected to be maintained or properly abandoned and proposed future monitoring locations.

It is recommended that the monitoring data be compiled, plotted, and analyzed on an annual basis and the results be presented in a Technical Memorandum that is submitted to the City of Guelph. Recommendations related to the monitoring program, including any proposed modifications, would be included. In the event of unexpected changes in groundwater elevations or quality, the frequency of monitoring, sampling, and reporting would be evaluated and revised as required. It is noted that these monitoring recommendations are consistent with the Hanlon Creek State-of-the-Watershed Study Report (2003).

It is anticipated that as many as 42 out of 43 of the proposed permanent monitoring wells will, or can, be located on City-owned lands (e.g. stormwater management areas and road allowances). The monitoring of groundwater elevations is linked to the confirmation of the performance of lot-level stormwater management facilities and the City's catchment-level stormwater management facilities. The long-term groundwater monitoring program could therefore be the responsibility of the City, with the potential of establishing cost-sharing arrangements with each land-owner in the HCBP. The GRCA should also receive a copy for review and comment in relation to maintenance of groundwater levels across the site, but with particular emphasis on the Provincially Significant Wetlands and Hanlon Creek Tributary 'A'.

Monitoring recommendations are consistent with the Hanlon Creek State of the Watershed Study Report (2003) (BGE 2008).

14.0 Stormwater Management

14.1 Overview of Stormwater Management

The following description of the stormwater management for the HCBP is based on the January 2009 report entitled: "*Hanlon Creek Business Park Stormwater Management Report - Ponds 1, 2, 3 and 4*" prepared by AECOM (2009a). The reader is referred to this report (see Appendix XI), as well as the November 2004 Servicing Report prepared by TSH (2004). Detailed site drainage and grading plans, and sediment and erosion control plans are included in Appendix XI and included in Drawing L22490-01-E13 (back pocket of EIR).

The 2009 SWM report expands on the preliminary modeling and design contained in the November 2004 Servicing Report. The proposed zoning for the development was revised through the Ontario Municipal Board process to allow more building and parking coverage for the developable blocks. As a result, the post-development impervious percentage of 65%, used in the 2004 modeling, is no longer appropriate and a value of 85% has been used in the current modeling. In order to limit the land required for stormwater conveyance, some on-site quantity controls are included for the lands tributary to Pond 4. In order to avoid encroachment into the wetland adjacent to Downey Road, the previously proposed conveyance channel to Pond 2 has been changed to a storm sewer. Some on-site quantity controls are therefore included for lands tributary to Pond 2. On-site quantity controls will be provided on the Blocks to limit post development flows to 180 l/s/ha. This will allow major storm flows to be conveyed via the storm sewer system. Otherwise, the general design parameters used in 2004 have been maintained with the current modeling and design. The wetland and woodland buffers and 'no touch' zones established and agreed upon in 2004 have been maintained in the current design.

Due to the increase in the post-development impervious percentage, the SWM facilities have increased in size but are generally in the same location as shown in the 2004 Servicing Report, with the following minor exceptions:

- Pond 3 has been shifted from the northwest side of Block 15 to the west side of the Block

- Pond 2 has been merged with the adjacent Kortright IV stormwater pond due to the proximity of these two ponds

The proposed development is divided into 6 separate catchment areas and each catchment area drains to a stormwater management facility to provide quality and quantity control of run-off. The proposed facility will consist of two main systems: a collection/conveyance system and a treatment system (AECOM 2009a). As displayed in the 2004 Servicing Report (TSH 2004), the treatment system for the Hanlon Creek Business Park includes the construction of six stormwater management facilities (SWM ponds). For Phase I and II proposed development, SWM ponds 1, 2, 3 and 4 were designed and modeled. Ponds 5 and 6 are situated within Phase III of the development and will be designed to the same criteria in the future (AECOM 2009a).

Detailed output and performance results for ponds 1, 2, 3, and 4 can be found in the 2009 Stormwater Management Report (AECOM). AECOM concluded that MOE criteria for detention pond design have been achieved in the design of these facilities (AECOM 2009a).

The 2004 Servicing Report prepared by TSH, stated that infiltration is a key 'driver' of the water balance within the wetlands and that any reductions in infiltration from the proposed development would be mitigated using appropriate stormwater management control. The location of infiltration was noted by TSH to also be an important factor for consideration and specifically state that specific issues are:

- *"no decrease in recharge conditions across the site,*
- *maintenance of the baseflow provided by the tile drain, to the east, tributary,*
- *maintenance of recharge to the east tributary through diffuse stormwater infiltration to the east of the tributary."*

A groundwater balance was completed to address the above issues and determine if the proposed development could be designed in a manner such that pre-development recharge rates could be maintained or exceeded in post-development. TSH (2004) provided an analysis of the water balance and concluded that on-site controls can be

used and would provide a more uniform distribution of the groundwater recharge throughout the area.

In the *Hanlon Creek Business Park City of Guelph Environmental Implementation Report – Hydrogeology Report* (BGE 2008), target infiltration rates were set on a block-by-block basis based on a block-by-block groundwater infiltration reassessment. Infiltration will be maintained throughout all phases of the development through the block-by-block recharge targets, which are to be met by the developers. Refer to Section 13.0 Hydrogeology for additional details.

Existing water quality in the creek has been found to have high levels of nutrients and pesticides from agricultural sources. The recommendations for stormwater management quality have been provided to reduce this existing condition. Implementation of these measures in conjunction with vegetated setbacks from the wetlands and creek and establishment of vegetated landscapes associated with lots are anticipated to improve current degraded water quality.

Silt deposits in the forebay of the SWM facilities will be removed when 50% of the acceptable storage capacity is reached. Interim infiltration galleries, consisting of hickenbottom inlets within the temporary sedimentation areas and perforated pipe bedded in clear stone within the native subgrade are proposed to ensure that infiltration rates are maintained prior to final development of the Blocks. Permanent infiltration galleries to maintain the prescribed infiltration targets will be designed and approved at the site plan stage.

Swales

Routing the surface water runoff from the road surfaces and parking lots to storm facilities require that a series of swales be constructed along the rear of many of the lots. The extent of the drainage swales are shown on plans prepared by TSH (2004) and these are reflected in the Draft Plan. These drainage ways will prevent lot runoff from entering the wetland directly and will convey the runoff along these shallowly sloped and vegetated ditches to stormwater management ponds. The details of the ditches are included in TSH (2004).

