February 16, 2021

Andrea Dear
Planning and Economic Development Department
Development Planning, Heritage and Design – Urban Team
71 Main Street West, 5th Floor
Hamilton, ON L8P 4Y5

Maureen Wilson
Councillor Ward 1
71 Main Street West, 2nd Floor
Hamilton, ON L8P 4Y5

Dear Ms. Dear and Ms. Wilson:

RE: UHOPA-20-012 and ZAC20-016
1107 Main Street West, Hamilton (Ward) 1
Objections to three-level underground parking garage
Inconsistency with PPS and lack of conformity to Growth Plan GGH and UHOP
Chedoke Creek Valley System subwatershed and the detrimental impact on neighbouring residences and properties, and the forested slope of the CCVS

We, the undersigned residents in the immediate vicinity of the subject site, strongly object to the proposed development. Although there are many valid reasons for requesting that the two above captioned applications be denied, the specific concerns raised in this objection letter relate to the three-level underground parking garage and the detrimental impact that it will have on the neighbouring properties, the Chedoke Creek Valley System subwatershed, and the forested slope that separates the residences from the general open space and Provincial Highway 403.

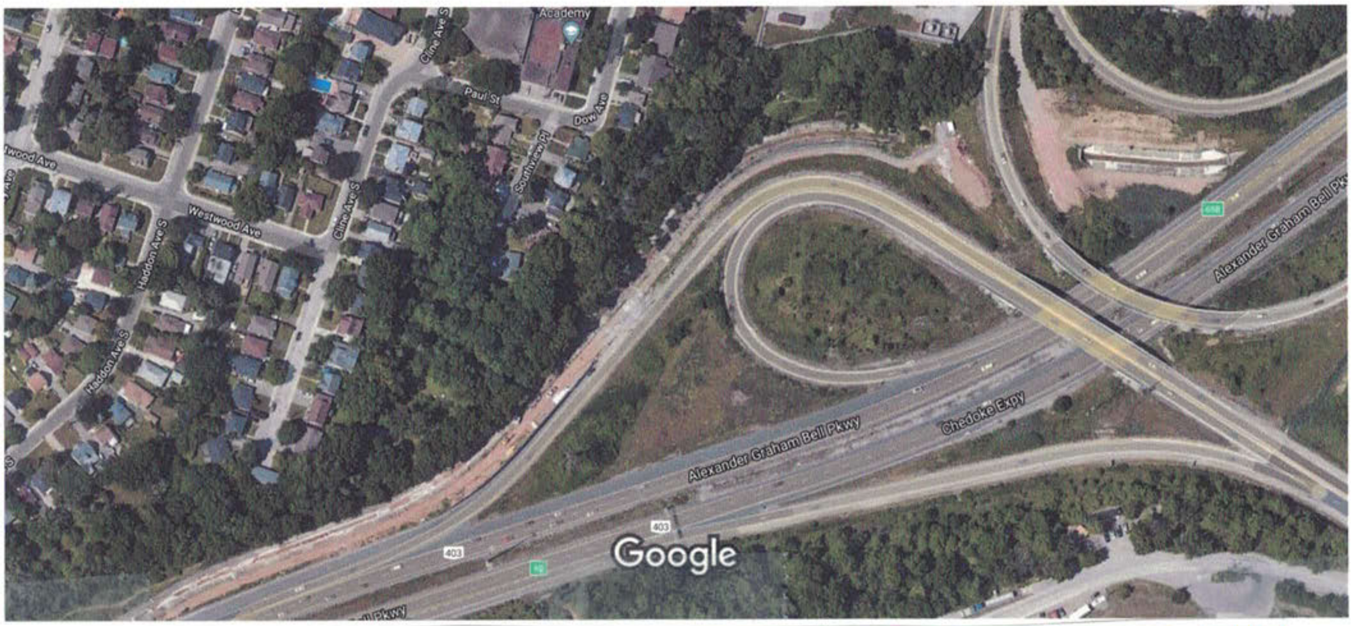
A) LANDS IMMEDIATELY TO THE SOUTH OF THE SUBJECT SITE

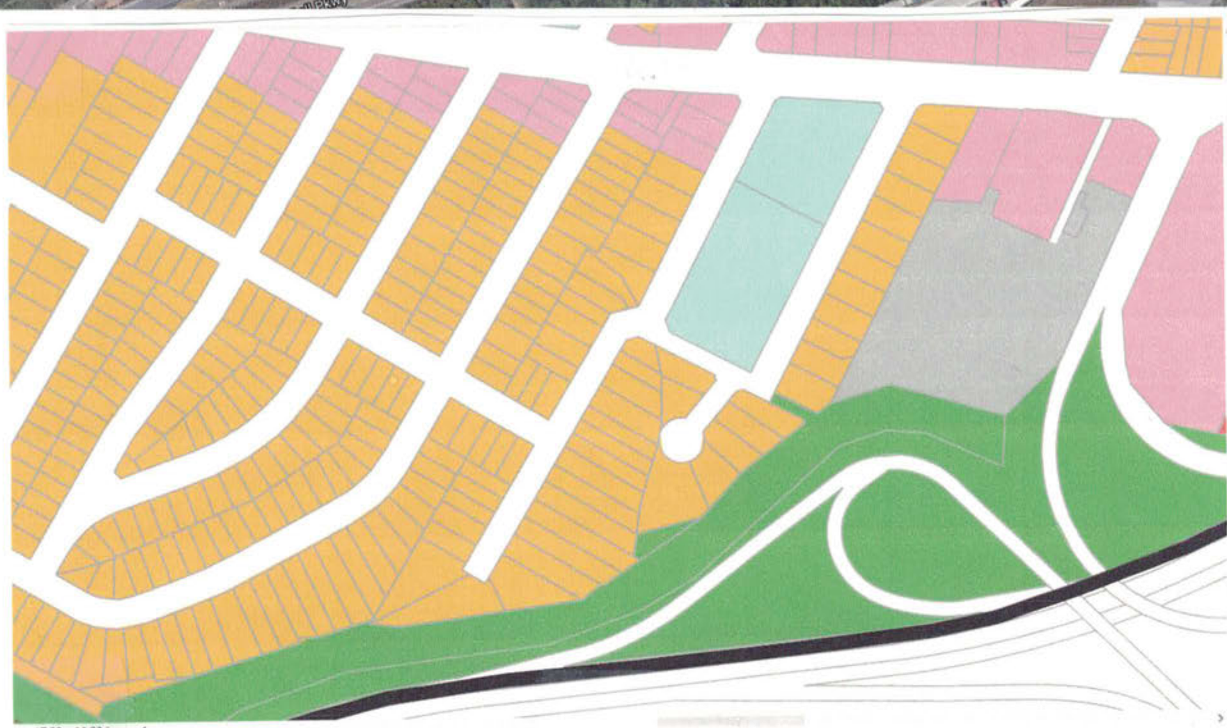
Although the Planning Rationale submitted by the Applicant went to great lengths to give an expansive description of the lands to the north, east and west of the subject site, and cited proposed developments often several thousand metres away, the description set out in the Planning Rationale for the lands to the "south" totally omitted the lands lying within 200 metres of the site and which are designated as "general open space" (Neighbourhood map) and "forest" HCA Chedoke Subwatershed map), as well as ignoring the Chedoke Creek, which are both situated between the residential properties and Hwy 403.

The description of these lands lying to the south, in comparison to the lands to the east, west and north of the subject site, can be visually appreciated in the following maps and pictures:

1) The Ainslie Wood Westdale Land Use Plan from 2015;
2) The Site Location Map prepared by GHD in the Transportation Study;

