Hamilton Harbour Remedial Action Plan

Erosion and Sediment Control on Active Construction Sites Report and Recommendations

Prepared by: Sediment Control on Active Construction Sites Task Group

Dated: October 20, 2016

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Erosion and Sediment Control on Active Construction Sites Report
Executive Summary

For the first time in 100 years the quality of the water in Hamilton Harbour will be determined by its watershed runoff. By 2021 upgrades to wastewater treatment plants will be complete and no longer will impacts from the watershed be masked by wastewater effluent. The hundreds of millions of dollars invested in wastewater treatment upgrades will not on their own be enough to make sustainable changes in Harbour water quality. If Hamilton Harbour is to delist as an Area of Concern, watersheds will also need to lower phosphorus and sediment levels.

For this reason, the Hamilton Harbour Remedial Action Plan (HHRAP) set up the Sediment Control on Active Construction Sites Task Group with municipal, regional, conservation authorities, provincial, federal, RBG, and community stakeholder representatives. This report is the collective overview of local erosion and sediment control practice and contains recommendations for opportunities to improve. The recommended change is not unique to this area, but is in line with changes already occurring in the understanding and practice of erosion and sediment control practice on active construction sites throughout Ontario and North America.

The key categories of recommendations from the Sediment Control on Active Construction Sites Task Group include:

- improving the ESC process for subdivisions, site plans, infrastructure and capital projects, and single lot applications;
- providing education and training;
- updating and coordinating ESC guidelines; and
- update contracting tools to improve ESC performance in the industry.

Underpinning many of the necessary changes will be the need for increased education and training. No longer can erosion and sediment control practice be limited to an afterthought in planning or something that is installed once and not updated or maintained. The awareness of best practices through ongoing training will be the quickest and most sustainable way to enact change in this area.

This improvement in erosion and sediment control practice is in line with the visions of the municipalities and conservation authorities, and the Hamilton Harbour Remedial Action Plan. When erosion and sediment control practice is done well, the amount of sediment leaving construction sites will be reduced and nature will thrive with cleaner streams; when it fails, streams will struggle to sustain health. **Hamilton Harbour, the Cities of Burlington and Hamilton, the Regional Municipality of Halton, Hamilton Conservation Authority and Conservation Halton will benefit from this improvement in erosion and sediment control practice as the Harbour continues to strive to achieve delisting and become a vibrant centrepiece for the community.**

NOTE: *In all the recommendations "municipalities" refers to the City of Hamilton, City of Burlington, and when applicable, the Regional Municipality of Halton; "conservation authorities" refers to the Hamilton Conservation Authority and Conservation Halton.*

Recommendations for ESC process for Subdivisions

PREPARATION OF ESC PLANS AND ON SITE INSPECTION

E1) It is recommended that prior to initiating engineering design require joint pre-consultation, by the applicant's engineer with the municipality and conservation authority, for preparing ESC plans in the municipal subdivision application process and for CA applications.

E2) It is recommended that individualized and tailored ESC plans for the three phases of construction of subdivisions be required to ensure practical and effective ESC controls through all phases of construction: 1) earthworks/site grading; 2) servicing/road construction and; 3) building construction phases of work.

E3) It is recommended that municipalities shall clearly identify that they will take the lead for ensuring ongoing compliance with ESC measures during the three stages of construction of subdivisions.

E4) It is recommended that an appropriate development funded inspection and reporting system shall be designed and implemented by the municipalities and conservation authorities to ensure compliance with ESC measures during the three stages of construction.

E5) It is recommended that municipalities and conservation authorities, through subdivision agreements and CA permits, require applicants to provide notification when a project is to start and require regular ESC inspection reports be filed with the municipalities and CAs.

E6) It is recommended that the applicant be required to identify an on-site person who is designated responsible for the construction, maintenance, and operation of ESC for each stage of construction.

STABILIZING AND VEGETATING STORMWATER MANAGEMENT PONDS AND ASSOCIATED CREEK WORKS

E7) It is recommended that ESC plans identify the timely stabilization/vegetation of stormwater management ponds and/or associated creek works as early in the site grading process as possible.

Recommendations for ESC process for Site Plans

CORRECTING NON-COMPLIANCE IN CA REGULATED AREAS

E8) It is recommended that the Province include Stop Work Order or Order to Comply powers through amendments to the Conservation Authorities Act or alternatively/preferably allow CAs the ability to issue Part 1 Certificate of Offence (tickets) for non-compliance of permit (ESC) conditions.

PRE-CONSULTATION

E9) It is recommended that prior to initiating engineering design require joint pre-consultation, by the applicant's engineer with the municipality and conservation authority, for preparing ESC plans in the municipal site plan application process and for CA applications.

PREPARATION OF ESC PLANS AND ON SITE INSPECTION

E10) It is recommended that municipalities and conservation authorities, through site plan agreements and CA permits, require applicants to provide notification when a project is to start and for large scale projects require regular ESC inspection reports be filed with the municipalities and CAs.

E11) It is recommended that the applicant be required to identify an on-site person who is designated responsible for the construction, maintenance and operation of ESC for each stage of construction.

Recommendations for ESC process for Infrastructure and Capital Projects

PRE-CONSULTATION

E12) It is recommended that municipal departmental pre-consultation with conservation authorities should occur as early as possible in the development of engineering plans for major municipal infrastructure and capital projects within CA regulated areas in order to allow collaboration in the development of ESC.

PHASING DESIGN OF ESC PLANS

E13) It is recommended that municipal and conservation authority infrastructure and capital project ESC plans identify specific measures to be employed during the three phases of construction: 1) removals, 2) construction/grading, and 3) site restoration.

TIMELY SITE RESTORATION

E14) It is recommended that municipalities and conservation authorities work together to phase site revegetation/restoration efforts on infrastructure and capital projects in order to reasonably reduce the length of time soil is exposed between construction/grading and site restoration phases of construction.

INSPECTION OF ESC MEASURES FOR MUNICIPAL INFRASTRUCTURE PROJECTS

E15) It is recommended that municipalities and conservation authorities identify processes of collaboration for the ongoing inspection of ESC requirements for infrastructure projects.

Recommendations for ESC process for Single Lot Applications

E16) It is recommended that for single lot applications, where no conservation authority approval is required, e.g. infills or demo/rebuilds, that municipalities seek a mechanism to require an approved grading plan complete with an ESC plan prior to issuance of a building permit.

E17) It is recommended that where applicable, require municipal grading inspectors inspect ESC works to ensure they are installed in accordance with the approved grading plan.

Recommendations for Education and Training

F1) It is recommended that municipalities and conservation authorities ensure that knowledge of ESC measures and application are translated across department offices and divisions through internal or joint training initiatives. Training for municipal and CA employees should be offered annually to account for staff turnover and sequential upgrades in learning. Employees meeting minimum prequalification requirements to become CPESC and/or CISEC certified are encouraged to take the examinations offered.

F2) It is recommended that consulting teams hired to prepare municipal tenders and contracts for infrastructure and capital projects be required to demonstrate proper knowledge, training and (preferably) certification in ESC practices.

