Conservation Halton Board Meeting

Conservation Halton
2596 Britannia Road West, Burlington, ON
February 15, 2024, 1:00 PM - 4:00 PM EST

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Restoration of Sixteen Mile Creek

1847 Farmhouse

Lumber mill operated 1847-1920

(last mill owner Peter Sayers and family)

Ruins of the lumber mill still remain today.

Sayers Mills Lumber


By 1920 all the trees were cut down and the mill was closed and abandoned

Beavers periodically blocked the narrow channel further.

Beaver lodge

Beaver dam

In spring fast water gushed straight down the narrow passage with no floodplain to expand into….

…and in the summer months, the steep, narrow millrace barely flowed and was blocked with boulders.

For decades one bank of the old millpond became a dumping ground.

For many decades horses pastured in the wetlands.

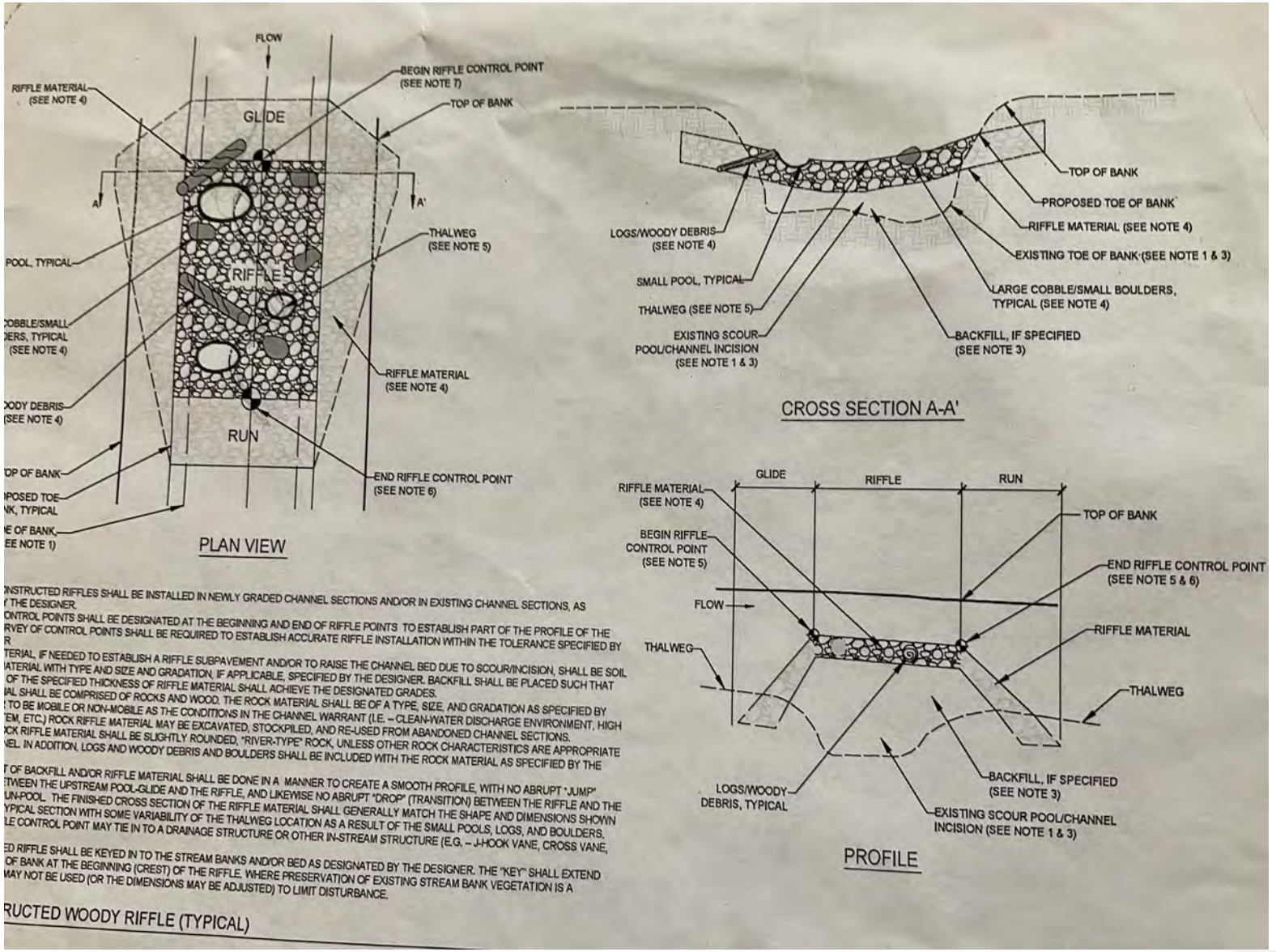
Nitrogen added to the water created excessive algae.