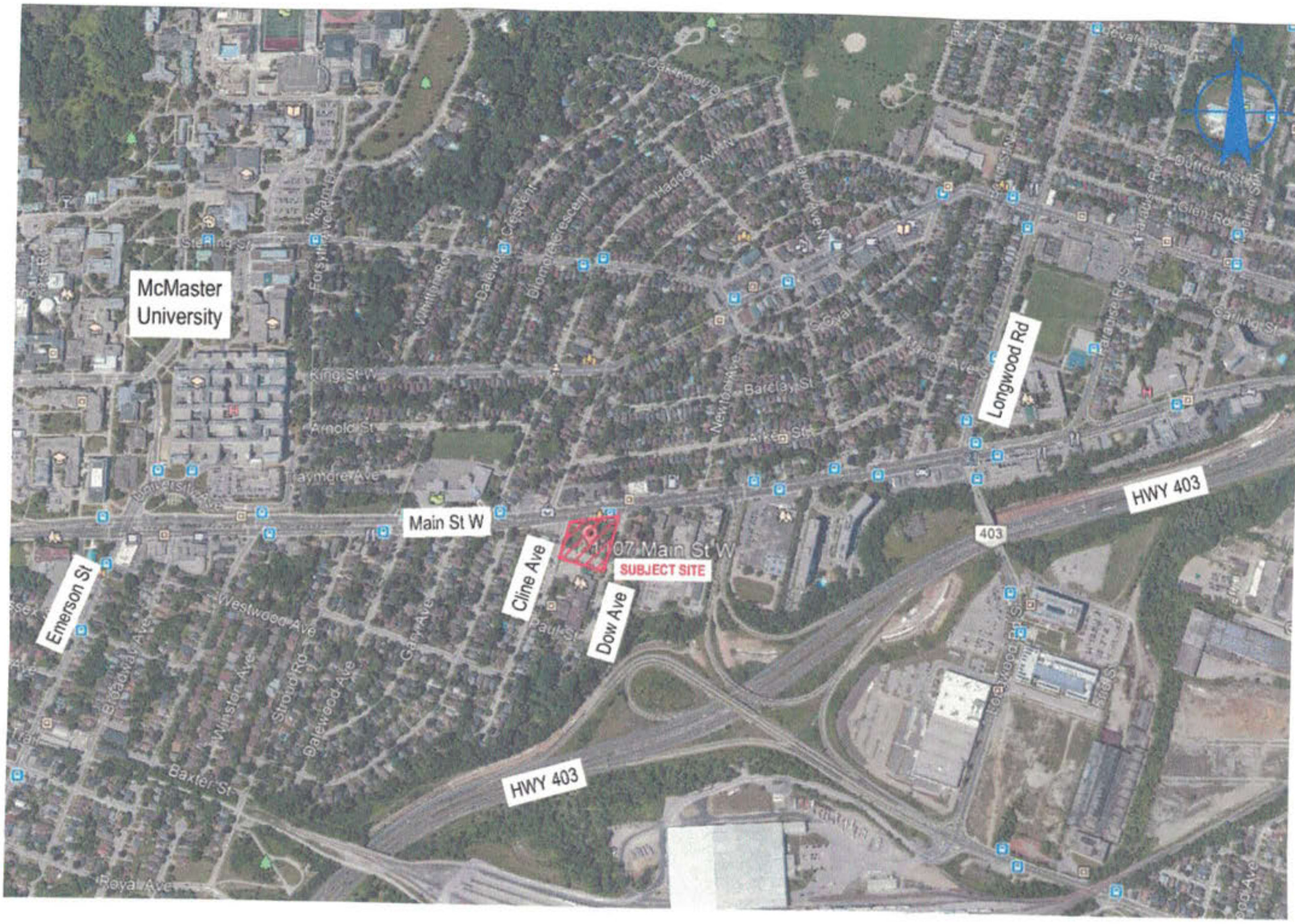
Google Maps

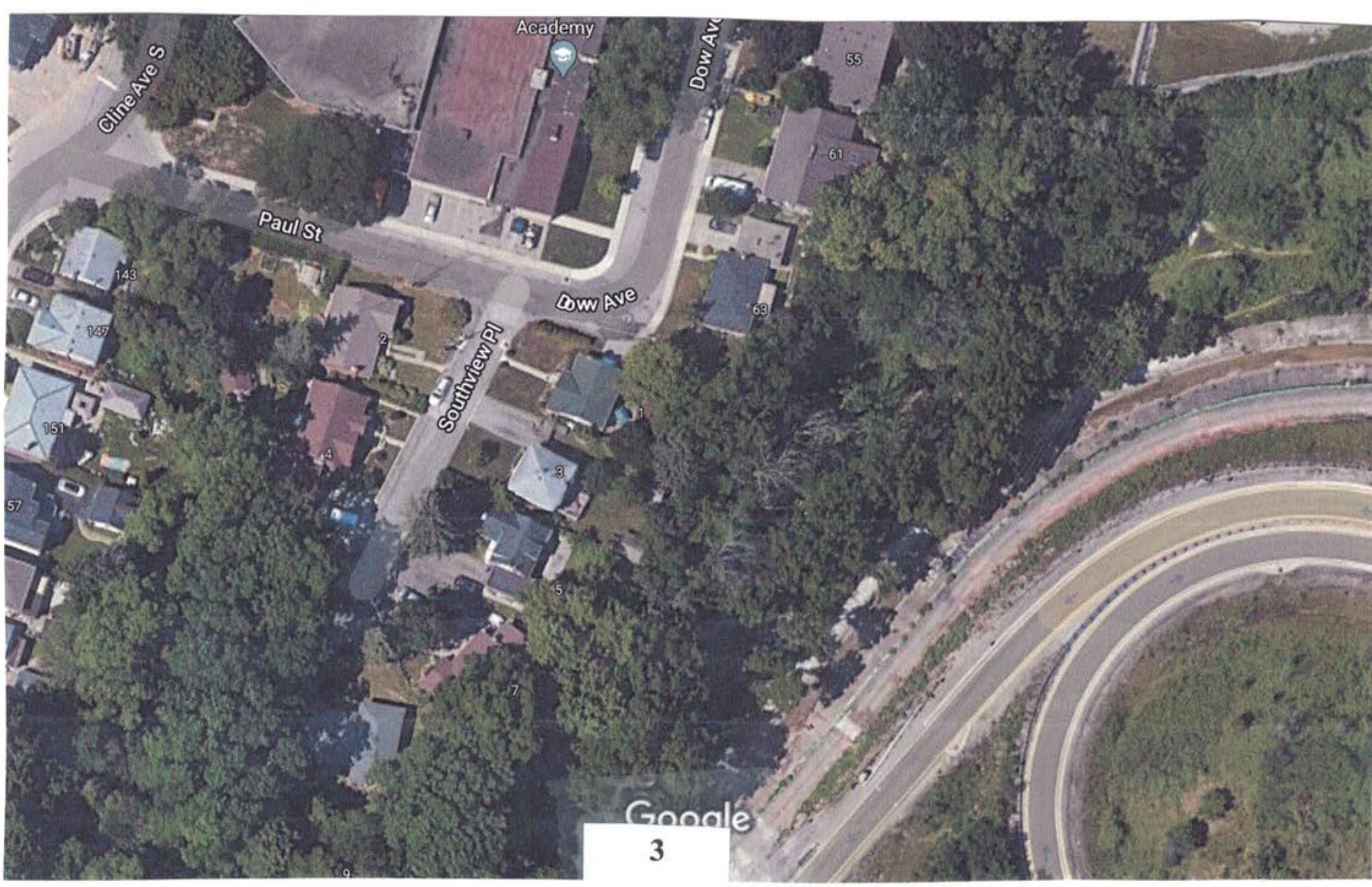




Parks and Open Space Designations

- Parkette
- Neighbourhood Park
- Community Park
- General Open Space
- Natural Open Space


McMaster University
Main St W
Cline Ave
Dow Ave
SUBJECT SITE
Longwood Rd
HWY 403
403
HWY 403
Emerson St


Academy
Cline Ave S
Dow Ave
Paul St
Dow Ave
Southview Pl
Google

3) Google Satellite Map with Hwy 403;
4) Google Satellite May with close-up of the forest canopy on Dow Avenue, Southview Place and Cline Avenue South;
5) Map CH-9: Chedoke East Catchment of the Chedoke Creek Subwatershed as prepared by Hamilton Conservation Authority.

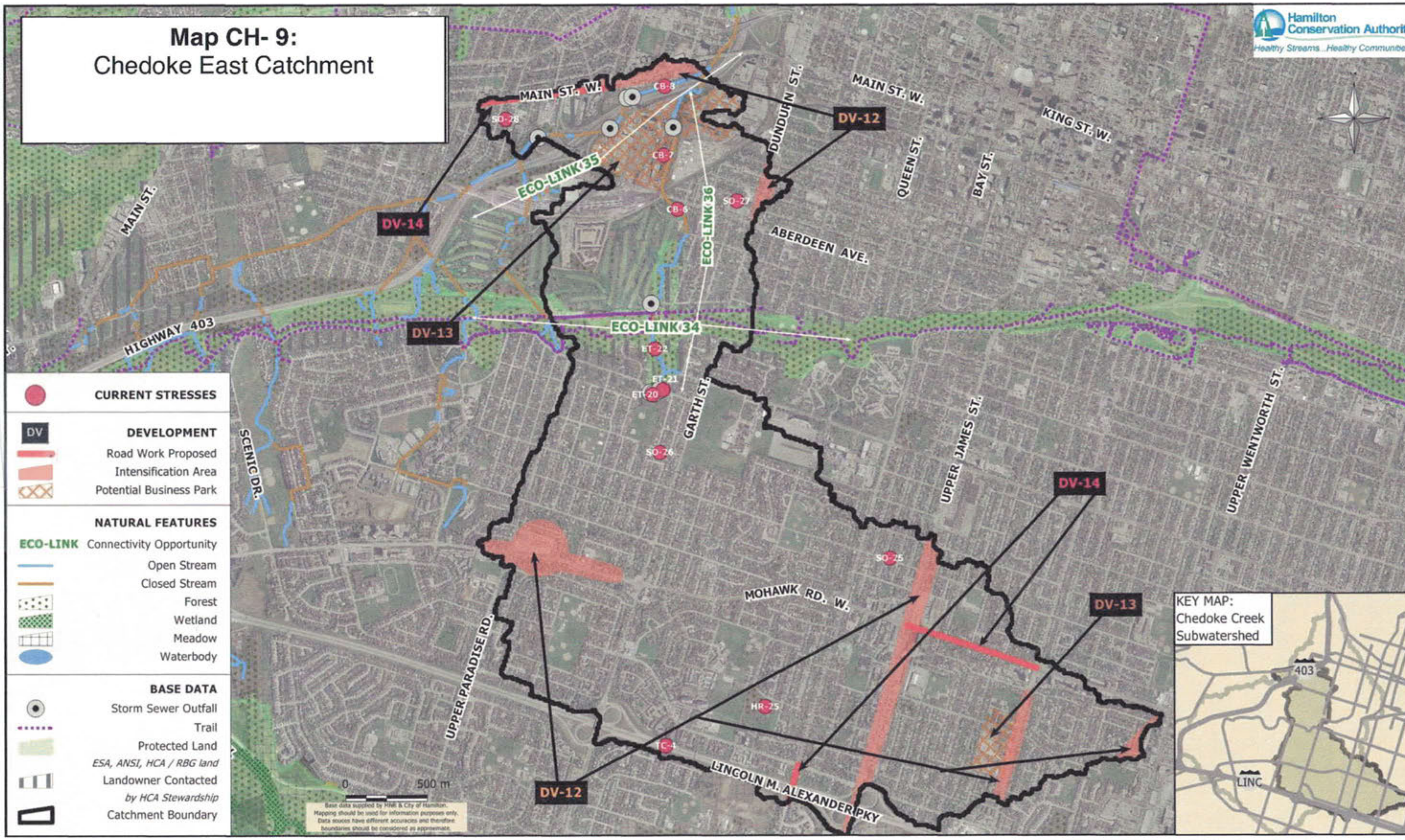
From these maps one can ascertain the valuable role the forested canopy of these lands has in the aesthetic beauty of the neighbourhood. But most importantly this natural landscape feature serves as a barrier in three distinct capacities, a visual barrier blocking the view of Hwy 403 from the neighbourhood, a noise barrier reducing the noise and decibel levels from the truck and motor vehicle traffic on Hwy 403, and; an air pollution abatement barrier absorbing by deposition some of the harmful vehicle emissions from Hwy 403.

B) CHEDOKE CREEK VALLEY SYSTEM SUBWATERHED AND STRESSORS

The Chedoke Creek watershed is 25.1 square kms in area and the portion in which the subject site lies is the Chedoke East Catchment as set out in Map CH-9. According to the Hamilton Conservation Authority guideline comparison of the Chedoke Creek watershed to Environment Canada' 'How much Habitat is Enough' Guidelines for three landscape features, the Chedoke Creek subwatershed only has 0.02% Wetland when the Guideline suggests 6%; only has 9.6% Forest when the Guideline suggests 30%; and has 76% Impervious Surface when the Guideline suggest no higher than 10% impervious surface.

In addition, the Chedoke Creek Watershed contains three areas designated by the City of Hamilton as Environmentally Significant Area (ESAs), these being Iroquoia Heights Conservation Area, Hamilton Escarpment, and Cootes Paradise. It also is the home of significant species in the natural areas of the watershed according to HCA, such as the Butternut tree, Cooper's Hawk, Monarch and Northern Ribbon Snake.

The Hamilton Conservation Authority as part of its stewardship plan to protect habitat, and to improve the health of the Chedoke Creek Watershed identified 15 Stressors, three of which are considered Dominant Stresses, the other 12 being considered Associated Stresses, in the various sections of the subwatershed and also recommended some general guidelines applicable to the entire area. These include such matters as: maintaining the natural features on a property; planting native trees, shrubs and herbaceous plants in front, rear and side yards; disconnecting downspouts that direct water into the storm sever and instead directing them to yards and gardens; collection of rain water in rain barrels to use for watering gardens; alternative driveway design to reduce the amount of impermeable driveway surface; applying the Yellow Fish Road to all catchbasins and the Stream of Dreams program to increase awareness regarding stormwater input and the impacts of CSO outfalls on stream systems; reducing the use of road salt and implementing a road salt management plan, and; *enhancing groundwater recharge by ensuring that **70%** of all land, post construction must remain pervious as a condition for development application approval.*


Map CH- 9:
Chedoke East Catchment
Hamilton Conservation Authority
Healthy Streams...Healthy Communities
MAIN ST. W.
KING ST. W.
QUEEN ST.
BAY ST.
DUNDURN ST.
ABERDEEN AVE.
GARTH ST.
UPPER JAMES ST.
UPPER WENTWORTH ST.
MOHAWK RD. W.
UPPER PARADISE RD.
LINCOLN M. ALEXANDER PKY
SCENIC DR.
HIGHWAY 403
MAIN ST.
ECO-LINK 34
ECO-LINK 35
ECO-LINK 36
DV-12
DV-13
DV-14
SO-28
CB-8
CB-7
CB-6
SO-27
ET-22
ET-21
ET-20
SO-26
SO-25
HR-25
TC-4
CURRENT STRESSES
DEVELOPMENT
DV
Road Work Proposed
Intensification Area
Potential Business Park
NATURAL FEATURES
ECO-LINK Connectivity Opportunity
Open Stream
Closed Stream
Forest
Wetland
Meadow
Waterbody
BASE DATA
Storm Sewer Outfall
Trail
Protected Land
ESA, ANSI, HCA / RBG land
Landowner Contacted
by HCA Stewardship
Catchment Boundary
0
500 m
KEY MAP:
Chedoke Creek
Subwatershed
403
LINC