F3) It is recommended that municipalities and conservation authorities work with the construction industry to promote and facilitate training workshops for private sector contractors and site supervisors in ESC.

F4) It is recommended that municipalities along with their respective conservation authorities develop a formal inspection process and reporting forms for ESC inspection.

F5) It is recommended that municipalities along with their respective conservation authorities prepare a user friendly brochure for citizens and small contractors to explain single lot ESC.

Recommendations for Updating and Coordinating ESC Guidelines

G1) It is recommended that the municipalities and conservation authorities encourage the Toronto and Region Conservation Authority to initiate an update to the *Erosion and Sediment Control Guideline for Urban Construction* (Greater Golden Horseshoe Area Conservation Authorities, 2006) document to ensure that it is current, accurate and comprehensive; and work from this updated document when preparing or reviewing ESC plans.

G2) It is recommended that the municipalities and conservation authorities work with the Ontario Provincial Standards (OPS) and Canadian Construction Documents Committee (CCDC) to further update the OPS and CCDC libraries to advance the status of ESC practice in the Province of Ontario.

G3) It is recommended that the municipalities and conservation authorities require consultants and contractors to follow the updated ESC guideline document in their submissions for development and infrastructure contracts once approved.

Recommendations for Contracting Tools to Improve ESC Performance in the Industry

FORM OF PAYMENT FOR ESC

H1) It is recommended that the municipalities and conservation authorities utilize unit prices for ESC contracted items in their infrastructure and capital projects to ensure that ESC measures are installed and maintained appropriately throughout their construction projects.

H2) It is recommended that the municipalities and conservation authorities encourage through their approval processes that private contracts for ESC items for developments are based on unit costs rather than lump sums.

SPECIAL CONTRACT PROVISIONS

H3) It is recommended that municipal and conservation authority contracts include special provisions to ensure that ESC measures are properly installed and maintained during all stages of construction projects.

H4) It is recommended that the Province consider the implementation of a procurement policy for all provincial contracts that include a provision that requires knowledge and/or training in ESC in active construction projects where there is potential for sediment and erosion control issues.

PRE-QUALIFICATION OF ESC CONTRACTORS

H5) It is recommended that the municipalities and conservation authorities be encouraged to begin a process, where applicable, of pre-qualifying contractors to ensure a basic level of ESC competence in ESC is achieved for future projects.

VENDOR MANAGEMENT SYSTEMS

H6) It is recommended that the municipalities and conservation authorities are encouraged to add ESC scoring to any existing contractor evaluation processes.

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ii) City of Hamilton Erosion and Sediment Control Process Audit

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A. Introduction

The delisting of Hamilton Harbour as an Area of Concern under the Great Lakes Water Quality Agreement between Canada and the United States requires that various water quality and natural habitat requirements are achieved for Hamilton Harbour (HH) and its associated coastal wetlands of Cootes Paradise and the mouth of the Grindstone Creek. With upgrades to the Harbour's wastewater treatment plants underway it is anticipated that by 2021 the main determinant of water quality in the Harbour will be runoff from its watersheds (Kim et al., 2014, Ramin et al., 2012, Gudimov et al., 2011). As the two major wetland complexes are located at the mouths of Spencer and Grindstone Creeks the effect of runoff is even more critical to restoring these areas. With this in mind, in April of 2013 the Bay Area Implementation Team (BAIT) hosted a day long watershed workshop to identify rural and urban runoff issues. Recommendations by participants highlighted the need for further work in: a) stormwater management and b) erosion and sediment control on active construction sites.

One of the actions included in the workshop report was the formation of a multi-agency senior staff advisory group. This group, Chaired by the Director of Hamilton Water, City of Hamilton was established in September 2014 and identified four task groups to be formed:

- Urban Runoff – Burlington
- Urban Runoff – Hamilton
- Sediment Control on Active Construction Sites
- Rural Runoff

The terms of reference (Appendix 1) directing the Task Groups identified the following terms of reference for this Task Group: auditing and better defining erosion and sediment control practice in Burlington and Hamilton; developing methods to measure sediment coming from construction sites; and making the Cootes Paradise watershed a priority for erosion and sediment control practice.

The following report represents the work of the Sediment Control On Active Construction Sites Task Group during 12 meetings from December 2014 through to August 2016. The participating members of the Task Group are listed in Appendix 2 with meeting summaries provided electronically in Appendix 6.

B. What Happens When It Rains?

The Task Group received a presentation from the Ontario Ministry of Environment and Climate Change (MOECC) a rigorous analysis of total phosphorus (TP) and sediment generated within the Hamilton Harbour Watershed based on a peer-reviewed published study (Long et al., 2014 and 2015). While the focus of the study was on phosphorus it showed a direct correlation between phosphorus and sediment.

This is because phosphorus is often bound to sediment. That being the case, as rates of sediment rise so do rates of TP (Wall et al.; 1996).

The MOECC study sampled 87 runoff events including rain, snowmelt, and base flows between July 2010 and May 2012. This spanned the relatively cold winter of 2010-11 and the mild winter of 2011-12. Sampling was carried out in 1 hour intervals over 24 hour periods for all events monitored in order to provide a realistic understanding of nutrient and sediment concentrations during the rising and falling limbs of runoff events (Figure 1).

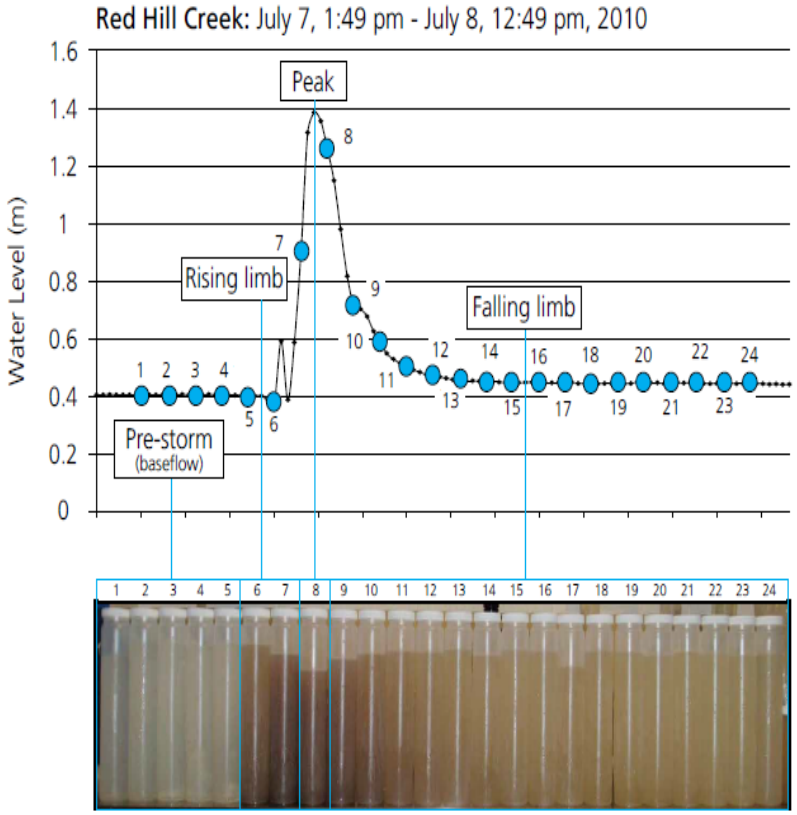

Figure 1: Example of results from the once per hour sampling over 24-hours of a storm on Red Hill Creek. Source: T. Long, MOECC