- The ditches have been laid out to avoid intrusions into the wetlands
- To allow for the ditches to be downslope of the proposed lots and to positively drain, these features are proposed to be located within the wetland setbacks
- Due to the proximity of the construction to the wetlands, care must be exercised in terms of sediment and erosion control measures
- 'No touch' zones recommended for use (i.e. 5m from wetlands or 1m from upland driplines) have been used in the layout of these swales.
- The construction of the swales has been based on the City's design requirements as well as consideration of site-specific characteristics, especially the relationship of the swale to the water table and nearby wetlands.
- The long runs of some of the flows in these swales will allow for maximum contact with vegetation as well as some infiltration of flows into the soils.

Cooling Trenches

The outlets for Ponds 1, 2, 3 and 4 include bottom draw features to help reduce the thermal impacts to the receiving watercourse. In addition, restoration planting plans have been proposed along the exterior berm, pond outlets and watercourse to provide shading to help cool the pond discharge (AECOM 2009a). Stormwater management ponds 1, 3 and 4 include rock-filled cooling trenches from each pond outlet to the watercourse. The existing infiltration gallery included on the outlet of Pond 2 has been maintained as part of the merged facility. The outlet from SWM Pond 4 was initially proposed to be a buried pipeline along the north side of Laird Road. In this location, no impacts to natural vegetation were anticipated. Due to grading and constructability issues, it was concluded that the pipe be located along the south side of Laird Road. In this location, wetlands and upland woodlands are found immediately adjacent to the roadbed. The placement of a typical outlet pipe as well as a cooling pipe beneath the ground on the south side of Laird Road was assessed. The work zones associated with the installation presented a number of potential impacts to the surrounding natural features. In order to achieve a cooling trench with its benefits to the aquatic resources, a work zone approximately 6m in width would be required (to achieve the pipe size, slope and depth). This would result in approximately 660m^2 of land impacted as a result of the underground piping (approximately 330m^2 of wetland and upland vegetation).

To accommodate impacts presented in the original plans (TSH 2004), the most recent grading plans have been altered to show cooling trenches for SWM Pond 3 and 4 within upland woodlot areas. Cooling trench locations have been recommended based on field observations by NRSI biologists. Cooling trench locations were based on the number of trees >10cm dbh that would be impacted and/or removed due to construction and proximity of cooling trench to wetland features. In July 2008, the GRCA provided comment on the placement of headwalls and cooling trenches (SWM Pond 1, 3 and 4) and their setback from the wetland boundary and/or forest dripline. During a site visit with NRSI, AECOM and GRCA staff in August 2008, the location of cooling trenches for SWM 1, 3 and 4 were discussed. Cooling trench plans have since been revised and approved by the GRCA. Based on personal communication with Fred Natolochny from the GRCA on January 14, 2009, it was determined that the GRCA is prepared to accept the loss of some trees within these areas given that the tree loss will be minimized and trenches avoid the wetlands. An on-site meeting/review as a condition of permit will be required at the time of construction/grading. Refer to Appendix IV and V for a summary of trees identified for removal along the cooling trench areas.

The cooling trench for SWM Pond 3 is projected to be approximately 2m wide and 40m long (approx. 83m^2) SWM Pond 4 cooling trench is situated within an upland woodland away from any adjacent wetland features and is 3m wide, 90.8m long with an area of 275m^2 compared to an area of 660m^2 impacted by the underground piping initially proposed. SWM 4 cooling trench will discharge into Tributary A further upstream of Laird Road, increasing the cooling potential before the stormwater discharge reaches the tributary north of Laird Road.

Restoration planting plans have been proposed for SWM 1, 3 and 4 cooling trench areas to provide additional shading to cool pond discharge (refer to restoration planting plan L-03, L-04, L-12, L-13 and L-14 - back pocket of EIR).

Stream protection fluvial geomorphology has been considered in the design of stormwater management facilities outflows. In order to limit the land required for stormwater conveyance, some on-site quantity controls are included for the lands tributary to Pond 4. In order to avoid encroachment into the wetland adjacent to Downey Road, the previously proposed conveyance channel to Pond 2 has been changed to a

storm sewer. Some on-site quantity controls are therefore included for the lands tributary to Pond 2. No wetland or trees will be impacted by the installation of this pipe.

The proposed stormwater management works include infiltration measures, source control works, open conveyance channels and stormwater management ponds to enhanced level of treatment (including the associated extended detention) (AECOM 2009a).

To limit the impact of development on the adjacent properties and receiving watercourses, the following recommendations were made in the Stormwater Management Report (AECOM 2009a):

- Erosion and sediment control will be provided during the construction period
- Controls such as continuous silt fencing, temporary storage areas, straw bale dykes, stone check dams and catch basin treatments, etc. will be implemented
- Disturbed landscaped areas not subject to construction activities will be covered in topsoil, fine graded and seeded immediately following the earthworks operation
- Silt deposits in the forebay of the SWM facilities will be removed when 50% of the acceptable storage capacity is reached
- Interim infiltration galleries, consisting of hickenbottom inlets within the temporary sedimentation areas and perforated pipe bedded in clear stone within the native subgrade are necessary to ensure infiltration rates are maintained prior to final Block development
- Installation of permanent infiltration galleries to maintain prescribed infiltration targets to be designed and approved at the site plan stage

14.2 Downey Road Stormwater Management Pipe

The 2004 Servicing Report (TSH) proposed a conveyance channel along the east side of Downey Road to convey stormwater to Pond 2. In order to avoid encroachment into the wetland adjacent to Downey Road, the conveyance channel has been changed to a storm sewer. Some on-site quantity controls are therefore included for the lands tributary to Pond 2 The wetland setback and buffers established and agreed upon in

2004 have been maintained in the current design (AECOM 2009a). No wetland or trees will be impacted by the installation of this pipe.

14.3 Grading

The grading plans prepared by AECOM (2009a) are split into separate categories in preparation of the tendering process; Interim and Ultimate. Interim grading plans are required for tender submission in 2009 and works are anticipated to occur in spring/early summer 2009. The Interim tender will include works associated with road building within Phase I and II, service installation beneath road surfaces and stormwater management facilities (ponds, swales and cooling trenches). Lot-level grading details are not provided within the Interim plans.