The entire wetland was over-grazed and badly degraded.

Once the dump was removed, and the horses were relocated, the vegetation began to recover, but the narrow, obstructed millrace and crumbling dam continued to obstruct fish. Without proper flow, excessive silt and algae had built up in the old millpond above the dam.

(video)

Conservation Halton began by contracting Environmental Engineers to conduct a survey and develop a detailed restoration plan.

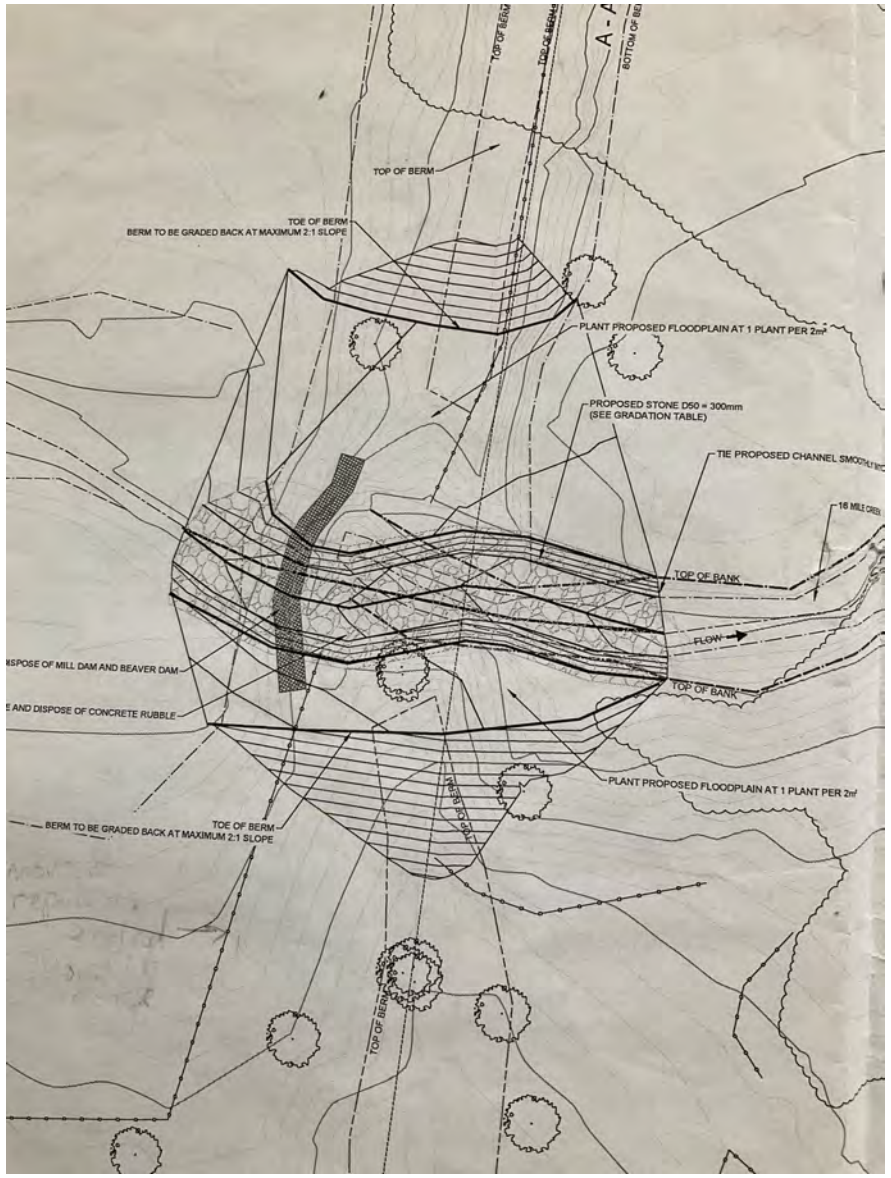


NSTRUCTED RIFFLES SHALL BE INSTALLED IN NEWLY GRADED CHANNEL SECTIONS AND/OR IN EXISTING CHANNEL SECTIONS, AS
THE DESIGNER.
ONTROL POINTS SHALL BE DESIGNATED AT THE BEGINNING AND END OF RIFFLE POINTS TO ESTABLISH PART OF THE PROFILE OF THE
RVEY OF CONTROL POINTS SHALL BE REQUIRED TO ESTABLISH ACCURATE RIFFLE INSTALLATION WITHIN THE TOLERANCE SPECIFIED BY
R
TERIAL, IF NEEDED TO ESTABLISH A RIFFLE SUBPAVEMENT AND/OR TO RAISE THE CHANNEL BED DUE TO SCOUR/INCISION, SHALL BE SOIL
ATERIAL WITH TYPE AND SIZE AND GRADATION, IF APPLICABLE, SPECIFIED BY THE DESIGNER. BACKFILL SHALL BE PLACED SUCH THAT
OF THE SPECIFIED THICKNESS OF RIFFLE MATERIAL SHALL ACHIEVE THE DESIGNATED GRADES.
AL SHALL BE COMPRISED OF ROCKS AND WOOD. THE ROCK MATERIAL SHALL BE OF A TYPE, SIZE, AND GRADATION AS SPECIFIED BY
TO BE MOBILE OR NON-MOBILE AS THE CONDITIONS IN THE CHANNEL WARRANT (I.E. – CLEAN-WATER DISCHARGE ENVIRONMENT, HIGH