From the MOECC work the following general conclusions can be reached:

- The highest seasonal load of total phosphorus (TP) and sediment often occurs in the winter and spring freshet, falling into either the winter season or the spring season depending on snowpack melt (Figure 2)(*corresponding sediment graphs were not available*);
- Maximum loads of phosphorus are approximately 12 times greater than inputs from HH wastewater treatment plants (WWTPs). After WWTP upgrades are fully completed in 2021 the maximum phosphorus loads from creeks, with no improvements, could be as much as 20 times greater than wastewater effluent (Table 1);

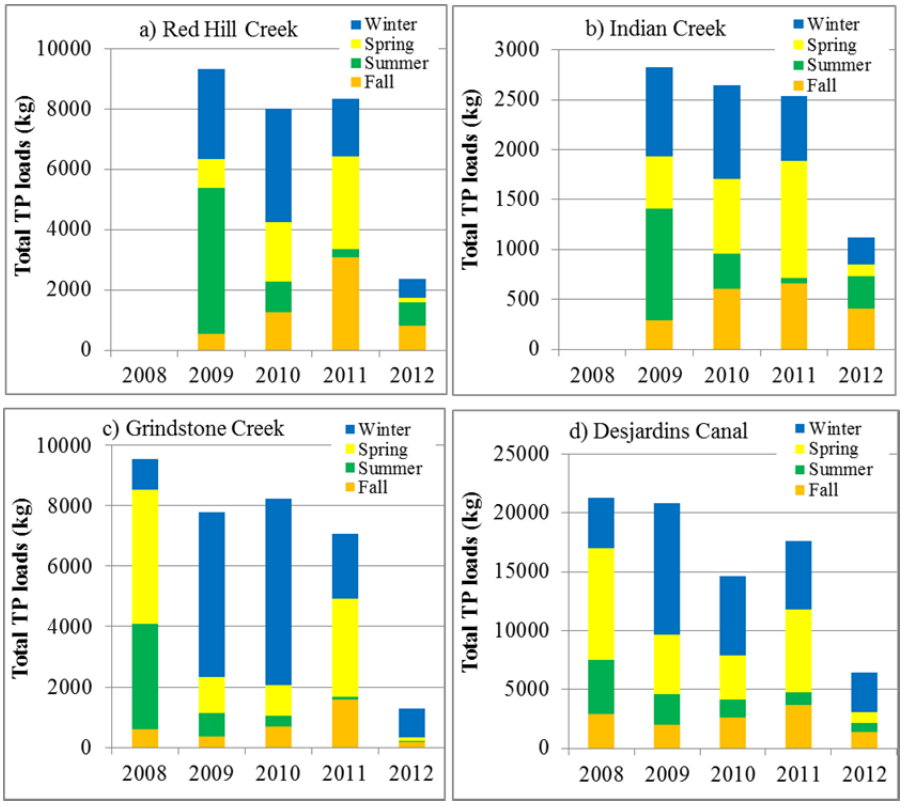

Figure 2: Largest seasonal phosphorus loads often occurs in winter and spring. Source: T. Long, MOECC

CREEKS	Min daily load (kg/d)	Max daily load (kg/d)	Event of maximum loading
Red Hill Creek	0.1	841	Sep 28-29, 2010 (54.8 mm)
Indian Creek	0.1	152	Nov 29-30, 2011 (40.2 mm)
Grindstone Creek	0.2	334	Mar 10-11, 2011 (22.1 mm + melt)
Desjardins Canal	1.8	704	Mar 11-12, 2011 (9.6 mm + melt)
Total	**2.2**	**2031**	

WWTPs	Skyway	Woodward + CSO	**Total**	**Max creek loads** (2031 kg/d) **relative to WWTP loads**
Current load (kg/d)	20	156	**176**	12 times greater
Final load (kg/d)	12	82	**94**	20 times greater

Table 1: Comparison of potential maximum daily loads from HH Creeks vs WWTPs. Source: T. Long, MOECC

In the past, phosphorus from combined sewer overflows (CSOs) and wastewater treatment plants (WWTPs) tended to mask the effect of phosphorus coming from creeks flowing into Hamilton Harbour. The upgrades to tertiary treatment will reduce levels of phosphorus and sediment in WWTP effluent to as low as technologically possible. Once upgrades to the Woodward WWTP are completed in 2021, for the first time in about 100 years the quality of water in Hamilton Harbour will be dictated by inflow from the watershed, both urban and rural, rather than the WWTPs that discharge to the Harbour.

It is important to understand, in general terms, how sediment from construction sites affects the Cootes Paradise marsh, the Grindstone Creek mouth, and Hamilton Harbour. A summer rain storm may exchange good water quality provided by base flow from Spencer Creek for highly turbid urban water. This can result in sediment covering aquatic plants and interfering with critical life cycles of marsh fish and wildlife.

Literature reviews generally identify between 10-200 times the sediment loads generated from active construction sites compared to natural levels of erosion (Trenouth, 2011; EPA, 2000; Harbor, 1999). In extreme examples this can reach 40,000 times predevelopment erosion rates (Harbor, 1999). Most active construction sites are associated with urban development and are serviced by a storm sewer system. The potential for generating runoff increases in urban areas because impervious conditions normally increase and once eroded, sediment is often more efficiently transmitted to a receiving stream by a storm sewer system (University of Wisconsin-Extension, 1997). This has the double effect of causing sediment from urban areas, normally sourced from construction sites to be transmitted to a receiving stream at a greater rate and more efficiently than from rural lands especially during the summer. Unfortunately, urban sediment in the summer is generated during the growing season when it can have a dramatic negative effect on a receiving water body. By comparison, the highest levels of total stream sediment generation is normally the winter and spring of the year often when rural runoff can have a more substantial impact. This is not to diminish the importance of reducing sediment generation in all seasons from active urban construction sites, but to highlight this particular compounding summer condition.

C. Watershed Nutrient and Sediment Targets

The total phosphorus water quality target measured within Hamilton Harbour (HH) at Centre Station is <20 µg/L. This target is set at a level required to prevent excessive algal blooms. This is also the MOECC guideline for lakes and represents a mesotrophic or “middle of the road” ecological water quality target.