Ultimate plans provide detailed grading associated with development Blocks. The plans detail the final grades for all development lots. The timeline associated with Ultimate plans will be variable as they will be utilized as Blocks are built out.

Interim plans are not provided for Phase II lands due to the fact that there will be an excess of fill from Phase II and clearing and grubbing activities will cover all of the development blocks. Excess fill will be relocated within Phase I.

The Ultimate grading plans were used for the analysis of tree retention/removal due to construction. Refer to Section 2.0 and Appendix IV and V for a detailed analysis of tree inventory and preservation plan.

Sediment and erosion control plans will be required at the Site Plan stage for each development Block.

14.4 Monitoring Recommendations

An adaptive management approach is recommended in the 2009 Stormwater Management Report (AECOM), to ensure that the stormwater management approach is resulting in minimal impacts on water temperatures within Tributary A. The following recommendations were identified:

- *"Temperature monitoring should be carried out during and after construction of the HCBP to ensure that post-development temperatures are suitable for brook trout. Monitoring should occur both within the stormwater ponds and the stream to identify the function of each mitigative element in the system (bottom draw, cooling trench, increased vegetative cover).*
- *Flow monitoring should be carried out in conjunction with temperature monitoring to facilitate better analysis of temperature data. In particular, this will help isolate the causes of temperature impacts, should any occur.*
- *Monitoring of fish and benthic invertebrates should be carried out to determine whether any changes occur in the suitability of the habitat for brook trout."*

The monitoring protocol adhered to in 2006, 2007 and 2008 within stream and in groundwater monitoring wells will be maintained by the City of Guelph during construction.

AECOM recommended that additional temperature monitors be installed in the SWM ponds as follows:

- temperature and flow monitor at the inlet locations of each pond,
- 3 temperature monitors on a weighted line at varying depths within the permanent pool of each pond to document any temperature stratification;
- temperature and flow monitor at the outlet location of each pond, upstream of the cooling trench,
- temperature monitor at the outlet location of each cooling trench, and,
- temperature and flow monitors in the receiving stream, upstream and just downstream of the pond discharge points.

15.0 Thermal Impact Analysis

An analysis of the potential for thermal impacts from the stormwater management ponds on the creek was completed and is appended to the EIR (see Appendix X). The appended report specifically addresses the monitoring of hydrogeology, creek flows and temperatures, aquatic biota and wetlands arising from the Draft Plan Condition 12 (see below) to provide baseline information on interactions and as input to the design of stormwater management facilities that discharge to Tributary A. Adequate baseline pre-construction stream temperature and flow monitoring was collected in 2006 and 2007. Stream temperature data was not collected from May to August, 2007 as some instrumentation problems arose, resulting in a loss of data from this period.

Tributary A is part of the Hanlon Creek system, which is to be managed as coldwater habitat as per the Grand River Fisheries Management Plan (MNR and GRCA 1998) and the Hanlon Creek Watershed Plan (MMM Ltd. and LGL Ltd., 1993). The report outlines the modeling approach used to evaluate the design of the stormwater management facilities and control measures with respect to their impact on stream temperatures, including coldwater fisheries thresholds.

> Draft Plan Conditions (Settlement)
>
> *12. That the Developer shall prepare an **Environmental Implementation Report** (EIR) based on terms of reference approved by the City and Grand River Conservation Authority (GRCA). The EIR shall confirm the recharge targets to be meteorological and the developers' responsibilities to demonstrate how the recharge targets will be meteorological through the site plan approval process. Such a report will include a monitoring program to assess the performance of the storm water management facilities and to assess seasonal trends in water levels in the core wetland through monitoring of water levels in the wetland. The monitoring program for stormwater facilities will include temperature and stream flow monitoring of Tributary A between Laird and Road A. Modeling of summer stream temperatures on a continuous-in-time model basis shall be undertaken to demonstrate that SWM Ponds 4 and 5, have no significant negative impact on coldwater habitats in Tributary A from temperature increases, to the satisfaction of GRCA. The following factors are to be considered in the modeling: (1) magnitude of temperature difference, (2) duration of discharge, and (3) characteristics of fish species. The EIR shall establish post-development recharge infiltration rate targets that set target infiltration rates on a block-by-block basis through a block-by-block groundwater infiltration reassessment taking into account the spatial distribution of infiltration with special attention to the effects of depressional topography. The Developer shall implement all*

recommendations of the EIR and establish an appropriate monitoring period to satisfaction of the City and GRCA. Further, the Developer shall address all items and recommendations expressed in the Hydro-geological Report, the Environmental Advisory Committee comments including the detailed comments from the City's former Environmental Planner and the Guelph Field Naturalists comments, and include consideration of the Hanlon Creek State of the Watershed Study, to the satisfaction of the City and the GRCA, prior to the registration of the plan.

A number of meetings and discussions between members of the study team and staff of the GRCA occurred as part of the assessment. Based on the input from the GRCA, the following additional components were included in the thermal assessment:

- Although Condition #12 only requires the impacts of stormwater management Ponds 4 and 5 be evaluated, Ponds 1, 3, 4 and 5 were included in the assessment
- The focus of Condition #12 was on summer temperatures, but the assessment included evaluations of spring, summer, autumn and winter conditions
- Condition #12 specifically requires that the thermal assessment focus on the main Tributary A from Laird Road to Road A. However, the assessment was expanded to include all of Tributary A on the HCBP property.

To assess the impact of the stormwater management approach of the Hanlon Creek Business Park on summer temperatures of Hanlon Creek Tributary A, a temperature model of the stream was developed using HSP-F (Hydrologic Simulation Program – FORTRAN). The model was calibrated and verified using the in stream monitoring data from 2006 and 2007. The model was run to simulate continuous temperature conditions for an eight year period under all flow regimes for both existing and future conditions to assess the magnitude, frequency, duration and spatial extent of any impacts. Mitigation measures including pond bottom draws, cooling trenches and increased riparian vegetation were also investigated.

The 2004 Consolidated EIS (NRSI 2004) noted that Section 4.4 of the Stormwater Management Planning and Design Manual (MOE March 2003) outlined the mitigation measures for increased temperatures in SWM facilities. The MOE recognized that urbanization usually causes a temperature increase in stormwater runoff. The increase

in temperature of runoff from wetland style ponds is about 3.4°C and in Wet ponds is 5.1°C.