CHEDOKE EAST DATA SHEET

SITE-LEVELSTRESSES

FUTURE STRESSES	DESCRIPTION	STEWARDSHIP ACTIONS		
		AWARENESS OPPORTUNITY	SPECIAL STUDY OPPORTUNITY	RESTORATION OPPORTUNITY
DV-12	Intensification Areas	☑	☑	☑
DV-13	Proposed Business Parks	☑	☑	☑
DV-14	Road Work Proposed – improvements	☑		

CURRENT STRESSES	DESCRIPTION	PUBLIC LAND	PRIVATE LAND	STEWARDSHIP ACTIONS			DFO COMP PROJECT POTENTIAL	DEMO SITE POTENTIAL
				AWARENESS OPPORTUNITY	SPECIAL STUDY OPPORTUNITY	RESTORATION OPPORTUNITY		
CB-6	Buried stream	☑		☑		☑	☑	☑
CB-7	Buried stream		☑	☑		☑	☑	
CB-8	Channelized stream	☑		☑		☑	☑	☑
ET-20	Ecotourism at Chedoke Falls	☑		☑	☑	☑		☑
ET-21	Ecotourism at Denlow Falls	☑		☑				☑
ET-22	Ecotourism at Lower Chedoke Falls	☑		☑	☑	☑		☑
HR-25	Habitat fragmentation – loss of forest cover	☑		☑		☑		☑
SO-25	Combined sewer system		☑	☑		☑		
SO-26	Storm sewers	☑		☑		☑		☑
SO-27	Combined sewer system		☑	☑		☑		
SO-28	Combined sewer system		☑	☑		☑		
TC-4	Water contamination from Lincoln Alexander Parkway	☑		☑		☑		☑

The specific future and current Dominant Stressors for the vicinity immediately surrounding the subject site as identified by HCA on the Chedoke East subwatershed map are listed as DV-14, (Development DV) being Road Work Proposed -Improvements on Main Street West, and SO-28, (Storm Sewer Outfalls (SO) being an Associate Stress from the Dominant Street Detachment from Nature (DT) which in the case of Chedoke East subwatershed is identified as the Combined Sewer System. (see attached Chedoke East Date Sheet CH-51 prepared by HCA)

C) EXISTING PROBLEMS WITH STORM SEWER/COMBINED SEWER WITHIN THE NEIGHBOURHOOD

Within the last few years there have been severe basement flooding and raw sewage backflows into basements on Dow Avenue, Southview Place and Cline Avenue South due to cross connections between the storm and sanitary sewers. More specifically, within the last 6 months there have been major basement flooding issues for a number of properties within 120 metres of the subject site.

These problems are ongoing, and in fact many of these very complaints that related to the inadequate stormwater and sanitary sewer infrastructure in the neighbourhood, were raised directly with the Applicant at the Virtual Community Meeting held on August 11, 2020. These infrastructure issues, and the amount of stormwater flow, however, remain to be resolved with the municipality, and accordingly we are extremely worried about any further increase in the amount of stormwater entering the system.

Another serious issue of concern is the Chedoke Creek Valley System forested slope which runs along the rear of the lots on Dow Avenue, Southview Place and Cline Avenue South. It is this slope which appears to be undergoing erosion due to the steep angle of the slope and the effect of climate change. The discharge and underground flooding in the area due to storm water discharge, and which is only metres away from the top of the slope, as well as the recent Hwy 403 bridge construction that was carried out by the Province of Ontario and MTO in which a large amount of soil was removed from the "toe" of the slope, but which was never replaced after construction was completed, are two issues that have caused much alarm and consternation among the residents in the neighbourhood.

D) EXISTING AND PROPOSED STORM WATER MANAGEMENT AT THE SUBJECT SITE

The IBI Group Functional Service Report submitted by the Applicant correctly identified the fact that the Grace Lutheran Church has no connection or discharge into the storm sewers. This is because Grace Lutheran Church collected all their rooftop rainwater in large rain barrels at every downspout around the perimeter of the building. The rainwater was then used entirely for watering the extensive church gardens, special gardens, landscaped areas and community gardens, resulting in a an almost 100% recharge in to the Chedoke Creek subwatershed.

SUBWATERSHED STRESSES & STEWARDSHIP ACTIONS

There are fifteen Subwatershed-wide Stresses identified within the Chedoke Creek subwatershed. Three of these are considered Dominant Stresses while the others are considered Associated Stresses as they directly relate to the Dominant Stresses. These stresses and their relationships to one another are listed in **Table CH-5.**Error! Reference source not found.

Table CH-6 outlines the Stewardship Actions and measurable targets for each of the Subwatershed-wide Stresses listed in **Table CH-5**; the Dominant Stresses are highlighted in yellow for quick reference. Additionally, each Dominant and Associated Stress has Site-level Stresses identified on the catchment maps, the details of which are within the corresponding catchment datasheets. Within the Chedoke Creek subwatershed, 82 Site-level Stresses have been identified. Inventories and the location of the Site-level stresses found in each of the catchments are listed under the Stress description in **Table CH-6**.

Erosion stresses have been noted within both the Development and Habitat Degradation Dominant Stress categories and all Storm water Mismanagement Stresses have been noted under both the Development and Detachment from Nature Dominant Stress categories as the Stewardship Actions directly relate to both of these Dominant Stresses.

In summary, future urban intensification in the Mid-Chedoke, Chedoke East and Lower Chedoke Creek catchments of this subwatershed is of main concern to the fisheries potential as it increases the potential for erosion downstream. Present natural systems (aquatic & terrestrial) must remain intact and preserved and be used as a foundation for restoration in this warm water system. In order to maintain or enhance the water quality of this subwatershed, contamination as a result of salt application on major arterial roadways must be reduced. Wetland and upland forest restoration above the escarpment may also be of benefit to mitigate existing erosion resulting from past development. Additionally, phosphorus loading and pesticide use are of great concern in this urban area of the City of Hamilton.

Findings of note in this subwatershed to highlight in this plan are the extensive natural areas bordering the Niagara Escarpment, the open stream tributaries and the Friends of Chedoke group along the Chedoke Ravine. Also, there are many accessible waterfalls located within in this subwatershed that have the potential to serve as excellent awareness opportunities through interpretive signage & trail opportunities. These eco-tourism sites can be incorporated into the enhancement of noted ecological linkages, ensuring connectivity for terrestrial species to reach Cootes Paradise Marsh through this urban environment.

Table CH- 5: Dominant & Associated Subwatershed-wide Stresses

DOMINANT STRESS	ASSOCIATED STRESS
Development (DV)	Erosion (ER)
	Storm Water Mismanagement (SW)
	Water Contamination through Transportation Corridors (TC)
Detachment from Nature (DT)	Eco-tourism Related Degradation (ET)
	Storm Sewer Outfalls (SO)
	Storm Water Mismanagement (SW)
Terrestrial Habitat Degradation & Lack of Riparian Buffer (HR)	Channelized / Buried Streams (CB)
	Debris Jams (DJ)
	Encroachment (EN)
	Erosion (ER)
	On-line Ponds / Culverts (PC)
	Phosphorus Loading (PL)
	Pesticide Use (PS)
	Plowed Watercourses (PW)

Table CH-6 Stewardship Actions & Inventories of Site Level Stresses

Development **Map Code: DV**  **Definition:** The process of developing populated settlements; including housing and supporting infrastructure. **Inventory of Sites Identified** = 12 **Catchment Locations:** Chedoke West (2) Lang's Creek (1) Mid-Chedoke (2) Cliffview (1) Chedoke East (3) Lower Chedoke Creek (3) **Audience:** CITY / HHHBA / developers / private landowners	<u>**2008-2012:**</u> Host annual training sessions for City staff & developers to create awareness regarding the incorporation of development related BMPs into planning applications (i.e. pervious pavement, green rooftops, storm water management, road-salt alternatives, snow-piling, erosion &s sediment control measures, compliance & enforcement, etc.); ▪ **Partners:** BARC / CITY / DFO / FSRT / Green Venture / HCA / MTO <u>**2008-2012**</u>: Apply Yellow Fish Road to all catchbasins on streets and in parking areas to educate private landowners post-development; ▪ **Partners:** BARC / CITY / DFO / FSRT / Green Venture / HCA / MTO	<u>**2008-2012**</u>: Continue to complete ecological surveys (using the Ecological Land Classification system) to ensure species at risk habitat or rare ecological areas are not disrupted; • **Partners:** CITY / HCA / post-sec. schools <u>**2008-2012:**</u> Continue to incorporate downstream assessments of creek conditions, with recommendations for improvement, as part of the subwatershed-wide subwatershed studies conducted as part of new Greenfield development planning; • **Partners:** CITY / HCA / post-sec. schools <u>**2008-2012**</u>: HCA staff to develop an internal mechanism to ensure that BMP's and Stewardship Actions to preserve and enhance habitat are addressed in development application prior to construction; • **Partners:** BARC / CITY / DFO / FSRT / Green Venture / HCA / MTO	<u>**2008-2012**</u>: Use the terrestrial habitat and ecological linkages identified in this plan to preserve & rehabilitate these areas as part of new Greenfield developments in the subwatershed; ▪ **Partners**: HCA / CITY <u>**2008-2012**</u>: Enhance groundwater recharge by ensuring that 70% of all land, post construction must remain pervious as a condition for development application approval; ▪ **Partners:** HCA / CITY <u>**2008-2012**</u>: Implement the fish habitat buffer requirements for warm and coldwater streams as outlined in the HCA Planning and Regulations Policy and Guidelines document (30m setback for coldwater systems and 15m setback for warmwater systems); ▪ **Partners:** HCA / CITY

Plowed Watercourse **Map Code: PW**  **Definition:** Headwater swales or small watercourses that are worked for agricultural production. **Inventory of Sites Identified** = 0 **Audience:** private agricultural landowners	<u>2008-2012:</u> Utilize workshops, information sessions, literature & webpages & direct private landowner contact to create awareness regarding environmental effects of plowed watercourses; ▪ **Partners:** DFO / HCA / OMAFRA / Ont. Stewardship Council / HHWSP <u>2008-2012:</u> Promote the Environmental Farm Plan program and associated Cost Sharing Programs for the implementation of Beneficial Management Practices projects; ▪ **Partners:** Stewardship Council / HHWSP / OSCIA	<u>2010:</u> Assess landowner motivation for installing grassed waterways and riparian buffers; ▪ **Partners:** HCA / OMAFRA / HHWSP / HWSCIA	<u>2008-2012</u>: Reduce sedimentation through the creation of a minimum of one riparian buffer on private lands, target 15m from top of bank for warm water systems and 30m from top of bank for coldwater systems; ▪ **Partners:** HCA / landowner / HHWSP
Stormsewer Outfalls / CSO's **Map Code: SO**  **Definition:** The point where a combined sewer overflow system discharges into a watercourse during a storm event. **Inventory of Sites Identified** = 19 **Catchment Locations:** Chedoke West (2) Lang's Creek (2) Mid-Chedoke (5) Cliffview (2) Chedoke East (4) Lower Chedoke Creek (4) **Audience:** children & private landowners (residential / commercial / industrial)	<u>2008-2012:</u> Implement the Stream of Dreams and Yellow Fish Road Programs with local schools, scout, girl guides and other children's groups, to create awareness regarding stormwater input & the impacts of CSO outfalls on stream systems; • **Partners:** BARC / CITY / FSRT / HCA <u>2008-2012</u>: Support Sewer-Use Bylaw enforcement (City of Hamilton By-law No. 04-150); ▪ **Partners:** BARC / CITY / FSRT / HCA	<u>2008-2012:</u> Conduct water quality testing at storm sewer outfalls to support a study on illegal sewer hookups, Sewer Use Bylaw enforcement, & restoration efforts; ▪ **Partners:** CITY / HCA / post-sec. schools <u>2008-2012</u>: Conduction water quality testing at CSO outfalls pre and post mitigation to support mitigation measures; ▪ **Partners:** CITY / HCA / post-sec. schools	<u>2008-2010</u>: Reduce flows & sedimentation through riparian buffer establishment downstream of CSO outfalls (public lands); ▪ **Partners:** CITY / FSRT / Green Venture / HCA / Ont. Stewardship Council / landowners & citizens <u>By 2012:</u> 80% of connected downspouts to be disconnected & rain barrels to be utilized as an alternative; ▪ **Partners:** CITY / FSRT / Green Venture / HCA / Ont. Stewardship Council / landowners & citizens