EM, ETC.) ROCK RIFFLE MATERIAL MAY BE EXCAVATED, STOCKPILED, AND RE-USED FROM ABANDONED CHANNEL SECTIONS.
CK RIFFLE MATERIAL SHALL BE SLIGHTLY ROUNDED, "RIVER-TYPE" ROCK, UNLESS OTHER ROCK CHARACTERISTICS ARE APPROPRIATE
EL. IN ADDITION, LOGS AND WOODY DEBRIS AND BOULDERS SHALL BE INCLUDED WITH THE ROCK MATERIAL AS SPECIFIED BY THE

T OF BACKFILL AND/OR RIFFLE MATERIAL SHALL BE DONE IN A MANNER TO CREATE A SMOOTH PROFILE, WITH NO ABRUPT "JUMP"
TWEEN THE UPSTREAM POOL-GLIDE AND THE RIFFLE, AND LIKEWISE NO ABRUPT "DROP" (TRANSITION) BETWEEN THE RIFFLE AND THE
UN-POOL. THE FINISHED CROSS SECTION OF THE RIFFLE MATERIAL SHALL GENERALLY MATCH THE SHAPE AND DIMENSIONS SHOWN
YPICAL SECTION WITH SOME VARIABILITY OF THE THALWEG LOCATION AS A RESULT OF THE SMALL POOLS, LOGS, AND BOULDERS.
LE CONTROL POINT MAY TIE IN TO A DRAINAGE STRUCTURE OR OTHER IN-STREAM STRUCTURE (E.G. – J-HOOK VANE, CROSS VANE,

D RIFFLE SHALL BE KEYED IN TO THE STREAM BANKS AND/OR BED AS DESIGNATED BY THE DESIGNER. THE "KEY" SHALL EXTEND
OF BANK AT THE BEGINNING (CREST) OF THE RIFFLE. WHERE PRESERVATION OF EXISTING STREAM BANK VEGETATION IS A
MAY NOT BE USED (OR THE DIMENSIONS MAY BE ADJUSTED) TO LIMIT DISTURBANCE.

RUCTED WOODY RIFFLE (TYPICAL)



The plan called for the removal of the rusty culvert to be replaced by a wooden bridge. Underneath, the stream could flow freely over the newly installed river-rock.