Major upgrades to the WWTPs discharging to HH are presently being carried out by the Region of Halton and City of Hamilton. Effluent targets for the WWTPs were based on this Harbour target of <20 µg/L. Once WWTP upgrades are complete, the combination of WWTP effluent and creek base-flows is expected to allow < 20 µg/L phosphorus to be achieved in the Harbour (Kim et al., 2014, Ramin et al.,

2012, Gudimov et al., 2011). It must be remembered that the flow input to the Harbour is approximately 50% from WWTPs and 50% from the watershed. As a result, if the Harbour is at 20 µg/L under base flow conditions then watershed runoff events can create spikes in the Harbour TP levels leading to algal blooms. As mentioned previously TP increases positively with sediment as much of the TP is attached to sediment.

In a presentation provided by the Royal Botanical Gardens it was pointed out that the situation is amplified for the Cootes Paradise Marsh and mouth of the Grindstone Creek as they are more directly influenced by watershed runoff. The Cootes Grindstone Water Quality Targets Subcommittee is in the process of considering final targets of 30-50 µg/L phosphorus for these marshes down from initial targets of 60-70 µg/L to encourage a diverse marsh plant community. The upper tolerable concentration of suspended sediment identified for fish species is between 25-80 ppm (Birtwell, 1999) and 25 ppm is presently the preliminary level used as a maximum in Cootes Paradise. It should be recognized that this level is frequently greatly exceeded during runoff events, for example the maximum TSS for Cootes Paradise Marsh in 2013 was 97.6 ppm (Gillespie et al., 2014).

The Sediment Control on Active Construction Sites Task Group focused on providing recommendations for reducing sediment runoff from construction sites thereby reducing both total phosphorus and sediment concentrations and loadings.

D. How Do We Measure Effectiveness of Sediment Controls?

The effectiveness of erosion and sediment controls is tied back to the design, implementation and oversight of erosion and sediment control measures. Prior to development, an erosion and sediment control (ESC) plan is normally prepared which is intended to guide sediment control during the various phases of construction. There are few true quantitative methods to assess ESC performance (aside from water sampling upstream and downstream of controls) and the performance assessment is largely based on qualitative observation.

Special Issues

Soil Types

Different soil types may require different approaches and techniques for ESC on construction sites. Hamilton Harbour is surrounded by the Niagara Escarpment and this has a profound influence on soils and topography. In simple terms the downslopes of the Niagara Escarpment are shales and clays. Clay soils are sticky, small in size and shaped like saucers, so while they are difficult to erode, once in suspension they are very hard to settle or strain out of water. In Burlington, this is the case for lands draining into portions of the Indian Creek and within the Hager and Rambo Creek watersheds. In urban Hamilton, areas within the Red Hill, Chedoke, Spencer and Borers Creeks contain these predominantly clay soils below the Niagara Escarpment. Fortunately an area of

Hamilton and Burlington below the Niagara Escarpment is covered by the former bed of Glacial Lake Iroquois. Aldershot in Burlington and much of the downtown core of Hamilton is covered in sandy soil. This soil while easy to erode is also easier to settle and strain out of water. The lands above the Escarpment are typically a mixture of sandy and clay loams. So what does the difference in soil mean? It means different approaches to ESC may be required on these various soil types and topography.

Time of Year Effects

Summer water quality conditions are critical to the coastal wetlands of Cootes Paradise and the mouth of the Grindstone Creek as well as the rest of Hamilton Harbour. Summer is typically the busiest construction season but also the easiest to build. Freeze thaw in winter can make construction difficult and inactive construction sites are often not managed effectively over the winter and spring months. This creates problems for typical ESC practice. Climate change for its part can create more frequent intense storms which can overwhelm typical ESC. Often the approach taken to intense storms is to inspect and repair controls before and after significant events. Unfortunately these differences in time of year and intensity of storms are seldom recognized in ESCs.

E. Audits of Existing Erosion and Sediment Control Practice

At the outset, the efforts and work by the Task Group partners over the last 10-20 years in this area is acknowledged. Focus and importance on erosion and sediment control (ESC) continues to change with improvements in the understanding and practice of ESC throughout Ontario and North America. The recommendations within here are in most part an extension and improvement of work already being done.

The Cities of Hamilton and Burlington, Conservation Halton, and the Hamilton Conservation Authority carried out individual self-audits of their own erosion and sediment control performance as it related to various forms of permits and development applications under their jurisdiction. They reviewed the process they followed for ESC design, approval and on site implementation used for development applications. These four process audits/reviews are contained electronically in Appendix 6. Reviews were categorized into the following types of development: plans of subdivisions, site plans, infrastructure and capital projects, and single lot applications. A chart outlining which agencies are responsible for ESC within the HH watershed was developed for this report and can be found in Appendix 3.

The Region of Halton provided information on their process for construction management and in field supervision. This is contained electronically in Appendix 6.

In addition, the Task Group members referred to the 2016 "Lake Simcoe Region Conservation Authority Erosion and Sediment Control Research Study" and information provided on the Sustainable Technologies Evaluation Program (STEP) website www.sustainabletechnologies.ca .

a) Plans of Subdivisions

Plans of subdivisions represent the largest development types covering the greatest amount of land. Developers and their consultants are required to submit ESC designs as part of the municipal process for submitting plans. As per the Memorandum of Agreement/Understanding with municipal partners, Conservation Authorities take an active commenting role in ESC review for entire subdivision areas. Municipalities are to take the lead role. ESC deficiencies are often reported by CAs given that sediment eventually finds its way to receiving streams. It should be remembered that while all subdivisions eventually outlet to a receiving stream (except in the case of combined sewers in Hamilton) many may be up-line on the storm sewer system.

Both the CAs and the municipalities require that ESCs are prepared as part of the draft approval of any plans. The draft plan approval conditions then become enforceable through municipal agreements and any letters of credit held to secure commitments contained in the agreements. For direct storm water outlets or works within a creek system the CAs issue separate approvals under regulations that the CAs directly administer.

Approved ESC plans are monitored for compliance through the developer's consultant on a full time basis with spot checks by City inspectors and CA staff. Some of the municipal oversight of ESC measures is complaint based.

Review of ESC Process [Plans of Subdivisions]

The audits of plans of subdivisions from the Cities and the CAs identified the following issues and Task Group members crafted the associated recommendations for improvements.

- Preparation of ESC Plans and On Site Inspection
- Stabilizing and Vegetating Stormwater Management Ponds and Associated Creek Works
- Correcting Non-Compliance in CA Regulated Areas

Preparation of ESC Plans and On Site Inspection

Often one ESC plan is prepared for the typical three stages of construction on a site: grading, servicing, and building construction. While the first two stages have potential for regular inspection by the engineering consultant, the last stage is often only dealt with on a complaint basis, as the site is turned over to the home builders. It is the building stage which can generate a lot of poorly controlled sediment as various builders move in and out roads and around homes. As well, in this stage the applicants and consultants do not assign much time to on site supervision. The CAs and

municipalities advised that current staff resources do not allow for anything more than the occasional spot checks and consequently non-compliance is often encountered during the building stage of construction. The inspection and compliance process would also be more efficient if a specific individual responsible for ESC was designated by the applicant with whom the municipalities and CAs would have direct contact.