In order to mitigate the potential for increased temperatures from the stormwater management ponds, the following measures were considered in the HSP-F simulation:

- On-line pond removed and replaced by a natural channel section. This has the effect of reducing the peak temperatures downstream of the future Road A/Tributary A crossing.
- Addition of canopy along stream reaches to reduce temperatures.
- Inclusion of a bottom draw for the pond outlet. It is proposed that a "reverse pipe" outlet be installed for each pond outlet that has the effect of drawing water from the pond bottom below 2m.
- Inclusion of outlet cooling trenches. This measure consists of a rock-filled trench with a perforated pipe to carry flow. The trench is in contact or filled with cold groundwater. When the outlet is flowing, the water mixes with the groundwater and is cooled by the rocks in the trench. In addition, the trench effectively shades the outlet flow so that it doesn't heat up before it reaches the Creek.

The analysis of temperature effects on consisted of the following four factors:

- The actual temperature of exposure.
- The duration of the exposure.
- The frequency of exposure.
- The spatial extent of exposure.

The mitigation measures reflect the aim of the HCBP to correct existing pre-development summer temperature impacts on Tributary A. The existing impacts include an online pond at the future crossing of Road A, and lack of adequate vegetative shading near Laird Road. Pre-development water temperature monitoring results indicated that stream temperatures exceeded lethal limits for brook trout from time to time (especially downstream of the online pond). The HCBP plan includes removal of the online pond in conjunction with the Road A crossing, and a planting plan to enhance shade at various locations along the creek.

The modeling results for future mitigated conditions were used to generate a variety of statistics that provide a representation of summer temperatures as compared to brook trout temperature requirements. These statistics included:

- summer (July-August) average maximum, summer average, and summer average minimum temperatures as compared to the optimum summer temperature range of 10 to 19°C;
- 3-day and 7-day moving maximum averages, and 7-day moving maximum average of daily maximums as compared to specific studies in the scientific literature that utilized the same calculations in calculating and defining the upper temperature tolerance for brook trout; and
- hours during July and August that temperatures were above 19°C (the upper limit of the optimum) and 24°C (the maximum temperature tolerance determined from a number of laboratory and field studies), including the range in the modeled years, percent of total time in July and August, frequency of exceedance, and duration of exceedance per event.

Based on these analyses of modeling results for future mitigated conditions, summer temperatures are expected to be suitable for brook trout.

In addition to the analysis of summer temperatures, modeling results were used to assess autumn temperatures. Analysis of future mitigated modeling results included average temperature, average daily maximum temperature, and average daily minimum temperature for the period from mid-October to the end of November. It was determined that the temperatures are at the lower end of the general spawning temperature of 4°C to 11°C, and slightly below the optimum spawning temperature of 6°C to 9°C. At the same time, analysis of the number of hours above 11°C (the upper limit of the general spawning temperature range) showed that occasional exceedances occur. The combination of low average temperatures with occasional exceedances of 11°C suggested that ambient stream temperature conditions may not be ideal for brook trout spawning due to excessive diurnal temperature fluctuations. Modeled results of existing conditions were also reviewed, and it was determined that this potential limitation for brook trout spawning is an inherent part of the Tributary A system. It should be noted that ambient stream temperature is only one component of brook trout spawning

conditions. Day length, and increase in precipitation and groundwater discharge are other factors that influence brook trout spawning behaviour.

Winter and spring temperatures were also discussed in the stream temperature impact report, although these seasons were not included in the modeling. The groundwater interaction in the wet pools of the ponds, the bottom-draw outlets, and the cooling trenches (which also interact with groundwater) are expected to provide mitigating effects in the winter and spring. Because groundwater is warmer than surface-water in the winter, interaction with groundwater is expected to mitigate against freezing temperatures in the winter. Spring monitoring results from the existing Max Becker Subdivision Pond were reviewed as an example of a stormwater management facility with similar mitigation features (MTE Consultants Limited, 2008, unpublished data supplied by GRCA). Discharge temperatures were found to be suitable for brook trout temperature requirements for hatching in the spring (maximum of 20°C and maximum mean of 16°C). This provided evidence that these mitigation measures will serve to mitigate warm temperatures in spring. Should spawning occur, these moderating effects on the stormwater discharge temperatures during the winter and spring will help to facilitate thermal suitability for egg development, hatching, and early free-living stages of brook trout.

The following conclusions were made with respect to the impact of stormwater runoff on the streams in their management for brook trout (AECOM 2009b).

1. *"The modeled post-development summer temperatures are suitable for coldwater streams containing brook trout.*
2. *The stormwater outflows are not expected to impact brook trout spawning in autumn.*
3. *The stormwater outflows are not expected to impact the suitability of winter stream temperatures for incubation of brook trout eggs.*
4. *The stormwater outflows are not expected to impact brook trout egg hatching or the early free-living stages."*

15.1 Monitoring Recommendations

To ensure that the stormwater management approach is working and has minimal impacts on water temperatures within the Tributary A system, an adaptive management approach should be adopted. As part of that approach, the following recommendations have been identified (AECOM 2009b):

1. *Temperature monitoring should be carried out during and after construction of the HCBP to ensure that post-development temperatures are suitable for brook trout. Monitoring should occur both within the stormwater ponds and Tributary A to identify the function of each mitigative element in the system (bottom draw, cooling trench, increased vegetative cover).*
2. *Flow monitoring should be carried out in conjunction with temperature monitoring to facilitate better analysis of temperature data. In particular, this will help isolate the causes of temperature impacts, should any occur.*
3. *Monitoring of fish and benthic invertebrates will continue during construction and should be used for information purposes to help determine whether any changes occur in the suitability of the habitat for brook trout. Specific triggers from the biological information are not provided due to large natural variability in results and absence of brook trout in the quantitative data from pre-construction monitoring. Future fish and benthic monitoring results should be reviewed for potential as triggers. For example, development of a consistent brook trout population may facilitate valid tracking of the population.*
4. *Monitoring of groundwater levels and temperatures are also being continued during development, and should be used to help identify general causes of temperature changes such as climatic variation."*

The stream temperature impact report (AECOM 2009b) provides a description of the temperature monitoring strategy for the SWM facilities, such that a total of 8 loggers are located at the pond inlet, pond outlet, outlet of the cooling trench, varying depths in the wet pool of the pond, and in the creek upstream and downstream of the outlet.