Water Contamination through Transportation Corridors **Map Code: TC**  **Definition:** Contamination resulting from stormwater runoff from major arterial roadways; often associated with the application of salts for de-icing and the residual precipitate created by automobile exhaust. **Inventory of Sites Identified** = 3 **Catchment Locations:** Mid-Chedoke (2) Chedoke East (1) **Audience:** CITY / MTO	**2008-2012:** Host training sessions for City staff to create awareness & encourage environmentally friendly road salt alternatives & proper snow removal practices; ▪ **Partners:** CITY / DFO / HCA / MTO / Ont. Stewardship Council	**By 2010:** Determine the best method to mitigate contamination from transportation corridors into watercourses by studying alternatives to road salt for de-icing & incorporating into a road salt management plan; ▪ **Partner:** CITY / HCA / MTO / post-sec. schools	**2010-2012:** Implement road salt management plans & reduce use of salt for de-icing by 15% over 5yrs; Increase use of vacuum street sweepers; Increase vegetated filter strips / grassed swales along medians & roadsides, where ditches are present incorporate non-invasive native vegetation; ▪ **Partners:** CITY / MTO

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We believe that the sheet flows from the subject site to the stormwater infrastructure calculation for the existing Church may not be correct in the IBI Group Functional Service Report which was submitted, as a different calculation should be used when a property is completely disconnected from the storm sewers and the rainwater is collected and reused on permeable soil and landscaping on site. This calculation is attached as a Schedule, and data provided by IBI should therefore be reviewed to determine the additional discharge into the storm sewers as a result of the proposed development.

E) PROPOSED DEVELOPMENT, ROOFTOP TERRACES AND ABSORPITON OF RAINWATER INTO UNTREATED STORAGE TANKS

The IBI Group Report further discloses that the "proposed development will construct a building whose face will be near to the property line with the building's **footprint being at least 70% of the subject land area"**. It was also disclosed by the Applicant at a meeting that the entire site is to be excavated for the underground parking garage, which indicates that even the maximum 30% of ground level area of the development will be directly above the parking garage. From this fact we can conclude that the subject site will therefore have **0% recharge** in direct conflict with the Hamilton Conservation Authority and City of Hamilton Guidelines for the Chedoke Creek Subwatershed which sought to "*enhance groundwater recharge by ensuring* ***that 70% of all land, post construction must remain pervious*** *as a condition for development application approval.*"

Although there is a benefit to be derived by having a rooftop which will incorporate methods of absorption to collect and store rainwater, it appears from the site plan and the architectural drawings that there still is a very large percentage of impervious area at ground level which will permit sheet flow directly into the storm sewers on Dow Avenue. This is in contrast with the Grace Lutheran Church which collected all its rainwater and which had pervious soil, pervious landscaping and gravel right up to the street sidewalks, with the exception of the concrete walkways on the interior of the property. The IBI Report further claims that "some small areas at the boundary of the site will sheet drain to the adjacent lands as is the exiting condition", but it appears that these proposed areas are much larger than anything that currently exists on the Grace Lutheran Church property, and that this additional sheet flow will be a considerable increase over what is currently flowing into the stormwater infrastructure, a storm sewer system which is in urgent need of repair, and which cannot presently handle the existing stormwater flows.

The landscape drawings indicate that there are two small areas on the terrace levels on the 10th Floor which are identified as being "Green Roof - No Public Access", but the exact percentage that this area constitutes in relation to the entire roof top of the proposed development, has not been presented. The City of Hamilton does not yet have a Green Roofs By-law, however based on the City of Toronto 'Green Roofs By-law' which was pioneered in 2006, it is not clear as to whether the Applicant's proposed roof top, including these two small areas, qualifies in any of the three categories of 'Green Roof' established in the City of Toronto By-law.

The IBI Report also states that rainwater in some places will be absorbed and that all runoff from the building's roof and larger landscaped areas will be collected via areas drains. The Applicant then proposes to have on-site stormwater storage utilizing rooftop areas and an underground storage tank, which will not utilize any stormwater quality measures. The two questions which are relevant to the storage tank, however, relate to contamination and the discharge flow rate.

The identification of air contamination and pollution records for the very area in which the subject site is located, has some of the worst air pollution in Hamilton, and that some of these toxic contaminants may remain in collected rainwater. If the Applicant intends to store the rainwater in tanks, it should be recommended that due to the fact that the site runoff may not be from "clean sources", the underground stormwater storage tanks mentioned in the IBI Group Report, utilize stormwater quality measures that are readily available, and which are installed in many other new developments.

The issue of storage capacity and the discharge flow rate from the tanks are important as the existing stormwater infrastructure is already inadequate, and the amount of discharge flow can adversely affect the homeowners on Dow Avenue who have already had cross connection backups in their basements. The sheet flows from the proposed development will be much higher than the presently existing rate, and accordingly the collected rainwater will have to be stored for longer periods and only discharged into the stormwater infrastructure when it is safe to allow this discharge. To this extent there will be a requirement to have additional underground tanks for storage, and the number suggested by IBS Group appears to be inadequate.

F) <u>IMPACT OF THE THREE-LEVEL UNDERGOUND PARKING GARAGE</u>

The site area for the three-level underground parking garage consists of approximately one-half hectare and the Planner has advised that the area is 5,169.3 square metres. If the depth of the garage is a minimum of 10 metres, (perhaps it will be even deeper), the underground area of the garage will be 51,693 cubic metres. For the sake of comparison, it is known that an official Olympic sized swimming pool is 50 metres by 25 metres by 2 metres, or a total of 2,500 cubic metres. Accordingly, when dividing the cubic metre capacity for volume of water of the Olympic sized pool into the three -level underground parking garage, it is a volume of approximately 21 Olympic pools.

This is an enormous area to have excavated and then encased in concrete foundations and walls. The adverse impacts that will occur as a result of the removal of this massive amount of soil between Dow Avenue and Cline Avenue South, and the constructions of the three -level underground parking garage in such close proximity to the forested slope of the Chedoke Creek Valley system are as follows.

1) Drastic displacement of soil and ground water absorption resulting in a change in the water table and an increase in hydrostatic water pressure on neighbouring properties;

2) Opening of small cracks and fissures in the basements of houses along Dow Avenue and Cline Avenue South, especially at the subsurface mortar joints of the block foundations, causing basement water leakage and flooding, and perhaps the need to install sump pumps in these houses;
3) Increased hydrostatic water pressure in the soil adjacent to the forested slope of the Chedoke Creek Valley system;
4) Increased storm water release at the top of the slope due to larger volumes of stormwater drainage and its leakage from the defective and inadequate stormwater infrastructure along Dow Avenue, Paul Street, Southview Place, and Cline Avenue South;
5) A diversion and change in the subsurface groundwater flow and irreversible damage to the Chedoke East subwatershed and to the urban forest along these streets and within the slope itself.

G) RED FLAG WARNINGS FOR A LANDSLIDE OF THE FORESTED SLOPE

There are worrisome examples of forested slopes along Hwy 403 and which are in close proximity to the subject site, and which have already collapsed or which have caused great concern of collapse and landslide.

Hwy 403 Landslide

The first is a watermain that broke on York Boulevard near the Desjardins Canal where Cootes Paradise drains into Hamilton Harbour. As seen and stated in the attached two articles in the Hamilton Spectator, the underground water leakage resulted in a mudslide that crossed the embankment and entered unto Hwy 403.

Columbia Student Residence Development Proposal Main Street West and Longwood Road

The second example is even closer at only a few hundred metres away, and it concerns the forested slope of the Chedoke Creek Valley system at Main Street West and Longwood Road, and in the same Chedoke East subwatershed map as the subject site. This slope came under review as the owner wanted to redevelop the parcel and to infill a portion of the valley. Hamilton Conservation Authority staff however identified that "the property is associated with a regulated valley system, and that a geotechnical investigation would be required to determine the erosion hazard limit on the site and to establish an appropriate development setback from the hazard". Despite requesting specific supporting reports and technical studies "a geotechnical assessment to identify the erosion hazard on site, including the stable top of bank and an appropriate development setback, was not included with the submission".

According to the HCA staff memorandum "HCA provided the City with formal comments regarding these applications on May 30, 2016, identifying significant concerns with the proposed filling and development within the erosion hazard of the valley. As the delegated authority for representing the provincial interest in the implementation of natural hazard policy in municipal planning matters, HCA advised the City that HCA staff were of the opinion the proposal did not comply with municipal, HCA or provincial policy, and therefore recommended the applications be denied".

HCA staff further stated that in "their opinion there are potential public safety and property risks associated with the proposed development of an institutional use within valley lands susceptible to erosion hazards. As the delegated authority for representing the provincial interest in natural hazard policy matters, it is the HCA staff professional opinion the proposal is not consistent with the PPS."

A Floodplain Assessment Report submitted by the developer of 925 Main Street West and Longwood Road which was prepared by Amec Foster Wheeler dated December 3, 2015 concluded that:

> "On the basis of the forgoing, it is considered that the current regulated hazard on the property as depicted by HCA, *would potentially relate more to valley and slope form.* (our emphasis)That said, there is no water feature or flood plain which contacts the subject land, hence there may be a case whereby the currently depicted hazard limits can be modified since the creek cannot influence the slope through any long-term erosion processes. Further dialogue will be required with your geotechnical engineer and HCA regarding this perspective."

These comments support the position that it was the condition of the slope itself, rather than the floodplain, that is of major concern in respect of hazard policy regulation.

Finally, the HCA staff memorandum concluded that "the policy direction and importance of directing development to areas outside of hazardous lands is based not only on science relating to natural hazards, but also on real life experience. There are examples across the Province of development historically taking place within hazardous lands, specifically ravine lands, with resultant failure of ravine slopes and damage to property or loss of use with the subsequent economic and social losses. Locally, this issue was highlighted in an October 13, 2017 article entitled "Cracks in the foundation: The price of living on the edge", where the City was considering purchasing a residential property due to slope failure issues. This is but one example of ravine slope failure issues in the City of Hamilton. Provincial and HCA policies are in place to direct development outside of hazardous lands wherever possible to avoid future issues and to learn from the past."

Ultimately the proposed development was approved, but it appears that the approval came with a "save harmless" clause which meant that the developer was building at his own risk. This is set out in an online article published in "Raise the Hammer" on December 4, 2020 and which was written by Paul Weinberg. In his article the author writes that:
https://raisethehammer.org/article/3793/conservation_conundrum

> Notwithstanding the opposition of the HCA technical staff, the HCA board of directors (comprising both City Councillors and citizen appointees) voted unanimously for the

project with a series of requirements, including a "Save Harmless Agreement" between the developer and the HCA to avoid lawsuits in the event of a failure or mishap. "What that failure could look like, who knows," said Scott Peck, HCA deputy chief administrative officer and director of watershed planning and engineering, in an interview with me later. "It could be that a portion of the building fails, or a slope fails. Something that causes the owner of the property a monetary loss in the future sometime. They could always come back and say 'sue the authority, for whatever losses they have.' That [save harmless] agreement is really the authority's attempt to kind of say 'we told you not to build there, you were aware of it.'"