Stabilizing and Vegetating Stormwater Management Ponds and Associated Creek Works

A problem associated with stormwater management ponds and creek works on large developments is the timely stabilization of lands disturbed. Left exposed for extended periods these unvegetated areas, while intended to act as part of the ESC treatment train system, can become contributors of sediment themselves.

Correcting Non-Compliance in CA Regulated Areas

CA staff advised that compliance with permits to construct within CA regulated areas is difficult and cumbersome to enforce in a timely manner. While similar to municipalities, deficiencies when discovered are brought to the developer's attention. Unlike municipal subdivision, condominium and site plan agreements which allow the municipality to hire contractors to take corrective measures and pay for them from letters of credit, correcting continuing non-compliance requires a process of withdrawing approvals and laying charges under the Conservation Authorities Act. A more effective method for CAs to ensure compliance with ESC permit requirements would be the issuing of stop work orders or tickets by the CA for non-compliance of permit conditions. This would require the Province of Ontario to amend the Conservation Authorities Act to allow CAs these powers under CA regulations.

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Recommendations for ESC process for Plans of Subdivisions

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E7) It is recommended that ESC plans identify the timely stabilization/vegetation of stormwater management ponds and/or associated creek works as early in the site grading process as possible.

CORRECTING NON-COMPLIANCE IN CA REGULATED AREAS

E8) It is recommended that the Province include Stop Work Order or Order to Comply powers through amendments to the Conservation Authorities Act or alternatively/preferably allow CAs the ability to issue Part 1 Certificate of Offence (tickets) for non-compliance of permit (ESC) conditions.

b) Site Plans

Site plans involve individual lots and are frequently small to medium scale in scope; however, some site plans such as those associated with industrial development are large and complex involving significant time scales. The Cities of Hamilton and Burlington each have a process in place that requires developers to enter into site plan agreements. Each site plan presently requires an individual ESC which may or may not be integrated with surrounding ESCs depending on its context within an existing plan of subdivision for example. The Conservation Authorities are involved with review of an ESC if within a CA regulated area under their permitting process. The CAs may or may not be involved with site plans outside of regulated areas depending on the location and size of the site plan property and the municipal screening process.

Review of ESC Process [Site Plans]

The audits of site plans from the Cities and the CAs identified the following issues and Task Group members crafted the associated recommendations for improvements.

- Pre-Consultation
- Preparation of ESC Plans and On Site Inspection

Pre-Consultation

Consultation often takes place during the review of subdivision plans in cases where a site plan is directly tied to subdivision being actively developed. In the case of single isolated lots a plan may be developed independent of surrounding lands. Despite encouraging pre-consultation it has been the experience of the CAs that pre-consultation can vary significantly and may not occur at all prior to applications for permits within CA regulated areas. While CAs and municipalities encourage pre-consultation they also wish to avoid being too prescriptive in the approaches and techniques used within ESC plans.

Preparation of ESC Plans and On Site Inspection

As mentioned in the previous section, pre-consultation is important. In some cases however applications for site plans are prepared independent of subdivision pre-consultation and submitted in advance of the process particularly when attempting to process CA permits. It is important that coordination of activities within subdivisions occur for effective ESC rather than a rush to secure various permissions. When items are not coordinated the review period can increase as the reviewers spend more time in trying to determine coordination of ESC plans.

While inspection is required to be carried out under various municipal and CA agreements and permits, unfortunately, inspection is often not as rigorous for site plans especially those independent of subdivisions. This is because all levels of inspection can be limited by the time allocated to the site by the applicant's engineering consultant, municipal and CA staffs. Once again the process relies too heavily on complaints than proactive inspection.

Similar to subdivisions, the inspection and compliance process would also be more efficient if a specific individual responsible for ESC was designated by the applicant with whom the municipalities and CAs would have direct contact.

Recommendations for ESC process for Site Plans

PRE-CONSULTATION

E9) It is recommended that prior to initiating engineering design require joint pre-consultation, by the applicant's engineer with the municipality and conservation authority, for preparing ESC plans in the municipal site plan application process and for CA applications.

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E10) It is recommended that municipalities and conservation authorities, through site plan agreements and CA permits, require applicants to provide notification when a project is to start and for large scale projects require regular ESC inspection reports be filed with the municipalities and CAs.

E11) It is recommended that the applicant be required to identify an on-site person who is designated responsible for the construction, maintenance and operation of ESC for each stage of construction.

c) Infrastructure and Capital Projects

A large number of the public projects are infrastructure projects such as roads and stream crossings, watermains, sewers, and maintenance of municipal infrastructure.

Similar to the development process infrastructure projects fall into three phases of work namely: removals, construction/grading, and site restoration. ESC measures required for each phase should be adjusted to adapt to changing drainage patterns and temporary works to ensure that the ESC plan remains dynamic and effective. Of particular concern is the need to phase restoration to minimize the amount of exposed soil. Unique to watermain projects is the requirement to commission or "flush" mains and convey flushed water to a receiving sewer or watercourse.

Major capital projects often go through an environmental assessment and normally require a permit from the local CA if construction is within a regulated area or discharging to a regulated area. The process followed may or may not contain the following steps: pre-design consultation with the CA, submission of plans to CA for review and comment, issuing of CA permit, construction inspection and monitoring, site restoration. In the case of an environmental assessment the CA is circulated the EA and requested to provide comments.

Unlike development projects these infrastructure projects are contracted, overseen/supervised, and inspected directly by the municipalities and CAs for their own respective projects. CAs may make random inspections or respond to complaints.

If erosion and sediment control is to be enhanced on private developments then the municipalities and CAs should be seen to set an example of best practice for their own projects.

Review of ESC Process [Infrastructure and Capital Projects]

The audits of plans of infrastructure and capital projects from the Cities and the CAs identified the following issues and Task Group members crafted the associated recommendations for improvements.

- Pre-Consultation
- Phasing Design of ESC Plans
- Timely Site Restoration
- Inspection of ESC Measures for Municipal Infrastructure Projects

Pre-Consultation

Pre-consultation may vary from department to department as not all municipal project managers may be familiar with CA regulations or ESC requirements. In the case of the Region of Halton, while the Region is not responsible for overseeing new development it is responsible for Regional roads, watermains and sanitary sewers. As a result it has developed specialized inspection routines (Appendix 6) and has engaged directly with Conservation Halton to provide dedicated staff to review Environmental Assessments and permit applications under the CAs regulations for the Region of Halton infrastructure projects. This has allowed a close working relationship to evolve and improved coordination of design through to construction. Early and regular consultation and consistent staff members over the course of a project has improved communication levels, built effective relationships and increased review efficiencies.

Phasing Design of ESC Plans

Similar to private development, consultants employed by the Cities or those staff preparing in-house designs may not provide for ESC plans that take into account the three phases of construction.

Timely Site Restoration

Many projects leave site restoration to the very end of the project in order to avoid the landscaper from having to visit the site on numerous occasions. This can leave major areas open to erosion resulting in excessive off site sedimentation.

Inspection of ESC Measures for Municipal Infrastructure Projects

The protection of receiving streams from sedimentation is in the best interest of both the municipalities and the CAs. It is therefore in both parties interest to ensure that site installation and inspection of infrastructure projects ESC measures are functioning as required.