Finally, the 2009 stream temperature impact report (AECOM) recommends monthly download and review of instream temperature monitoring data, applying a two-level approach to triggers for adaptive management as follows.

1. *"Any single temperature exceedance of 22°C should be analyzed in an annual temperature and flow monitoring report, including an investigation of the cause of the exceedance and recommendations for adaptive management measures as warranted. The investigation should consider the frequency, duration and spatial distribution of the exceedance.*
2. *Any single temperature exceedance of 24°C should trigger an investigation commencing within 2 weeks of the monthly review of data that identified such an exceedance. This investigation should consider the frequency, duration and spatial distribution of the exceedance, seek to identify cause of the temperature exceedence, and provide recommendations for adaptive management measures as warranted. If adaptive management measures are warranted, the design and implementation of selected measures should be completed as soon as possible. At the latest, the selected measures should be implemented in the year following the exceedance of 24°C."*

16.0 Servicing Overview – Phase I and II

The servicing of the HCBP is divided into stormwater management (including ponds, swales and storm sewers), watermains and sanitary sewers. A detailed discussion of the stormwater management is included in the 2009 report prepared by AECOM which is appended to this report (see Appendix XI). An overview of the stormwater management for the HCBP is included in Section 14.0 of this EIR.

Watermains

Watermains are detailed on the design plans prepared by AECOM (2009a), which includes pipe sizing, connections, capacity etc. The reader is referred to these plans for these details. This section of the EIR focuses on the potential for impact of the watermains on natural features. As discussed in Section 1.0 of the EIR, the installation of all watermains will occur within existing and proposed roadways. As such, all watermain crossings of natural features will occur within road crossings.

An existing watermain along Downey Road will be extended along Downey as part of the Downey Road reconstruction. This watermain will be routed along Laird Road and as such will cross Tributary A at the existing culvert. In addition, the watermain will cross the headwater ditch of Tributary A1 at the existing road culvert east of the main culvert. A watermain will be installed along Road A to cross Tributary A when Tributary A is diverted for the culvert installation. The watermain crossing will be installed using trenchless technology and is anticipated to occur in late summer/fall 2008.

The watermains will be installed within the roadbed and will not affect the existing culverts or streams. This installation will occur in between May to December 2009 (respecting the coldwater construction window).

A second watermain will be installed under the Hanlon Expressway. This watermain, along with a sanitary sewer, will be directionally bored/tunneled under the roadbed. No natural features are located in this area. Otherwise the watermain will follow the proposed roads. No culvert crossings are required for this system.

Installation of subsurface watermains and backfilling with granular fill material may create a conduit for groundwater flows. As such, cutoff collars are likely to be required in cases where the watermains are installed below the groundwater (see Section 17.0 Site Plan Recommendations).

Sanitary Sewers

Similar to the watermains, the sanitary sewers are detailed on the design plans prepared by AECOM (2009a), which includes pipe sizing, connections, capacity etc. The reader is referred to these plans for these details. This section of the EIR focuses on the potential for impact of the sanitary sewers on natural features. As discussed in Section 1.0 of the EIR, the installation of all sanitary sewers will occur within existing and proposed roadways. No sanitary sewers will cross natural features.

An existing sanitary sewer along Downey Road will be extended along Downey as part of the Downey Road reconstruction. This sewer will be routed along Laird Road and as such will cross Tributary A at the existing culvert. In addition, the sanitary sewer will cross the headwater ditch of Tributary A1 at the existing road culvert east of the main culvert.

Like the watermains (discussed above), the sanitary sewer will be installed within the roadbed and will not affect the existing culverts or streams. This installation will occur between May and December 2009 (respecting the coldwater construction window).

Although the sanitary sewers will be located within the roads, Installation of subsurface sewers with granular fill material may create a conduit for groundwater flows. As such, cutoff collars are likely to be required in cases where sanitary sewers are installed below the groundwater (see Section 17.0 Site Plan Recommendations).

17.0 Site Plan Recommendations

A checklist of site plan recommendations are outlined below and provided in Appendix XXIV that corresponds to the City of Guelph Site Plan Approval Procedures and Guidelines (City of Guelph 2008).

17.1 Sediment and Erosion Control

The following recommendations are provided to ensure that any potential impacts due to construction are minimized:

- Sediment and erosion control plans are required for all site works and must be installed prior to and maintained during construction.
- All cleared and/or graded areas (bare soil) not built upon within 90 days must be seeded with the recommended seed mixes as outlined above in Section 5.1 – 5.8 and restoration planting plans (back pocket of EIR) to avoid gullying and erosion
- Existing areas of natural vegetation and vegetation associated with the recommended trail layout are to be retained wherever possible. In order to maximize the retention of trees and other areas of vegetation, the following recommendations are provided:
  - Trees and other areas of vegetation to be retained must be identified and delineated with temporary fencing located beyond the dripline of trees to ensure that vehicle movement or material storage does not disrupt vegetation (especially tree root zones)
  - Any limbs or roots to be retained which are damaged during construction must be pruned using appropriate arboricultural techniques.
- Maintenance of machinery during construction must occur at a designated location outside of natural features on-site and their associated buffers.
- Restoration planting plans must be installed in the recommended locations outlined in Figure 4 (i.e. buffer plantings, SWM swales) to maximize protection of these features from erosion, as well as unauthorized entry (especially of vehicles).
- No storage of equipment, materials or fill is to occur within the natural areas or their associated buffers.

- During the installation of the construction limit fencing, any hazard trees should be identified and removed as warranted.

Topsoil stockpile locations will be identified at the Site Plan stage and will take into account the natural features and functions described in the EIS and EIR. Sediment and erosion control measures (i.e. heavy duty paige-wire fencing) will be identified and implemented for these topsoil locations.

As per OMB Condition 10, it is recommended that a "*qualified environmental inspector, satisfactory to the Director of Planning and Development Services, be hired to inspect the site during all phases of development and construction including grading, servicing and building construction. The environmental inspector shall monitor and inspect the erosion and sediment control measures and procedures, compliant with the Environmental Impact Study and the Environmental Implementation Report on a weekly or more frequent basis if required. The environmental inspector shall report on their findings to the City on a monthly or more frequent basis*." The Environmental Inspector will also be responsible for determining where additional existing natural areas may be retained. It has been agreed upon by the City that Natural Resource Solutions Inc. will fulfil the role of Environmental Inspector during all on-site works.