The events that have transpired at the development project at Main Street West and Longwood Road, only a few blocks away from the subject site, and relating to a forested slope which is part of the same Chedoke Creek Valley system woodlot and open space designation, causes us great concern as these three slopes, (the Dow Avenue/Southview Place slope, the Cline Avenue South slope and the Main/Longwood slope) appear to possess the exact same slope steepness, type of tree and vegetative growth, and the same degree of erosion hazard.

Excavation and Construction of Garage and Underground Vibrations

Although it is not common to have landslides triggered by vibrations in sensitive ground caused from construction activities, it has been proven to occur where sensitive clays and loose soil deposits have already been impacted by natural factors, such as erosion and heavy precipitation and snow melt, and other destabilizing conditions including unfavourable groundwater conditions, artesian pressure, filling, etc., all causing the slope to become highly unstable. In this case the removal of soil from the toe of the slope and the already high erosion hazard ranking by Hamilton Conservation Authority, make the slope on Dow Avenue and Southview Place, and perhaps the slope on Cline Avenue South extremely susceptible to a triggering event from construction related vibrations, especially relating to vibro-pile driving.

Red Flags

The proposed development of the subject site with a three-level underground parking garage could cause considerable damage to the properties on Cline Avenue South, Dow Avenue, and Southview Place, as well as precipitating a landslide of the forested slope at the rear of the properties. The reasons for such a landslide being triggered is based on the following factors:

1) The increase in hydrostatic pressure at the top of the slope, and against the basement foundation walls of all neighbouring properties;
2) The change in the depth of the groundwater and water saturation due to the massive excavation and removal of soil resulting in an equivalent volume displacement towards the neighbouring houses and the top of the slope;
3) The defective stormwater infrastructure and underground water leakage on Dow Avenue resulting in basement flooding and backups, and the need for sump pumps, and which is all occurring in close proximity to the top of the slope;

4) The steepness of the slope and its high erosion hazards and instability due to climate change events and increased precipitation, as already identified by HCA on similar slopes in the Chedoke Creek Valley System subwatershed;
5) The large amount of soil that was removed and never replaced at the bottom or "toe" of the slope, resulting in a greater level of slope instability;
6) The vibrations and shock waves that will be emitted from the subject site during excavation and the sinking of the pilings into the ground, or perhaps into the bedrock, at the subject site, and which will travel beneath the surface and impact the forested slope.

All of these factors, working in combination, are the red flags that indicate a landslide of the forested slope could likely occur as a result of the proposed development, causing considerable loss, both monetarily and environmentally, to the residents who live in the immediate neighbourhood.

H) RATIONALE FOR CONSTRUCTING A THREE-LEVEL UNDERGOUND PARKING GARAGE

In the Formal Consultation Document that the Applicant signed with the City of Hamilton, the Applicant advised the City that it intended to construct a two-level underground parking garage with 152 parking stalls. Then, in December 2019 the Applicant stated in its Project Updates Post-Community information sheet, that having recently met with resident's associations on November 26th 2019, it redesigned the parking garage in response to the community requests for a reduction in the need for street parking. The Applicant provided a redesigned description and indicated it was now planning to construct a three-level underground parking garage with 226 parking stalls in direct response to the wishes of the neighbourhood associations.

We believe that the request made by the neighbourhood associations, if in fact true, to the Applicant was offered in haste and 1) without the benefit of consulting with the neighbours most affected by their wish to have a bigger parking garage in order to reduce street parking; 2) without a detailed review of plans and architectural drawings indicating the setbacks and angular plane; 3) without a review of the City of Hamilton Transportation Demand Measures and relevant parking policies of the City of Hamilton; 4) without consideration of the severe environmental harm and adverse impacts which would be caused by an excavation and construction of an underground garage of this magnitude, and; 5) without recognizing that the density and height of the proposed development could be reduced to reflect actual parking needs as determined by the City of Hamilton. In light of the issues and concerns associated with the Applicant's revised parking garage, we firmly believe that whoever raised this matter with the Applicant, would now willingly withdraw and rescind their request, and would emphatically insist that the underground parking garage be no more than two levels, and preferably just one level of underground parking.

I) PROVINCIAL POLICY STATEMENT (PPS) AND GROWTH PLAN FOR THE GREATER GOLDEN HORSESHOE

The proposed three-level underground parking garage is a) inconsistent with the Provincial Policy Statement and, b) does not conform to the Growth Plan for the Greater Golden Horseshoe, based on the issues and concerns set out above in this objection letter, and some of the specific and relevant provisions of these two documents are set out as follows:

Provincial Policy Statement

1.1.1 Healthy, liveable and safe communities are sustained by:
c) avoiding development and land use patterns *which may cause environmental or public health and safety concerns*;

1.6.6.7 Planning for stormwater management shall:
a) be integrated with planning for sewage and water services and ensure that systems are optimized, feasible and financially viable over the long term;
b) *minimize, or, where possible, prevent increases in contaminant loads*;
c) *minimize erosion and changes in water balance, and prepare for the impacts of a changing climate through the effective management of stormwater, including the use of green infrastructure;*
d) *mitigate risks to human health, safety, property and the environment*;
e) *maximize the extent and function of vegetative and pervious surfaces; and*
f) *promote stormwater management best practices, including stormwater attenuation and re-use, water conservation and efficiency, and low impact development.*

1.7.1 Long-term economic prosperity should be supported by:
e) *encouraging a sense of place, by promoting well-designed built form and cultural planning, and by conserving features that help define character, including built heritage resources and cultural heritage landscapes*;
k) *minimizing negative impacts from a changing climate and considering the ecological benefits provided by nature*;

2.1.2 *The diversity and connectivity of natural features in an area,* and the long-term ecological function and biodiversity of natural heritage systems, *should be maintained, restored or, where possible, improved, recognizing linkages between and among natural heritage features and areas, surface water features and ground water features.*

2.2.1 Planning authorities shall protect, improve or restore the quality and quantity of water by:
a) *using the watershed as the ecologically meaningful scale for integrated and long-term planning, which can be a foundation for considering cumulative impacts of development;*
b) *minimizing potential negative impacts, including cross-jurisdictional and cross-watershed impacts*;
c) *evaluating and preparing for the impacts of a changing climate to water resource systems at the watershed level*;

d) *identifying water resource systems consisting of ground water features, hydrologic functions*, natural heritage features and areas, and surface water features including shoreline areas, *which are necessary for the ecological and hydrological integrity of the watershed*;
e) maintaining linkages and related functions among ground water features, hydrologic functions, natural heritage features and areas, and surface water features including shoreline areas;
f) implementing necessary restrictions on development and site alteration to:

1. protect all municipal drinking water supplies and designated vulnerable areas; and
2. *protect, improve or restore vulnerable surface and ground water, sensitive surface water features and sensitive ground water features, and their hydrologic functions*;

g) planning for efficient and sustainable use of water resources, through practices for water conservation and sustaining water quality;
h) ensuring consideration of environmental lake capacity, where applicable; and
i) *ensuring stormwater management practices minimize stormwater volumes and contaminant loads, and maintain or increase the extent of vegetative and pervious surfaces.*

Growth Plan for the Greater Golden Horseshoe

3.2.7 Stormwater management

1. Municipalities will develop *stormwater master plans* or equivalent for serviced *settlement areas* that:
   a. are informed by *watershed planning* or equivalent;
   b. protect the *quality and quantity of water* by assessing existing stormwater facilities and systems;
   c. characterize existing environmental conditions;
   d. *examine the cumulative environmental impacts of stormwater from existing and planned development, including an assessment of how extreme weather events will exacerbate these impacts and the identification of appropriate adaptation strategies*;
   e. incorporate appropriate *low impact development* and *green infrastructure*;
   f. *identify the need for stormwater retrofits, where appropriate*;
   g. identify the full life cycle costs of the stormwater *infrastructure*, including maintenance costs, and develop options to pay for these costs over the long-term; and
   h. include an implementation and maintenance plan.

2. Proposals for large-scale *development* proceeding by way of a secondary plan, plan of subdivision, vacant land plan of condominium or site plan will be supported by a *stormwater management plan* or equivalent, that:

a. is informed by a *subwatershed plan* or equivalent;
b. incorporates an integrated treatment approach to minimize stormwater flows and reliance on stormwater ponds, which includes appropriate *low impact development* and *green infrastructure*;

c. *establishes planning, design, and construction practices to minimize vegetation removal, grading and soil compaction, sediment erosion, and impervious surfaces*; and
d. aligns with the *stormwater master plan* or equivalent for the *settlement area*, where applicable.

4.2.10 Climate change

1. Upper- and single-tier municipalities will develop policies in their official plans to identify actions that will reduce greenhouse gas emissions and address climate change adaptation goals, aligned with other provincial plans and policies for environmental protection, that will include:
    a. supporting the achievement of *complete communities* as well as the minimum intensification and density targets in this Plan;
    b. reducing dependence on the automobile and supporting existing and planned transit and *active transportation*;
    c. assessing *infrastructure* risks and vulnerabilities and identifying actions and investments to address these challenges;
    d. *undertaking stormwater management planning in a manner that assesses the impacts of extreme weather events and incorporates appropriate green infrastructure* and *low impact development*;
    e. recognizing the importance of *watershed planning* for the protection of the *quality and quantity of water* and the identification and protection of hydrologic features and areas;
    f. protecting the Natural Heritage System for the Growth Plan and water resource systems;
    g. promoting local food, food security, and soil health, and protecting the agricultural land base;
    h. providing direction that supports a culture of conservation in accordance with the policies in subsection 4.2.9; and
    i. any additional policies to reduce greenhouse gas emissions and build resilience, as appropriate, provided they do not conflict with this Plan.

5.2.5 Targets

1. The minimum intensification and density targets in this Plan, including any alternative targets that have been permitted by the Minister, are minimum standards and municipalities are encouraged to go beyond these minimum targets, *where appropriate, except where doing so would conflict with any policy of this Plan, the PPS or any other provincial plan.*

J) APPREHENDED FEAR OF ENVIRONMENTAL AND SAFETY CONCERNS, AND THE NEED FOR ADDITIONAL REPORTS AND STUDIES FROM THE APPLICANT

Although we do not currently have in our possession the studies and reports which will conclusively prove that the fears and concerns set out above will definitely occur, it is to be noted that the Provincial Policy Statement addresses the sustainability of healthy, liveable and safe communities by avoiding development and land use patterns *which may cause environmental or public health and safety concerns*. It is therefore clear that the relevant standard to adopt for this redevelopment Application of the subject site, is "may cause" and not the words "will cause".

The onus to disprove our contention, and the onus to prove consistency with the PPS and conformity with the GPGGH clearly lies with the Applicant. This can be accomplished by the Applicant submitting additional reports, studies, and /or plans, as well revising some of the studies already submitted, to address our concerns regarding the Chedoke Creek Valley system subwatershed, the forested slope, the stormwater infrastructure, hydrostatic water pressure, groundwater, rate of recharge, storage tank discharge flow rate, leakage and flooding of basements, and subsurface vibrations during construction activity.