Recommendations for ESC process for Infrastructure and Capital Projects

PRE-CONSULTATION

E12) It is recommended that municipal departmental pre-consultation with conservation authorities should occur as early as possible in the development of engineering plans for major municipal infrastructure and capital projects within CA regulated areas in order to allow collaboration in the development of ESC.

PHASING DESIGN OF ESC PLANS

E13) It is recommended that municipal and conservation authority infrastructure and capital project ESC plans identify specific measures to be employed during the three phases of construction: 1) removals, 2) construction/grading, and 3) site restoration.

TIMELY SITE RESTORATION

E14) It is recommended that municipalities and conservation authorities work together to phase site revegetation/restoration efforts on infrastructure and capital projects in order to reasonably reduce the length of time soil is exposed between construction/grading and site restoration phases of construction.

INSPECTION OF ESC MEASURES FOR MUNICIPAL INFRASTRUCTURE PROJECTS

E15) It is recommended that municipalities and conservation authorities identify processes of collaboration for the ongoing inspection of ESC requirements for infrastructure projects.

d) Single Lot Applications

Single lot development or redevelopment not covered by subdivisions or site plans was considered by the Task Group. It is a growing area of development especially for demolition and reconstruction and it can generate sediment impacting sewers and receiving streams. These projects are subject to zoning bylaws, building permits, and a permit under CA regulations when within a CA regulated area. The municipalities have no set method to require detailed grading and/or ESC plans if not covered by active subdivision/site plan agreements or site alteration bylaw. Simple reconstruction applications submitted to building departments on existing single lots most often require a lot plan showing zoning requirements for the building, lot grading within 1 metre of the building and a notation that building grades will not be changed at the lot lines. In addition, building department staff, while experts with respect to the building code, have no training with respect to lot grading or ESC.

Within CA regulated areas the CAs will follow their normal requirements for ESC plans to be filed with any application under their regulations. Monitoring of ESCs is typically done by municipalities on a complaint basis. Many home owners and building contractors are simply not aware of ESCs and need assistance from municipal and CA staff in preparing plans. Unfortunately often plans are simply not implemented.

Recommendations for ESC process for Single Lot Applications

E16) It is recommended that for single lot applications, where no conservation authority approval is required, e.g. infills or demo/rebuilds, that municipalities seek a mechanism to require an approved grading plan complete with an ESC plan prior to issuance of a building permit.

E17) It is recommended that where applicable, require municipal grading inspectors inspect ESC works to ensure they are installed in accordance with the approved grading plan.

F. Education and Training

Erosion and Sediment Control (ESC) has evolved over the past 20 plus years and many new techniques and materials have become available to improve the performance of ESC. The Task Group felt that education and training is a key component to successful ESC on construction sites with two initiatives already underway.

1) The resources of the TRIECA Conference were recommended as a helpful a resource for training. It is a high quality, stormwater and erosion and sediment control conference held in the Toronto area each March. Task Group members were encouraged to attend in 2015 and 2016. Positive feedback on the value of the conference was reported back by those attending.
2) With the assistance of funding from the MOECC, a two-day Certified Inspector of Sediment and Erosion Control (CISEC) course was held locally for Task Group agencies in February 2016. The course consisted of training and an examination to become a. In total 43 people from the Task Group agencies took the course, 18 wrote the examination, and 11 of 18 passed for certification. Those attending the course found it worthwhile and all indicated they advanced their personal knowledge with respect to ESC. The CISEC course will be offered again during 2017 along with some funding support again received from MOECC. While the course was originally arranged for the Task Group agencies, principally public sector employees, it may be opened to the private sector if enrollment numbers allow in 2017.

   Other certification opportunities such as Certified Professional in Erosion and Sediment Control (CPESC) through the Erosion and Sediment Control Association of Canada are also available, but were not pursued yet by this Task Group.

Training appears to fall into two categories: 1) the design of ESC plans and 2) the inspection and on site modification of ESC works. Unfortunately, too often ESC plans are prepared by those who have not had specialized training. Most ESC plans that are prepared are reactive sediment control plans as they often do not include any preventative (proactive) erosion control measures (i.e. minimized areas of disturbance, protection of recently disturbed areas, etc.) One consultant's pet peeve echoed by many is that "sediment control fence is window dressing …. a best management practice that is grossly misapplied … and perceived as a magical barrier". If better ESC is to be practiced then there is a need for systemic improvement at all stages of design and construction and by all those involved. This requires education and training of both public and private sector employees engaged in ESC. It must be recognized that it will take time to raise the standard of practice across sectors and disciplines. With this in mind the following recommendations are set out.

NOTE: *In all the recommendations "municipalities" refers to the City of Hamilton, City of Burlington, and when applicable, the Regional Municipality of Halton; "conservation authorities" refers to the Hamilton Conservation Authority and Conservation Halton.*

Recommendations for Education and Training

F1) It is recommended that municipalities and conservation authorities ensure that knowledge of ESC measures and application are translated across department offices and divisions through internal or joint training initiatives. Training for municipal and CA employees should be offered annually to account for staff turnover and sequential upgrades in learning. Employees meeting minimum prequalification requirements to become CPESC and/or CISEC certified are encouraged to take the examinations offered.

F2) It is recommended that consulting teams hired to prepare municipal tenders and contracts for infrastructure and capital projects be required to demonstrate proper knowledge, training and (preferably) certification in ESC practices.

F3) It is recommended that municipalities and conservation authorities work with the construction industry to promote and facilitate training workshops for private sector contractors and site supervisors in ESC.

F4) It is recommended that municipalities along with their respective conservation authorities develop a formal inspection process and reporting forms for ESC inspection.

F5) It is recommended that municipalities along with their respective conservation authorities prepare a user friendly brochure for citizens and small contractors to explain single lot ESC.

G. Updating and Coordinating Erosion and Sediment Control Guidelines

Many ESC guidelines have been generated over the past 30 plus years. Presently the Hamilton Harbour municipalities and CAs utilize the following guidelines: *Erosion and Sediment Control Guideline for Urban Construction* (Greater Golden Horseshoe Area Conservation Authorities, December, 2006); *Environmental Guide for Erosion and Sediment Control During Construction of Highway Projects* (Ministry of Transportation, September 2015 version); and *Erosion and Sediment Control Inspection Guide* (TRCA, 2008). In addition, the vast majority of construction contracts rely on Ontario Provincial Standard (OPS) specifications, Canadian Construction Documents Committee (CCDC) specifications, or municipalities will produce their own specific specification. Some of these guidelines are now approximately 10 years old and may not reflect changes in approach, techniques and materials. In addition, the present evolution of stormwater management practice utilizing low impact development (LID) techniques, which are dependent on infiltration, has increased the need to practice very effective ESC on construction sites. Poor ESC practice can easily lead to rendering LID infrastructure ineffective. The Task Group has the following recommendations with respect to Erosion and Sediment Control Guideline documents and standard drawings.