17.2 Dust Suppression

Prior to any development or grading of the site, the developer shall submit to the City a report indicating how regular dust suppression will be accomplished during the construction phase of the subdivision (OMB Condition 15).

During construction activities such as clearing and grubbing, dust can lead to the following issues:

- Dust particles may become a health hazard for individuals in and around the site as it can become trapped in the lungs
- Large amounts of dust may induce changes in vegetation due to increased heat absorption and decreased transpiration
- High levels of dust can fall into aquatic systems, causing adverse affects to aquatic plants and fish that are not adapted to high levels of sedimentation, and

- Dust produces an immediate visual impact that may affect surrounding residents (Department of Sustainable Development 2002)

Dust suppression control plans are required for all site works. Areas of bare soil will be moistened with water during all construction activities to ensure that the amount of dust within the study area is reduced. Topsoil stockpile locations will be identified and placed in areas of lesser wind exposure and away from natural features and their associated buffers.

17.3 Pesticides

In accordance with the City of Guelph By-Law Number (2007)-18308, 'no person shall apply or cause, or permit the application of a pesticide within the boundaries of the City of Guelph'. As the proposed development is situated within the City of Guelph, the pesticide by-law must be adhered to at the Site Plan stage. Refer to the City of Guelph pesticide By-Law for a list of pesticide alternatives in the event that pest management is required (City of Guelph 2007).

17.4 Salt

Road salt is typically not used for properties within the City of Guelph (City of Guelph 2008). When possible, sand should be applied to areas that require deicing. The City has outlined areas that are salt and high priority sand routes. Downey Road and Laird Road are currently high priority salt routes, while Forestell Road is a sand route (City of Guelph 2008). Management practices must be adopted, such as pre-wetting and anti-icing techniques, employee training on best practices and salt chemistry, as well as the identification of priority areas (Environment Canada 2004).

17.5 Tree Retention and Landscape Plantings

Trees on development blocks have been assessed and recommendations as per removal/retention are provided in Section 2.0. At the site plan stage the details of the lot layout including grading are to be compared to the trees identified for retention to assess the feasibility of retention. Existing areas of natural vegetation will be retained wherever possible. An Environmental Inspector hired by the developer will be on-site during all

site works to identify potential retention areas. In order to maximize the retention of trees and other areas of vegetation, the following recommendations are provided:

- Trees and other areas of vegetation within the natural areas, the Heritage Maple Grove and along the proposed trail network that are being retained must be identified and delineated with temporary fencing located beyond the dripline of trees, to ensure that vehicle movement or material storage does not disrupt vegetation (especially tree root zones)
- Temporary fencing must be used to retain and protect trees of significance along the proposed trail system and within the Heritage Maple Grove.
- Any limbs or roots of trees to be retained which are damaged during construction must be pruned using appropriate arboricultural techniques.
- For maximum protection from deer and rodents, either ventilated plastic spiral or galvanized wire mesh tree guards must be installed around proposed restoration plantings. Guard bottom is to be buried in soil approximately 5cm deep and the guard must be 45cm in height. Annually (in the fall) guards need to be checked to ensure they are 'mouse' tight, free of litter and not interfering with root development (Ministry of Agriculture 2008)
- Post educational signage throughout business park providing protective covenants for natural features and restoration areas (see Figure 9 for recommended wording)

Within the Open Space components of the Draft Plan, some trees with high hazard rating have been identified in the EIR. This listing is not exhaustive. It is recommended that the City review hazard trees as part of their ownership and management of these lands. Removal of high hazard trees may be warranted and should be determined by a certified arborist.

Landscape planting plans for the stormwater management blocks, swales, buffers, riparian areas and other specific areas within the Business Park are detailed in Section 5.0 above and restoration planting plans (back pocket of EIR). Native plant species have been recommended for all areas of restoration within the study area and species chosen are consistent with the surrounding natural features. These plans are to be implemented at the earliest possible point in the site plan process. It is recommended

that a landscape guide be provided to developers to ensure plantings are installed appropriately.

Lot-level landscape plans are to be prepared as part of the site plan process. These plans are to include:

- Native vegetation species
- Efforts be made to obtain locally sourced seed, tree and shrub stocks for naturalized plantings.
- Local availability of planting stock will determined at the site plan stage.

17.6 Lighting

Detailed lighting designs will be provided at the Site Plan stage. Lighting designs should include directional lighting for all areas of road and developments that are within 30 metres of the natural heritage features to eliminate lightwash.

17.7 Snow Storage

Over the course of a winter and multiple plowing sessions, snow can build up along roadways. In order to avoid large snow banks in areas with limited space, designated snow storage areas must be identified. As snow can be contaminated with items such as salts, oil, grease, litter and debris, designated snow storage areas away from sensitive natural features and buffers/setbacks are essential for best management practices.

Snow storage areas must be located at least 30m from wetland features and 10m from woodlot areas. Specific snow storage areas will be designated at the site plan stage taking into account the natural features and functions described in the EIS and EIR. In addition, the following principles will be adhered to when areas are chosen and functioning:

- Locate and operate snow disposal areas to minimize impacts to the natural environment
- Clearly delineate the actual snow disposal areas in a manner that is clearly identifiable under adverse winter conditions to ensure that the snow is placed in the proper location

- Manage the meltwater discharge to comply with the City of Guelph water quality regulations and protect surface and groundwater resources
- Collect and dispose of on-site litter, debris and sediment from meltwater that settles in area in accordance with the City of Guelph waste management legislation
- Control emissions (drainage, noise, dust, litter and fumes) to prevent off-site environmental impacts
- The snow handling, storage and disposal design must be practical and must not impose undue maintenance requirements.

(Transportation Association of Canada, 2003)

17.8 Maintenance and Refueling Areas

Maintenance and refueling areas must be located away from the natural features on-site (a minimum of 30m from wetland areas and 10m from woodlot edge). Site specific locations will be designated at the Site Plan stage. Storage locations for equipment, materials and fill should be located away from natural areas and buffers/setbacks. In the event that maintenance and refueling areas are located in proximity to natural features (i.e. 30m), minor grading must be used to direct surface runoff away from the natural feature. This generally consists of the slope of the course leading to a very shallow swale created by a low ridge of topsoil. The vegetated swale is configured to direct surface runoff along the swale back away from the wetland and woodlot edge.