The Applicant entered into a Formal Consultation Document in which it stated that it was constructing a two-level underground parking garage, but the submitted application was for a three-level underground parking garage. In addition, the City of Hamilton set out condition #6 in the FCD which reads "*it may be determined during review of the application that additional studies or information will be required as a result of issues arising during the processing of the application.*"

We firmly believe that the issues that we have set out in our objection letter warrant further reports to be provided before the hearing date of the subject applications to the Planning Committee, and we therefore kindly ask that the City of Hamilton Planning Department now request from the Applicant the following:

1) Revised Functional Servicing Report from IBI Group to address why the subject site will have **0% recharge** in direct conflict with the Hamilton Conservation Authority and City of Hamilton Guidelines for the Chedoke Creek Subwatershed which sought to "enhance groundwater recharge by ensuring that **70%** of all land, post construction must remain pervious as a condition for development application approval.
2) New Stormwater Management Report/Plan and Sub-watershed Plan to address sheet flow, recharge, groundwater, and storm sewer flow into the Chedoke Creek and the identified stressors on the subwatershed.
3) Hydrogeological Study of subject site, neighbouring lands and the neighbouring open space/forested slope of the Chedoke Creek Valley System.
4) Soils/Geotechnical Study on subject site and neighbouring properties and forested slope to be delivered before the hearing date of the subject applications for OP and Zoning By-law Amendment stage, and not to be delayed until Site Plan Approval stage.

5) Underground Vibration Study relating to proposed construction activity of the underground parking garage at the subject site.
6) Transportation Demand Management Options Report on the proposed renting or selling of parking stalls in the three-level underground parking garage to non-occupants/residents of the proposed building, to be delivered before the hearing date of the subject applications for OP and Zoning By-law Amendment stage, and not to be delayed until Site Plan Approval stage. (This is due to concern that a very large percentage of the parking stalls exceeding one full level of underground parking, may be reserved for first-year McMaster University students who will not be living on site but rather will be living at the university campus student residences on the north side of Main Street West at Traymore Avenue and Forsyth Avenue North)

We apologize for the delay in not having this objection letter submitted to you earlier, however much of the information set out in our letter only became recently available following the release a few months ago of the LPAT decision for the property at Main Street West and Longwood Road, and the very recent publication of an article on the Chedoke Creek Valley System forested slope in December 2020. Accordingly, we believe that our request for additional reports from the Applicant is merited, timely, made in good faith and not for any improper purpose, and deserving of your consideration under the Provincial Interest section of the Ontario Planning Act.

K) CONCLUSION

Our objection letter only sets out the issues relating to the three-level underground parking garage in the proposed development. There are numerous other equally valid issues that we have with the Applications for the UHOP and Zoning By-law Amendments, but these objections have already been delivered to you, and will continue to be raised and submitted separately to you. The common interest, however, to all of these issues is the detrimental impact that the proposed development will have on the character of our neighbourhood, our sense of place, and our right to reside in a healthy, liveable and safe community.

It is our sincere belief that not only will the three-level underground parking garage adversely impact the entire neighbourhood, but that it has the very real potential to lead to the destruction of the most valuable asset we have in the urban forested slope which is part of the adjoining Chedoke Creek Valley System. For not only does this slope serve as a crucial air pollution barrier, noise pollution barrier, and visual barrier separating us from Hwy 403, but it reflects our neighbourhood's character, its commitment to conservation and its aesthetic appeal to all its residents.

If you require any further information regarding our concerns or have questions on any of these issues, please do not hesitate to contact us.

Sincerely yours,

Address of Property: [redacted]

Signature(s): [redacted]

Name(s) RHONDA ROSS. JOHN ROSS

Address of Property: [redacted]

Signature(s): [redacted]

Name(s) NIKITA OHAYON EVELYNE OHAYON.

Address of Property: [redacted]

Signature(s): [redacted]

Name(s) DR. JASON & EVELYNE OHAYON.

Address of Property: [redacted]

Signature(s): [redacted]

Name(s) EVELYNE OHAYON.

Address of Property: [redacted]

Signature(s): [redacted]

Name(s) Joel Goldberg

Address of Property: [redacted]

Signature(s): [redacted]

Name(s) ILANA GOLDBERG

Address of Property: [redacted]

Signature(s):

Name(s) Agnes Gajdo

Address of Property: [redacted]

Signature(s):

Name(s) ADAM JANCZAK

Address of Property: [redacted]

Signature(s):

Name(s) STANISLAW LACH

Address of Property: [redacted]

Signature(s):

Name(s) ANNA FARYSEJ

Address of Property: [redacted]

Signature(s):

Name(s) Leslie Sugar Robert Sugar

Address of Property: ______________________

Signature(s): ______________________

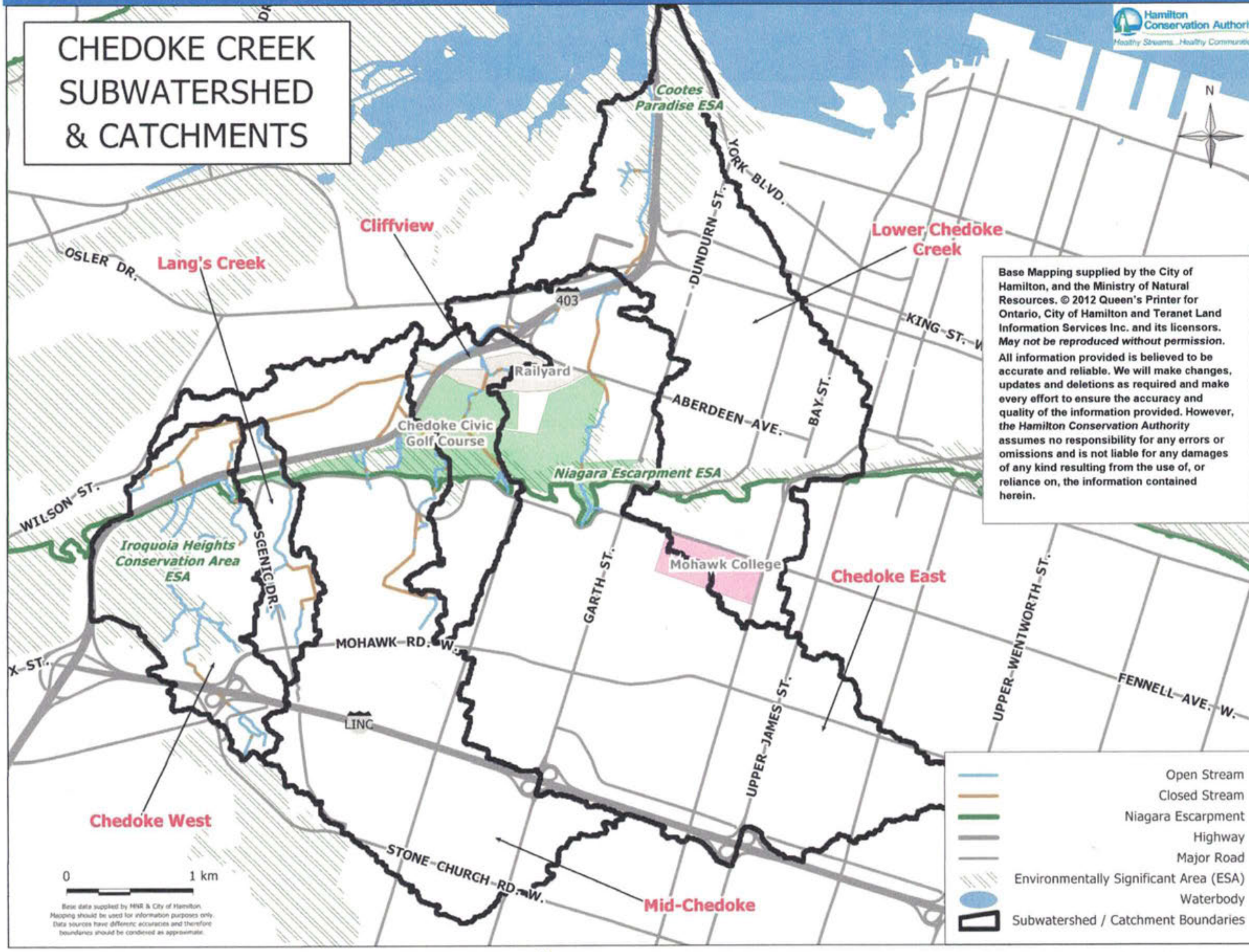
Name(s) ______________________

Address of Property: ______________________

Signature(s): ______________________

Name(s) ______________________

CHEDOKE CREEK WATERSHED



The Chedoke Creek watershed is 25.1 km^2 in area. The headwaters are located above the Niagara Escarpment with the only tributaries still present above the surface being located within Chedoke West, Lang's Creek and Mid-Chedoke catchments. The headwaters of the Chedoke West catchment are piped upstream but still supply the year round flowing Chedoke Falls. All of the tributaries flow over the escarpment and then travel eastward and align parallel with Highway 403 before outletting into Cootes Paradise.

Chedoke Creek watershed in comparison to Environment Canada's 'How much Habitat is Enough' Guidelines

Landscape Feature	Guideline	Subwatershed Status
Wetland	6%	0.02%
Forest	30%	9.6%
Impervious Surface	<10%	76%

Three municipally designated Environmentally Significant Areas (ESAs) are located within this subwatershed: Iroquoia Heights Conservation Area, Hamilton Escarpment, and Cootes Paradise.

Chedoke Creek is a warm water system.

Significant species found within the natural areas of this watershed include: Butternut (pictured at right), Cooper's Hawk, Monarch and Northern Ribbon Snake.

Much of the Chedoke Creek watershed has been altered over time as a result of intense urban development within the Hamilton area; subsequently the majority of the stream flow directly results from storm water input. Therefore, erosion, sedimentation and insufficient channel sizes occur at the outlet. The following locations are where natural stream channels can be found within the subwatershed: southwest of Golf Links Road and Scenic Drive, through Iroquoia Heights Conservation Area, through Olympic Park / Hydro lands east of Scenic Drive, through Lang's Park east of Scenic Drive, Hydro lands north of Highway 403, northwest of Upper Paradise Road and Mohawk Road, through Chedoke Golf Course, west of Chedoke Avenue, and parallel to Highway 403.

Three environmental stresses in the Chedoke Creek watershed, as identified within the Spencer Creek Stewardship Action Plans, are:

- **Insufficient riparian buffers (recommended width of 30 metres) along creeks,**
- **The degradation of terrestrial habitats, and**
- **Stormwater and runoff contamination from impervious surfaces**

What are we doing to protect habitat and improve the health of the Chedoke Creek subwatershed?

The Hamilton Watershed Stewardship Program works with the public and private property owners to develop and implement initiatives and restoration projects that create and enhance natural areas and habitats in the HCA watershed. The program offers free on-site consultation to private property owners who have natural features on their properties. Property owners that undertake restoration projects that create or enhance natural habitats or water quality may be eligible to apply for financial assistance.

What can landowners do to restore and protect the habitats and health of Chedoke Creek?

1. Re-establish riparian buffers where there are none and increase the width of existing riparian buffers.
2. Plant native trees, shrubs and herbaceous plants in front, rear and side yards.
3. Disconnect downspouts that direct water from roofs and eavestroughs to the storm sewer system and direct them to yards and gardens.
4. Consider an alternative driveway design that reduces the amount of impermeable driveway surface.
5. Collect rain water in rain barrels to use the water on gardens

Disconnected downspout at left. Riparian Buffer along Both Sides of the Creek at right.

Sources: Hamilton Conservation Authority (HCA) 2008. Chedoke Creek Subwatershed Stewardship Action Plan and the Canada-Ontario Environmental Farm Plan, Fourth Edition Workbook, 2013.