NOTE: *In all the recommendations "municipalities" refers to the City of Hamilton, City of Burlington, and when applicable, the Regional Municipality of Halton; "conservation authorities" refers to the Hamilton Conservation Authority and Conservation Halton.*

Recommendations for Updating and Coordinating ESC Guidelines

G1) It is recommended that the municipalities and conservation authorities encourage the Toronto and Region Conservation Authority to initiate an update to the *Erosion and Sediment Control Guideline for Urban Construction* (Greater Golden Horseshoe Area Conservation Authorities, 2006) document to ensure that it is current, accurate and comprehensive; and work from the same document when preparing or reviewing ESC plans.

G2) It is recommended that the municipalities and conservation authorities work with the Ontario Provincial Standards (OPS) and Canadian Construction Documents Committee (CCDC) to further update the OPS and CCDC libraries to advance the status of ESC practice in the Province of Ontario.

G3) It is recommended that the municipalities and conservation authorities require consultants and contractors to follow the updated ESC guideline document in their submissions for development and infrastructure contracts once approved.

H. Contracting Tools to Improve ESC Performance in the Industry

Whether contracting is through the private sector or the public sector, improvements to ESC will be delivered by the contractors working on site. Plans can be improved and inspections become more rigorous, but it is the on-site contractor that really determines the effectiveness and efficiency of ESC. If we are to improve the conditions in Hamilton Harbour and most importantly the associated coastal wetlands contractors need to be provided the tools to do their best work. With this in mind, the Task Group identified the following areas of importance along with associated recommendations.

- Form of Payment for ESC
- Special Contract Provisions
- Pre-Qualification of ESC Contractors
- Vendor Management Systems

Form of Payment for ESC

Ensuring on going performance of ESCs often requires that modifications are made to ESCs in the field. ESC after all is not just design and construction but is an ongoing on site "practice". Often ESC measures are defined in contracts as lump sums in contracts. This ignores the "practice" to ensure

ongoing effectiveness and efficiency of the ESC measures. When funds run out under the lump sum category the contractor is reluctant to implement changes or reinstate damaged ESC measures. It should also be remembered that ESC performance on construction site is directly related to runoff events and contractors shouldn't be expected to anticipate the weather. The Task Group felt the preferred method for ensuring competent ESC practice is payment of ESC items by unit costs within contracts whether they be private or public sector. Of course there is no control over private sector contracting but this can be encouraged.

Special Contract Provisions

Special provisions in contracts can be used to define work or procedures not covered in the standard specifications or to supplement or modify items in the standard specifications. Special provisions can also be used to encourage good performance by a contractor or discourage apathy in installing and maintaining ESC components. Municipalities may for example utilize special provisions in the form of a penalty when a road under construction does not have a clear traffic route through it during rush hour. The carrot and stick approach should be utilized to the benefit of the environment and the contractor because a significant public resource and investment is at stake, namely Hamilton Harbour.

Pre-Qualification of ESC Contractors

As training of consultants and contractors takes place contracting should provide an incentive for contractors competent in ESC practice to be recognized in the awarding of contracts. This is already done for specialties in other areas of public contracting.

Vendor Management Systems

In order to reward excellence in ESC practice and discourage poor performance existing contractor evaluation processes should be expanded to include ESC evaluations. Those contractors that score poorly are put in a probationary category until they show they have improved their competency through training or qualifications and those that have scored highly are noted as preferred.

NOTE: *In all the recommendations "municipalities" refers to the City of Hamilton, City of Burlington, and when applicable, the Regional Municipality of Halton; "conservation authorities" refers to the Hamilton Conservation Authority and Conservation Halton.*

Recommendations for Contracting Tools to Improve ESC Performance in the Industry

FORM OF PAYMENT FOR ESC

H1) It is recommended that the municipalities and conservation authorities utilize unit prices for ESC contracted items in their infrastructure and capital projects to ensure that ESC measures are installed and maintained appropriately throughout their construction projects.

H2) It is recommended that the municipalities and conservation authorities encourage through their approval processes that private contracts for ESC items for developments are based on unit costs rather than lump sums.

SPECIAL CONTRACT PROVISIONS

H3) It is recommended that municipal and conservation authority contracts include special provisions to ensure that ESC measures are properly installed and maintained during all stages of construction projects.

H4) It is recommended that the Province consider the implementation of a procurement policy for all provincial contracts that include a provision that requires knowledge and/or training in ESC in active construction projects where there is potential for sediment and erosion control issues.

PRE-QUALIFICATION OF ESC CONTRACTORS

H5) It is recommended that the municipalities and conservation authorities be encouraged to begin a process, where applicable, of pre-qualifying contractors to ensure a basic level of ESC competence in ESC is achieved for future projects.

VENDOR MANAGEMENT SYSTEMS

H6) It is recommended that the municipalities and conservation authorities are encouraged to add ESC scoring to any existing contractor evaluation processes.

Appendix 1: Terms of Reference for Task Group *(dated November 5, 2014)*

TERMS OF REFERENCE AND TASK GROUPS

Watershed Nutrient & Sediment Management Advisory Group (WNSMAG)

It is recognized that reductions in nutrients (principally phosphorus) and sediment concentrations and loads during runoff events from urban and rural watersheds are required to meet Hamilton Harbour Remedial Action Plan (HHRAP) environmental conditions to delist the Harbour as an Area of Concern.

Reporting to the Bay Area Implementation Team (BAIT) the WNSMAG will be developed from the attached list of agencies and groups.

WNSMAG will meet two to three times per year to share information and educate its members, analyze existing conditions and prepare recommendations for actions.

WNSMAG will be composed of senior staff who will direct various task groups to address:

- sedimentation from active construction sites
- urban watersheds and
- rural watersheds

Staff will be assigned to the task groups by the senior staff participants of WNSMAG.

In carrying out their work the groups will recognize the implications of climate change and coordinate, whenever possible, actions to reduce flooding with those actions reducing phosphorus and sediments.

All group members should work in an environment of mutual respect, mutual dependence and adaptive management. Their work should be action-oriented resulting in both short-term and long-term action plans.

Task groups may be established as per the wishes of the WNSMAG as set out below. This includes the option of establishing task groups based on municipal jurisdictions, e.g. an Urban Runoff Task Group for Hamilton and an Urban Task Group for Burlington, etc.

A. Sediment Control on Active Construction Sites Task Group

- audit and better define the existing erosion and sediment control practice utilized in Burlington and Hamilton for public and private sector projects
- develop methods to measure sediment coming from construction sites – need to measure to manage approach
- implement a priority project of ongoing inspection, reporting and enforcement of erosion and sediment control for development sites for the Cootes Paradise watershed

B. Urban Runoff Task Group for Nutrient and Sediment Management

Share information and develop a common understanding of our current knowledge with respect to:

- existing nutrient (phosphorus) and sediment concentrations occurring during runoff events;
- nutrient and sediment targets required to restore Hamilton Harbour and its coastal wetlands;
- existing best management practices in Hamilton Harbour's urban watersheds used to reduce nutrient and sediment discharges;
- potential additional pathways for nutrients to find their way to sewers and watercourses; and
- existing maintenance activities and their effectiveness for reducing nutrients and sediment from the urban storm-water management (SWM) system.