17.9 Site Specific Recommendations

Stormwater Management Ponds and Swales

Detailed stormwater management plans and swales have been prepared by AECOM (2009a). The design of these facilities and subsequent monitoring is to address the recommendations from the Stormwater Management Report (AECOM 2009a) and Stream Temperature Impact Report (AECOM 2009b). To limit the impact of development on the adjacent properties and receiving watercourses, the following recommendations were made in the Stormwater Management Report (AECOM 2009a):

- Erosion and sediment control will be provided during the construction period

- Controls such as continuous silt fencing, temporary storage areas, straw bale dykes, stone check dams and catch basin treatments, etc. will be implemented
- Disturbed landscaped areas not subject to construction activities will be covered in topsoil, fine graded and seeded immediately following the earthworks operation
- Silt deposits in the forebay of the SWM facilities will be removed when 50% of the acceptable storage capacity is reached
- Interim infiltration galleries, consisting of hickenbottom inlets within the temporary sedimentation areas and perforated pipe bedded in clear stone within the native subgrade are necessary to ensure infiltration rates are maintained prior to final Block development
- Installation of permanent infiltration galleries to maintain prescribed infiltration targets to be designed and approved at the site plan stage

Laird Road

The installation of subsurface utilities is to be prepared and reviewed by a qualified ecologist or biologist for potential impacts to neighbouring wetlands and watercourses. The installation is to use trench technology with no direct disruption of vegetation. Appropriate sediment and erosion control measures are to be implemented and maintained throughout the construction period.

The restoration recommended in Section 5.7 and 8.0 above is to be implemented upon closure of Laird Road.

Subsurface Watermains and Sewers

The use of granular backfill for subsurface pipes may create a conduit for groundwater flows. As such, all subsurface pipes that are to be installed in areas of high groundwater levels are to include cutoff collars to prevent impacts to groundwater flow patterns.

Road A Crossing of Tributary A

The details of the road crossing of Tributary A at Road A including restoration are provided in plans prepared by AECOM (Appendix X and XI) and Drawing 22490-01-P02 and 22490-01-C04 (back pocket of EIR). The conditions of the permit as issued by GRCA/DFO are to be implemented and monitored as per the permit(s).

Downey Road Watercourse

The details of the realignment and restoration of the Downey Road watercourse are provided in plans prepared by AECOM and Figure 13 above. Restoration plans are included in L-09 and L-10 (back pocket of EIR). The conditions of the permit as issued by GRCA/DFO are to be implemented and monitored as per the permit(s).

Heritage Maple Grove

The retention of the Heritage Maple Grove including a buffer area and 3:1 slope are described in Section 5.6 and shown in restoration planting plan L-21. The following additional recommendations are provided to be implemented by the developer prior to site grading:

- Sediment and erosion control measures must be installed prior to, and maintained during construction. Areas of bare soil must be re-vegetated within 90 days of being cleared to prevent erosion of soils and gullying.
- In order to maximize the retention of trees and other areas of vegetation, the following recommendations are provided:
    - Trees and other areas of vegetation to be retained must be identified and delineated with temporary fencing located beyond the dripline of trees, to ensure that vehicle movement or material storage does not disrupt vegetation (especially tree root zones).
    - Any limbs or roots to be retained which are damaged during construction must be pruned using appropriate arboricultural techniques.
- Maintenance of machinery during construction must occur at a designated location away from the Heritage Maple Grove and associated 3:1 vegetated slope.
- No storage of equipment, materials or fill is to occur within the heritage grove.
- During the installation of the construction limit fencing, any hazard trees must be identified by a certified arborist and removed as warranted.
- Signage is to be installed on the fencing to identify the Heritage Maple Grove as a tree retention area
- The 3:1 slope is to be re-vegetated as per recommendations in restoration planting plan L-21.

In addition, the following management guidelines are recommended by the City:

- The identified hazard trees are to be inspected by a qualified City staff person or designated arborist to determine the need for hazard tree management (pruning, removal etc.)
- The City prepare and implement an invasive species removal program (especially for common buckthorn)
- A heavy duty paige-wire fence should be installed around the perimeter of the Heritage Maple Grove to provide additional protection (see Figure 12)

A number of the trees in this area overlap with the right-of-way of Forestell Road. Any widening or work on this road is to consider the potential impacts to these trees.

18.0 References

AECOM. 2009a. Hanlon Creek Business Park Stormwater Management Report – Ponds 1, 2, 3 and 4. Prepared for the City of Guelph. January 2009.

AECOM. 2009b. Hanlon Creek Business Park Stream Temperature Impact Report Continuous Modelling with HSP-F. January 27, 2009.

Banks Groundwater Engineering Limited. 2008. Hanlon Creek Business Park Environmental Implementation Report – Hydrogeology Report. May 2008.

Bogart, Jim. 2008. Personal Communication. February 29, March 5, June 6, and July 8. University of Guelph, Faculty of Integrative Biology.

City of Guelph. Guelph Trail Master Plan. Fall 2005. Available online at: http://guelph.ca/uploads/CS_Group/parks/trails/gtmp_full.pdf

City of Guelph. Design Principles for Storm Water Management Facilities. October 1996. Available online at: http://guelph.ca/uploads/ET_Group/engineering/Design-Principles-Stormwater-Management.pdf

City of Guelph. Property Demarcation Policy. August 2006. Available online at: http://guelph.ca/uploads/cs_group/parks/property-demarcation-policy.pdf

City of Guelph. The Corporation of the City of Guelph By-Law Number (2007)-18308. 2007. Available online at: http://www.guelph.ca/uploads/PDF/By-laws/pesticide-bylaw.pdf

City of Guelph. Salt and High Priority Sand Routes. 22 May 2008. Available online at: http://guelph.ca/uploads/Maps/2007SaltSand_Map.pdf

City of Guelph. Site Plan Approval Procedures and Guidelines. March 2008. Available online at: http://guelph.ca/living.cfm?itemid=65116&smocid=1915

Department of Sustainable Development – Environmental Protection Service. Environmental Guideline for Dust Suppression. January 2002. Accessed 23 May 2008. Available online at: http://www.gov.nu.ca/env/suppression.pdf

Environmental Advisory Committee. Council Committee Room C Meeting Minutes – July 11th, 2007.