Hamilton Watershed Stewardship Program

Hamilton Watershed Stewardship Program
c/o Hamilton Conservation Authority
P.O. Box 81067, 838 Mineral Springs Road
Ancaster, Ontario L9G 4X1
www.hamiltonhaltonstewardship.ca
Office: (905) 525-2181, Ext. 181, 196

Are you interested in information about how you can protect water quality and habitat on your property?

Call to arrange a free on-site consultation!

Sites with Unconnected Impervious Cover

As described in detail in *Chapter 2: Low Impact Development Techniques*, an important nonstructural BMP will be new impervious cover that is not directly connected to a site's drainage system. Instead, runoff from these impervious areas will sheet flow onto adjacent pervious areas, where a portion of the impervious area runoff will be given a second opportunity to infiltrate into the soil. Under certain conditions described below, this can help provide both groundwater recharge and stormwater quality treatment for small rainfalls as well as reduce the overall runoff volume that must be treated and/or controlled in a structural BMP downstream. Unconnected impervious areas may either by on-grade (e.g., a parking lot) or above-grade (e.g., a roof), while downstream pervious areas may either be constructed (e.g., lawn) or natural (e.g., woods or meadow).

In most circumstances, impervious areas can be considered unconnected under the following conditions:

1. All runoff from the unconnected impervious area must be sheet flow.
2. Upon entering the downstream pervious area, all runoff must remain as sheet flow.
3. Flow from the impervious surface must enter the downstream pervious area as sheet flow or, in the case of roofs, from downspouts equipped with splash pads, level spreaders, or dispersion trenches that reduce flow velocity and induce sheet flow in the downstream pervious area.
5. All discharges onto the downstream pervious surfaces must be stable and nonerosive.
6. The shape, slope, and vegetated cover in the downstream pervious area must be sufficient to maintain sheet flow throughout it length. Maximum slope of the downstream pervious area is 8 percent.
7. The maximum roof area that can be drained by a single downspout is 600 square feet.

To determine the hydrologic effects of unconnected impervious cover, the combined effects of the impervious area disconnection and the subsequent infiltration in downstream pervious areas must be quantified. Techniques to do so are presented below.

- **Rational and Modified Rational Methods:** Due to the character of the basic Rational Equation, there is currently no technique for addressing the effects of unconnected impervious cover. As such, neither the Rational nor Modified Rational Methods can be recommended at this time for use at sites with unconnected impervious areas.
- **Methodology Using NRCS Equations:** Computation of the resultant runoff from unconnected impervious areas can be performed using two different methods. The first method is described in the NRCS TR-55. The second method is a two-step technique using the NRCS runoff equation. Both methods are discussed in detail below. Additional discussion and computed examples of unconnected impervious cover are presented in *Chapter 2: Low Impact Development Techniques*.
    - **NRCS TR-55 Methodology:** This method is based on the procedures to compute runoff from unconnected impervious surfaces described in the NRCS TR-55. Complete details of these procedures are described in Chapter 2 of TR-55. It should be noted that the TR-55 procedures are applicable only to sites with less than 30 percent total impervious coverage. In addition, the size of the downstream pervious area must be at least twice as large as the unconnected impervious area.
    - **Two-Step Technique:** This method is a two-step technique using the NRCS runoff equation. First, the resultant runoff from the unconnected impervious area should be computed separately, using the NRCS runoff equation in a manner similar to the technique described above for impervious surfaces. However, once the runoff from the unconnected impervious area is computed, it should then be considered as additional rainfall on the downstream pervious area it sheet flows onto. As a result, these pervious areas will effectively be subject to

their own direct rainfall as well as the "rainfall" flowing from the upstream unconnected impervious areas. The resultant runoff from the downstream pervious areas in response to this combined rainfall can then be computed using the NRCS runoff equation again.

Example 5-3 illustrates this two-step runoff computation technique for unconnected impervious areas. In reviewing the example, it is important to note that the unconnected impervious area runoff depth must be converted to an equivalent uniform rainfall depth over the entire downstream pervious area based on the relative sizes of the unconnected impervious and downstream pervious areas.

Example 5-3: Site With Unconnected Impervious Cover
Runoff Volume Computation Using Two-Step Technique

Description: A 3-acre development site is comprised of 1 acre of impervious surface and 2 acres of lawn and woods with an NRCS Curve Number (CN) of 65. Runoff from the entire impervious surface sheet flows onto to the pervious portion of the site before entering the site's drainage system. Compute the total runoff volume for the 1.25-inch stormwater quality design storm using the NRCS methodology.

Stormwater Quality Design Storm = P = 1.25 inches

Total drainage area = 3 acres

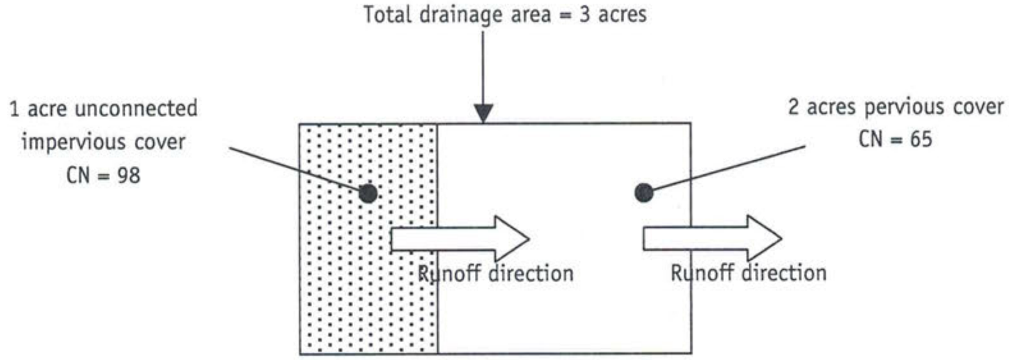
Impervious area = 1 acre (1/3 of total area)

Pervious area = 2 acres (2/3 of total area)

Pervious cover = mixture of lawn and woods pervious CN = 65

Impervious cover = asphalt impervious CN = 98

Note: All impervious area runoff sheet flows onto downstream pervious area



Impervious Area

$$\text{Impervious area } S = \frac{1000}{CN} - 10 = \frac{1000}{98} - 10 = 0.20 \text{ inches}$$

Impervious area initial abstraction = 0.2S = (0.2)(0.20) = 0.04 inches

0.8S = (0.8)(0.20) = 0.16 inches

$$\text{Impervious area runoff volume} = Q = \frac{(P - 0.2\,S)^2}{P + 0.8\,S} = \frac{(1.25 - 0.04)^2}{1.25 + 0.16} = 1.04 \text{ inches}$$

Runoff volume = (1.04 inches/12 inches per foot)(1 acre)(43,560 sf per acre)

Impervious area runoff volume = 3775 cubic feet

Equivalent rainfall depth on downstream pervious area =

(3775 cubic feet)/(2 acres)(43,560 sf per acre) = 0.043 feet = 0.52 inches

Pervious Area

Total effective rainfall = direct rainfall + unconnected impervious area runoff

= 1.25 inches + 0.52 inches = 1.77 inches total

$$\text{Pervious area } S = \frac{1000}{CN} - 10 = \frac{1000}{65} - 10 = 5.38 \text{ inches}$$

Pervious area initial abstraction = 0.2S = (0.2)(5.38) = 1.08 inches

0.8S = (0.8)(5.38) = 4.30 inches

$$\text{Pervious area runoff volume} = Q = \frac{(P - 0.2\,S)^2}{P + 0.8\,S} = \frac{(1.77 - 1.08)^2}{1.77 + 4.30} = 0.08 \text{ inches}$$

Runoff volume = (0.08 inches/12 inches per foot)(2 acres)(43,560 sf per acre)
= 581 cubic feet

Pervious area runoff volume = total runoff volume = 581 cubic feet

From the above example, it can be seen that a key parameter in the two-step runoff computation technique for unconnected impervious cover is the effective size of the downstream pervious area. The following three criteria, in conjunction with the seven requirements for all unconnected impervious areas shown above, should be used to determine the effective size of this downstream area:

1. The minimum sheet flow length across the downstream pervious area is 25 feet.
2. The maximum sheet flow length across the unconnected impervious area is 100 feet.
3. While the total flow length area may be greater, the maximum sheet flow length across the downstream pervious area that can be used to compute the total resultant runoff volume is 150 feet.

These criteria are illustrated below in Figures 5-5 and 5-6 for both on-grade and above-grade unconnected impervious areas, respectively. Additional criteria for determining the lower limits of the downstream pervious area are presented in Figure 5-7. When using Figure 5-6 with overlapping pervious areas downstream of roof downspouts, the overlapping areas should be counted only once in the computation of the total pervious area downstream of the roof.

Finally, when computing the peak runoff rate or hydrograph from an area with unconnected impervious cover, the time of concentration of the combined impervious and downstream pervious area should be based upon the Tc of the downstream pervious area only, with the Tc route beginning as sheet flow at the upper end of the pervious area.

4 Triggering of landslides in vibration sensitive ground

Norway have large areas covered with marine sediments now above sea level due to land heave after the last ice age. Due to fresh water leaching out the salt particles in between the clay and silt particle, many areas have loose soils (i.e. high porosity) with large water content. Such soils are known to be sensitive, i.e. they lose almost all of their strength after failure. The cause of landslides in sensitive clays and loose soil deposits is usually associated with natural factors (e.g., erosion and precipitation), human activities e.g., placing of fill, excavation, or a combination of both. In addition to this, vibrations and loads from earthquakes, blasting, piling and other construction activities are known to have triggered landslides in sensitive clays and loose soils.

Earthquake induced landslides are very common and a lot of the knowledge related to vibration behaviour of soils have been developed to deal with the seismic stability of natural and engineered slopes. The information compiled in this report is to some extent based on literature dealing with seismic slopes stability. However, since quick clay slides are common in Norway information pertinent to vibration susceptibility of slopes with quick clay is also given.

In 2015, a report (in Norwegian) was issued dealing with construction vibrations, and possible impact on the stability of slopes with vibration sensitive materials, [26]. The work in the present SOA-report builds on parts of the 2015 report and extends it. Further, in 2014, NGI was engaged through the NIFS organisation (Natural Hazard, Infrastructure, Flooding and Landsliding) in the investigation of the technical cause for the landslide at Nord-Statland on 29 January 2014, [27]. The landslide led to a tsunami that caused great material damage. The conclusion of the investigation was that the landslide with high probability was triggered in the area where construction activity was taking place, and the vibro-compaction of fill masses may have had significant impact on the local stability. On the basis of this work, it became clear that there was a need to look further at how vibrations from construction work can disturb the soil and trigger slides in slopes.

In [28] the Nord-Statland case is described in more detail and a numerical tool is applied to evaluate the effect of vibro-compaction on the slope stability. Below are some examples of landslides where blasting, and vibro compaction is contributing factor to the triggering. Mitigation measures related to vibro compaction and sheet pile installation near shore line slopes are listed in section 4.3.