Analyse the Situation to Determine:

- how new practices in SWM and low impact development (LID) may be applied to reduce nutrient and sediment discharges for new development;
- where opportunities may exist to retrofit the SWM system to reduce nutrients and sediment for existing development ;
- where reductions can occur for private properties (homes, commercial, institutional and industries).

Prepare Recommendations for:

- existing maintenance activities to reduce nutrients and sediment from the urban SWM system;
- new development practices in SWM and LID to reduce nutrient and sediment discharges;
- existing development to retrofit the SWM system to reduce nutrients and sediment discharges;
- private properties (homes, commercial, institutional and industries) on how reductions may be implemented effectively and/or enforced.

C. Rural Runoff Task Group for Nutrient and Sediment Management

Share information and develop a common understanding of our current knowledge with respect to:

- existing nutrient and sediment concentrations occurring during runoff events;
- nutrient and sediment targets required to restore Hamilton Harbour and its coastal wetlands;
- existing maintenance activities and their effectiveness for reducing nutrients and sediment from rural roads;
- existing rural land uses and their potential to discharge nutrients and sediments.

Analyse the Situation to Determine:

- where reductions in nutrients and sediment may occur for the rural roads system;
- where reductions in nutrients and sediment may occur for agricultural/rural lands.

Prepare Recommendations for:

- reducing nutrients and sediments from the rural roads system;
- reducing nutrients and sediment from agricultural/rural lands.

Appendix 2: Task Group Participating Membership *(as of Aug 2016)*

Bay Area Restoration Council (BARC)	Chris McLaughlin
City of Burlington (CofB)	Tom Kilgour Tom Redmond
City of Hamilton (CofH)	John Morgante Ed VanderWindt Marco Oddi Wes Kindree
Conservation Halton	Cory Harris
Hamilton Industrial Environmental Association (HIEA)	Karen Logan
Hamilton Conservation Authority	Darren Kenny *[Chair]*
Hamilton Harbour Remedial Action Plan	John Hall Kristin O'Connor
Ontario Ministry of the Environment and Climate Change	Cheriene Vieira
Region of Halton (RofH)	Bob Zawislak

Other key participants with various levels of participation over the length of the Task Group included: Bob Wicklund (RofH), Jeff Pidsadny (CofH), Jerry Parisotto (CofH), Kathy Smith (CofH), Laud Matos (Environment and Climate Change Canada), Scott Hamilton (CoB), Suzanne Mammel (Hamilton Halton Homebuilders' Association), Wayne Song (CofH)

Other Agencies invited to participate and included in all emails about Task Group: Environment Hamilton, Fisheries and Oceans Canada, Royal Botanical Gardens

Appendix 3: Chart of Responsibilities for Each Agency

Issue/Concern		Conservation Authority	Local Municipality	Region
Plan of Subdivision	Clearing and Earthworks		X	
	Servicing to base asphalt		X	
	Watercourse works and pond outfalls	X	X	
	Home construction		X	
	Final landscaping		X	
Site Plan	Clearing and Earthworks		X	
	Servicing		X	
	Stormwater Outfalls	X	X	
	Building construction		X	
	Final landscaping		X	
Single Residential Lots	Building permits, pool permits, etc.		X	
	Site Alteration Permits		X	
Capital and Infrastructure Projects	Municipal Road Construction		X	
	Municipal Parks		X	
	Creek Works	X	X	
	Regional Road Construction			X
	Watermain Installation		X	X
	Watermain Commissioning		X	X
	Sanitary Sewer Installation		X	X

Appendix 4: References *(Organized by chapter headings)*

A. Introduction

Hamilton Harbour Watershed Runoff Workshop – April 24, 2013. Breakout Group Topics 1-20. *Available through the HHRAP Office.*

B. What Happens When It Rains?

EPA. 2000 National Water Quality Inventory Report to Congress. https://www.epa.gov/waterdata/2000-national-water-quality-inventory-report-congress

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Wall, G.J., Bos, A.W., Marshall, A.H. 1996. The relationship between phosphorus and suspended sediment loads in Ontario watersheds. *Journal of Soil and Water Conservation. 51 (6): 504-507.*

C. What are the Hamilton Harbour Targets?

Birtwell, I.K. 1999. The effects of sediment on fish and their habitat. Canadian Stock Assessment Secretariat Research Document 99/139. http://www.dfo-mpo.gc.ca/Library/240698.pdf

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Ramin, M., Labencki, T., Boyd, D., Trolle, D., Arhonditsis, G.B., 2012. A Bayesian synthesis of predications from different models for setting water quality criteria. Ecol. Model. 242: 127-145.

D. How Do We Measure Effectiveness of Controls?

None

E. Audits of Existing Erosion and Sediment Control Practice

Golder Associates Ltd. 2016. Lake Simcoe Region Conservation Authority Erosion and Sediment Control Research Study http://www.lsrca.on.ca/Shared%20Documents/reports/erosion-sediment-control-study.pdf

STEP. Sustainable Technologies Evaluation Program. www.sustainabletechnologies.ca

F. Education and Training

TRIECA Conference http://trieca.com/

CISEC Training – Certified Inspector of Sediment and Erosion Control. https://www.thelivingcitycampus.com/workshops/professional-workshops

CPESC – Certified Professional in Erosion and Sediment Control http://www.escac.ca/cpesc

G. Updating and Coordinating Erosion and Sediment Control Guidelines

Greater Golden Horseshoe Area Conservation Authorities. December 2006. Erosion and Sediment Control Guideline for Urban Construction. http://www.sustainabletechnologies.ca/wp/home/erosion-and-sediment-control/

Ministry of Transportation. September 2015. Environmental Guide for Erosion and Sediment Control During Construction of Highway Projects. http://www.raqsb.mto.gov.on.ca/techpubs/eps.nsf/0/591e3e7b3ebba00285257f5b00510664/$FILE/MTO%20Erosion%20and%20Sediment%20Control%20Guide%202015%20Final%20ACC.pdf

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Appendix 5: Acronyms

BAIT	Bay Area Restoration Council
CA	conservation authority
CCDC	Canadian Construction Documents Committee
CISEC	Certified Inspector of Sediment and Erosion Control
CPESC	Certified Professional in Erosion and Sediment Control
CSO	combined sewer overflow
ESC	erosion and sediment control
HH	Hamilton Harbour
HHRAP	Hamilton Harbour Remedial Action Plan
LID	low impact development
MOECC	Ministry of Environment and Climate Change
OPS	Ontario Provincial Standards
ppm	parts per million *(mg/L equivalent)*
RBG	Royal Botanical Gardens
STEP	sustainable technologies evaluation program
TP	total phosphorus
TRCA	Toronto and Region Conservation Authority
WNSMAG	Watershed Nutrient & Sediment Management Advisory Group
WWTP	wastewater treatment plant