Environment Canada. "Protecting the Environment while Maintaining Road Safety in Winter." EnviroZine 49(2004). 9 December 2004. Available online at: http://www.ec.gc.ca/EnviroZine/English/issues/49/feature1_e.cfm

Fosdick, Dean. "Wildflower rescue groups often operate one step ahead of developer bulldozers." The Daily Independent Online. 4 March 2008. Accessed 11 June 11 2008. Available online at: http://www.dailyindependent.com/scienceenviro/local_story_064085316.html

Grand River Conservation Authority. A Checklist of Birds within the Grand River Watershed. 2008. Accessed 19 February 2008. Available online at: http://www.grandriver.ca/Birding/birdcheklist.pdf

Green Scheels Pidgeon. 2004. Hanlon Creek Business Park Draft Plan of Subdivision. (February 2004)

Irvine, D. E. 1993. Field Manual for Describing Soils in Ontario – 4th Edition. Ontario Centre for Soil Resource Evaluation. Guelph Agriculture Centre. Compiled by K.A. Denholm and L.W. Schut.

Kershner, B. 2006. Hanlon Creek Heritage Maple Grove Forest Survey Report. April 2006. Prepared for Kortwright Hills Community Association.

Lee, H.T., W.D. Bakowsky, J. Riley, J. Bowles, M. Puddister, P. Uhlig and S. McMurray. 1998. Ecological Land Classification for Southern Ontario: First Approximation and its Application. Ontario Ministry of Natural Resources, Southcentral Science Section, Science Development and Transfer Branch. SCSS Field Guide FG-02.

Marshall Macklin Monaghan Limited and LGL Limited. 1992. Hanlon Creek Watershed Study. Interim Report Volumes 1-4.

Marshall Macklin Monaghan Limited and LGL Limited. 1993. Hanlon Creek Watershed Study. Final Report.

Ministry of Agriculture – Food and Rural Affairs. Rodent and Deer Control in Orchards. 1 May 2008. Accessed 23 May 2008. Available online at: http://www.omafra.gov.on.ca/english/crops/facts/98-023.htm

Ministry of the Environment. 2003. Stormwater Management Planning and Design Manual. March 2003.

Natural Resource Solutions Inc. 2004. Hanlon Creek Business Park Consolidated Environmental Impact Study.

Natural Resource Solutions Inc. 2006. Hanlon Creek Business Park Environmental Monitoring Program Pre-Construction Terrestrial and Wetland Monitoring.

Natural Resource Solutions Inc. 2007. Hanlon Creek Business Park Environmental Monitoring Program Pre-Construction Terrestrial and Wetland Monitoring.

Natural Resource Solutions Inc. 2006. Hanlon Creek Business Park Pre-Construction Aquatic Monitoring.

Natural Resource Solutions Inc. 2007. Hanlon Creek Business Park Pre-Construction Aquatic Monitoring.

Natural Resource Solutions Inc. 2008. Hanlon Creek Business Park Pre-Construction Aquatic Monitoring.

Natural Heritage Information Centre. 2008. Species Search. Ministry of Natural Resources. Available online at: http://nhic.mnr.gov.on.ca/MNR/nhic/species.cfm

Old Growth Policy Advisory Committee. 1994. Conserving Ontario's Old Growth Forest Ecosystems. Ontario Ministy of Natural Resources, Toronto. 90 p.

Ontario Municipal Board. Hanlon Creek Business Park Conditions of Draft Plan Approval. OMB Approval in Principle June 6, 2006.

Planning & Engineering Initiatives. 2003. Hanlon Creek State of the Watershed. City of Guelph.

Toronto Region Conservation Authority. 2004. Stormwater Management Facility Planting Guidelines. July 2004.

Totten Sims Hubicki Associates et al. 2000. Hanlon Creek Business Park Environmental Impact Study. (August 2000).

Totten Sims Hubicki Associates and Natural Resource Solutions Inc. 2002. Hanlon Creek Business Park Environmental Impact Study Addendum #2.

Totten Sims Hubicki Associates. 2004. Hanlon Creek Business Park Servicing Report (November 2003).

Totten Sims Hubicki Associates. 2008. Hanlon Creek Business Park Preliminary SWM Design Report (June 2008).

Transportation Association of Canada. Syntheses of Best Practices Salt Management – Snow Storage and Disposal. September 2003. Accessed 23 May 2008 < http://www.tac-atc.ca/english/pdf/storage.PDF>

Uhlig, P., A. Harris, G. Craig, C. Bowling, B. Chambers, B. Naylor, and G. Beemer. 2001. Old Growth Forest Definitions for Ontario. Ontario Ministry of Natural Resources. Queen's Printer for Ontario, Toronto, ON. 43 p.

Waterloo Hydrogeologic, Inc. 2004. Hanlon Creek Business Park Hydrogeological Study (November 2003).

APPENDIX I

Terms of Reference (May 29, 2007)

APPENDIX II

Consolidated Bird Species List (2008)

APPENDIX III

Consolidated Herpetofauna Species List (2008)

APPENDIX IV

Hanlon Creek Business Park Tree Inventory – Phase I

APPENDIX V

Hanlon Creek Business Park Tree Inventory – Phase II

APPENDIX VI
Heritage Maple Grove Tree Inventory

APPENDIX VII
Small Wetland Photos

APPENDIX VIII
Small Wetland Soil Surveys

APPENDIX IX

Laird Road Memo, City of Guelph

APPENDIX X

Stream Temperature Impact Report (2009)

APPENDIX XI
Stormwater Management Report (2008)

APPENDIX XII
Hydrogeology Report (2008)

APPENDIX XIII

Terrestrial and Wetland Monitoring Report (2006)

APPENDIX XIV

Terrestrial and Wetland Monitoring Report (2007)

APPENDIX XV

Terrestrial and Wetland Monitoring Report (2008)

APPENDIX XVI
Aquatic Monitoring Report (2006)

APPENDIX XVII
Aquatic Monitoring Report (2007)

APPENDIX XVIII

Aquatic Monitoring Report (2008)

APPENDIX XIX

Response to GRCA Stream Temperature Impact Report Review
(December 16, 2008)

APPENDIX XX

HCBP Subdivision Application 23T-03501 Memo (January 29, 2009)

APPENDIX XXI

EIR Agency Review Comments (2008)

APPENDIX XXII

EIR Public Review Comments (2008)

APPENDIX XXIII

Hanlon Creek Business Park – EIR Checklist

APPENDIX XXIV

Hanlon Creek Business Park – Site Plan Recommendation Checklist