4.1 Case histories vibration induced landslides

Release of landslides in sensitive clays and other deposits with vibration sensitive material, such as loose sand and silt, is usually associated with natural factors (e.g., erosion and precipitation), human activities (e.g., filling, digging), or a combination of both. In addition to this, vibrations and loads from earthquakes, blasting, vibro-compaction, piling and construction traffic are known to have triggered landslides in

Table 7. Landslides possibly triggered by blasting or where blasting was recorded before landslides. References are given in [26]

Location	Country	Date	Volume (x 10^6 m^3)	PPV (mm/s)	Time range
Lade, Trondheim	Norway	04.25.1990	6	>20-25	3h21
Finneidfjord	Norway	??.01.1978	0.2	?	?
Finneidfjord	Norway	06.20.1996	1	> 9.25	2-3 t
Finneidfjord	Norway	03.11.2006	0.2	?	?
Kattmarka	Norway	03.13.2009	0.4	5.2	30 s
Sandnessjøen	Norway	01.06.1967	0.3-1	?	Shortly after blasting
Toulnustouc River, Quebec	Canada	23.05.1962	?	?	Shortly after blasting
La Romaine, Quebec	Canada	08.01.2009	~0.5	300	?
Uddevalla	Sweden	05.06.1973	?	?	?
Lödöse	Sweden	2011	?	30	< 24 t
Fröland	Sweden	1973	?	?	30-60 s

4.1.2 Slides where construction activities other than blasting may have been a contributing factor

Except for blasting, other construction activities which can induce vibrations large enough to trigger landslides are e.g vibro-compaction, and vibro-driving of sheet piles. Conventional hammer driving of piles is known to have caused landslides, but it is mainly thought to be due the static loads impose by the soil mass displacement. These types of effects are studied in a separate Remedy subproject.

Vibrations from vibro-compaction cause cyclical stresses and strains, which can lead to pore pressure build-up, cyclical degradation and failure of vibration sensitive soils. Too high water content in the ground can also create difficulties for the compaction work. If cyclic stresses from the compaction reach down to a fine-grained saturated soil, the pore pressure may increase in the material and thus reduce the strength, [26].

Table 8 give a brief list of landslides possibly triggered vibratory compaction or induced vibrations, which are described further below.

Table 8. Landslides possibly triggered vibratory compaction or induced vibrations.

Location	Country	Date	Reference
Trestycke vatten, South of Uddevalla	Sweden	1990	[31]
Åsele	Sweden	1983	[32]
Lake Ackerman, Michigan	USA	1987	[33]
Nord-Statland	Norway	2014	[27][26][34][35]

The investigation committee of the landslide of 29 January 2014 at the Nord-Statland in the Namdalseid municipality concluded the landslide was likely triggered by the construction activity, and that the impact of the compaction work with a vibratory roller may have been significant for the local stability, [27]. The vibratory roller used at Statland, was a Volvo SD115 D6 with vibration frequencies in the range of 23-33 Hz, and a maximum dynamic load of 258 kN [36][37]. Vibration analysis showed that the soil down to a depth of some 5 m may have been weakened due to the compaction work. The landslide occurred about an hour to an hour and half after compaction work was finished for the day. Based on these conditions, the simplified calculations in [27] showed that the cyclic shear stresses, due to underlying ground geometry and resonance, likely exceeded the cyclic strength of the soil materials in the shore area at Statland.

In Sweden, vibratory roller compaction caused a slope failure of a filling along the road RV 351 in Åsele on October 4, 1983, [32]. The landslide was triggered by a 3.3-ton tractor pulled roller doing repairs to the road fill, Figure 13. The road embankment was partly submerged and consisted of mass surplus from surrounding moraine masses.

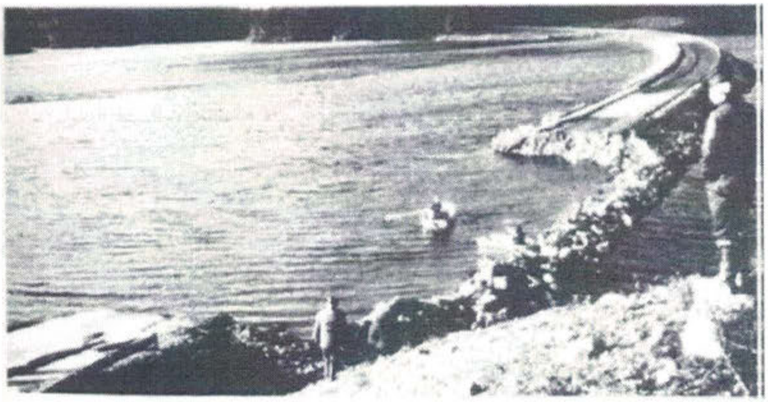


Figure 13. Overview of slide area at Åsele, 1983 (after [32]).

On July 24, 1987, a landslide was triggered in a road closure along Lake Ackerman on Highway 94 in Michigan, USA [33]. The landslide was triggered by six 22-ton (196-kN) trucks that generated seismic vibrations for a seismic reflection study. The road filling was a hydraulic filling consisting of loose and fine - medium sand. Studies by Hryciw et al. [33] indicate the vibrations from the seismic sources generated shear strains up to 0.055% and a shear stress ratio (τ / σ'v) estimated at 0.12. Each car at 2 meter intervals produced at least 25 load cycles above γ = 0.01% every 15 seconds. Results from stability evaluation show that the residual shear strength of the loose sand was on the order of 8-12 kPa.

A vibratory roller is also believed to have caused a landslide into a lake in Sweden in 1990. The following description is based on [31]. Some 80 km north of Gothenburg, south of Uddevalla, a slide occurred in connection with the construction of a berm designed to provide additional stability to an embankment for the E6 highway. The highway embankment was 1 year old when a layer of topsoil for vegetation was being placed with bulldozers and compacted by heavy vibratory roller. The embankment did not fail since it was founded on rock fill down to a competent base. However, a slide occurred towards the end of the placement of top soil. All the way from the highway embankment toe to the lake shore, the slope of the original ground surface was uniform and remarkably small ($\approx 1°$), which indicates the cause of the slide was related to the ongoing construction work and not due to inherent instability. The roughly 5 m high supporting berm had been constructed already in the fall of 1989 but was completed about a year later by adding a layer of topsoil for vegetation. The heavy berm had thus remained stable for more than a year, and during this period the underlying soil had been subject to drainage and consolidation. It seems, therefore, very unlikely that the slide was initiated solely by the weight of the thin layer of humus-rich topsoil, constituting only some 5 % of the total weight of fill that had already been placed more than a year before. Hence, the impact of the heavy vibratory roller on the subsoil is assumed to have been the triggering agent in the slide initiation process.

4.2 Effect of vibration on triggering landslides

4.2.1 Vibro compaction

Ground vibrations from vibratory rollers transmits large loads to the soil which can cause build-up of pore pressure and reduce soil strength in vibration susceptible soils such as loose silt and sand, and sensitive clays. This should be considered when carrying out construction work near slopes with such soils. The strength reduction is dependent on soil state, load amplitude and number of cycles.

Vibratory roller compaction is performed by passing over the same area up to 8 times [6], which means that a soil element is exposed to a large number of vibration cycles. The number of load cycles a soil element is subjected to depends on the speed of the roller, the vibration frequency and the depth. Vibratory rollers typically have vibration frequencies between 20-40 Hz. Both the load amplitude and vibration frequency varies with the type of soil and the thickness of the compacted layer. The operating speed is usually between 0.5 m/s (2 km/h) to 1.5 m/s (6 km/h). In [27] it was estimated that soil the elements were subjected to several hundreds of load cycles. A shallow soil element is in general subjected to larger amplitudes than a deeper soil element. Even though a deeper soil element is subjected to smaller vibration amplitude it is influenced by the vibratory equipment over a wider area.

To estimate the effect of compaction induced vibrations on a slope with vibration sensitive material, one can use empirical equations, e.g. [38], to estimate vibration amplitudes. However, such equations give vibration amplitude on the ground surface, while the slope failure is likely to be induced at some depth beneath the vibratory equipment. To evaluate the potential effect of vibro-compaction on the slope stability a numerical tool has been developed further and applied in the Remedy project to analyse the Nord-Statland landslide, see further description in [28].

An important aspect of predicting vibrations induced by construction activities is to account for the load dependent behaviour of the soil materials. Therefore, a nonlinear soil model has been used to capture the reduction of stiffness and increase in damping with increasing strain in the soil. The tool used in Remedy is promising in that results compare well with field experiments of vibratory compaction and pile experiments. The numerical tool has been used to analyse the effect of vibrations from compaction on the stability of the slope in connection with the Statland landslide described in section 4.1.2. The analysis supports the earlier findings in [27], that vibratory compaction can likely have caused an initial failure in the upper part of the slope, which then may have induced a wider large-scale failure of the slope. The effect of the vibrations from the vibratory roller in the analysed case reached to a depth of 4 m beneath and 13 m in front of the roller. An earlier study [39] suggested and influence zone of about 5 m thick by 15 m wide. Thus it seem pertinent to be very careful when performing vibratory compaction within some 15 m of the shore line.

4.2.2 Vibration from vibratory installation of sheet piles

We have not been able to find examples in the literature about slope failures or landslides caused by sheet pile installation. However, vibratory sheet pile installation do induce large vibrations that cause settlements in sand, and can cause damage to buildings close to the installation locations (see e.g. [40], [41], [37]). This indicates that vibratory sheet pile installation can cause failure in vibration sensitive soils. Therefore, one should plan carefully for installation of sheet piles in the vicinity of slopes with vibration sensitive materials as shown in Figure 14.

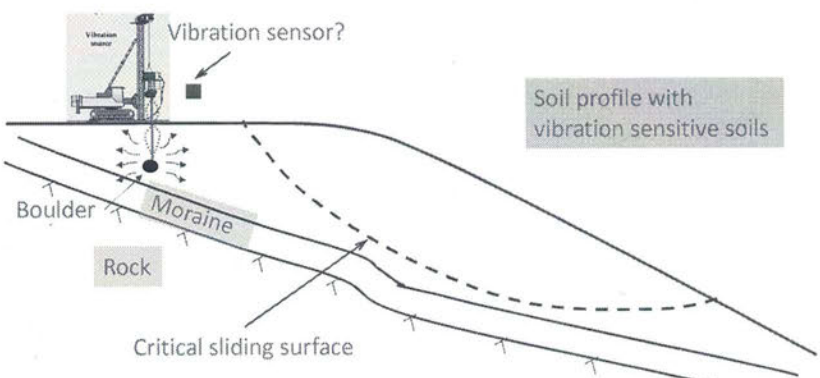


Figure 14. Vibratory sheet pile installation next to slope with vibration sensitive material. When the sheet pile hit strong materials like moraine or a boulder, vibrations in the soil can be become large. Driving-stop criteria can help avoiding large vibrations.

When the sheet pile is driven through quick clay material very little driving force is necessary to install the pile and thus induced vibrations are not very large. The fact that quick clay loses its strength also means it cannot transfer stresses and vibrations in to the surrounding soil. On the other hand, when the sheet pile hits strong materials such as moraine or a boulder outside or beneath the quick clay, the induced vibrations in the

Work and delays continue after Hamilton 403 landslide

By **David Brennan** - November 29, 2014, 7:18 pm

Crews were still working Saturday to repair the damage caused by a massive landslide Friday onto highway 403, triggered by a watermain break. It sent caused trees, mud and water sliding onto the highway just below York Boulevard, causing gridlock and chaos on Hamilton roads.

The 403 was closed for more than 10 hours and alternate routes were jammed. Saturday York Boulevard was still closed because of concerns the slope could collapse. City crews spent hours inspecting the hillside where the break happened.

Dan McKinnon, Director of Hamilton Water says they're not finished yet. "The first thing Monday morning there's going to be activity at the base of the slope again stabilizing the base of the slope that's likely going to require a lane closure on the 403." The work will take at least a week and will mean more delays for drivers on a stretch of highway that's already busy and often bottlenecked.

Hamilton Councillor for Ward 8 said the frustrating day illustrates a bigger problem. "We saw last night just the devastating effect it could have on travel throughout the lower city. We know the Ministry of Transportation is looking at expanding lanes on that stretch of road, we also know we need to do a better job on detouring traffic when there is a shut down that is a major corridor."

Crews will have to bring in material to the base of the slope and build it back up after 130 tonnes of dirt was trucked out after the landslide Friday. One lane of the Eastbound 403 will close after the morning rush hour on Monday.