In addition, the obstructing dam and the entire narrow millrace would be removed to be replaced by a natural meandering stream bed, flanked by a newly created floodplain.

In preparation, invasive Norway Maple trees were removed….

…and throughout the entire wetland, invasive vegetation, such as buckthorn, honeysuckle, and garlic mustard was removed and burned.

(video)

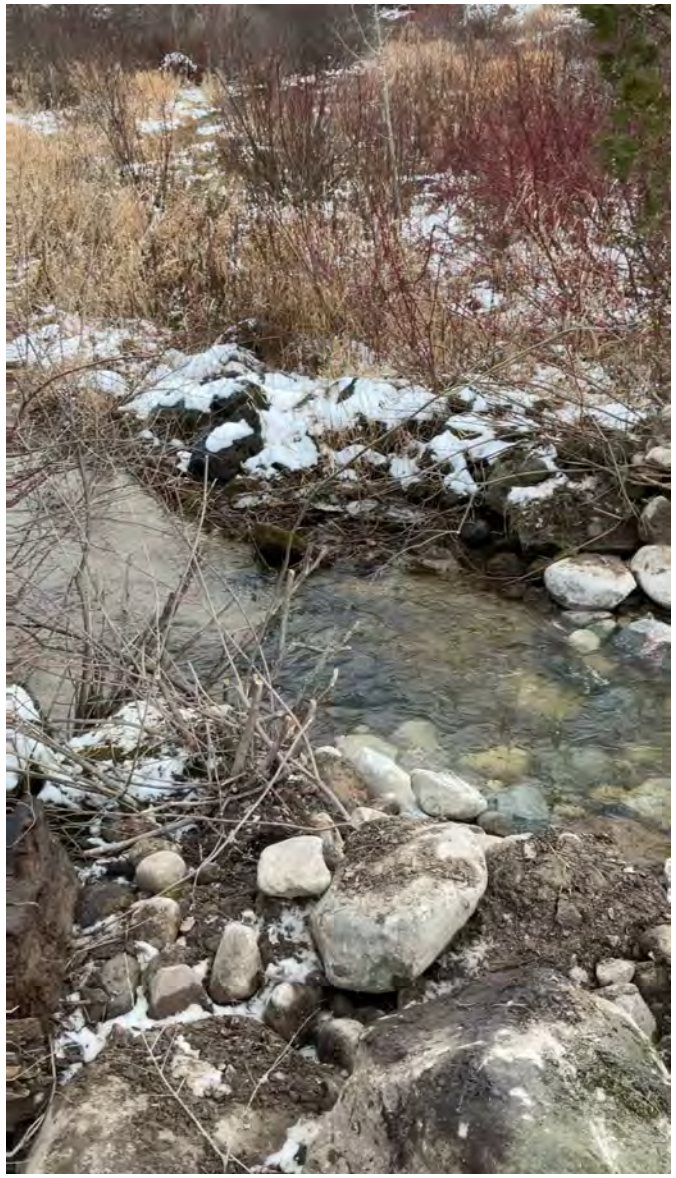
Trained Conservation Halton staff employed electrofishing methods to relocate any fish that lived in the area where construction would take place.

The creek flowed under a road, through a narrow rusty culvert at one end of the millpond.

The narrow culvert obstructed fish passage, and in high flow caused the area to flood badly.

The culvert was removed, and armor stone was brought in as a footing for the new wide wooden bridge.

River rock was delivered to replace the metal culvert with a natural stone creekbed.



Steel girders were anchored onto armor stone to span the creek for the new wooden bridge.

(video)

The stream flowed naturally and provided excellent fish and wildlife passage! (video)

Pump

Cofferdam (video)


DOOSAN

Cofferdam removed (video)

First winter **(video)**

Floodplain functions perfectly **(video)**

Biodegradable coir mats protected the disturbed slopes from erosion.

Live stakes of willow and dogwood were installed to encourage riparian growth along the creek.

In addition to native grass and wildflower seeds, hundreds of native trees and shrubs were planted.

...a diversity of native species

Work needed to be done to add meanders and narrow the creek for good fish habitat.

Conservation Halton staff installed sediment mats and log structures to shape the creek.

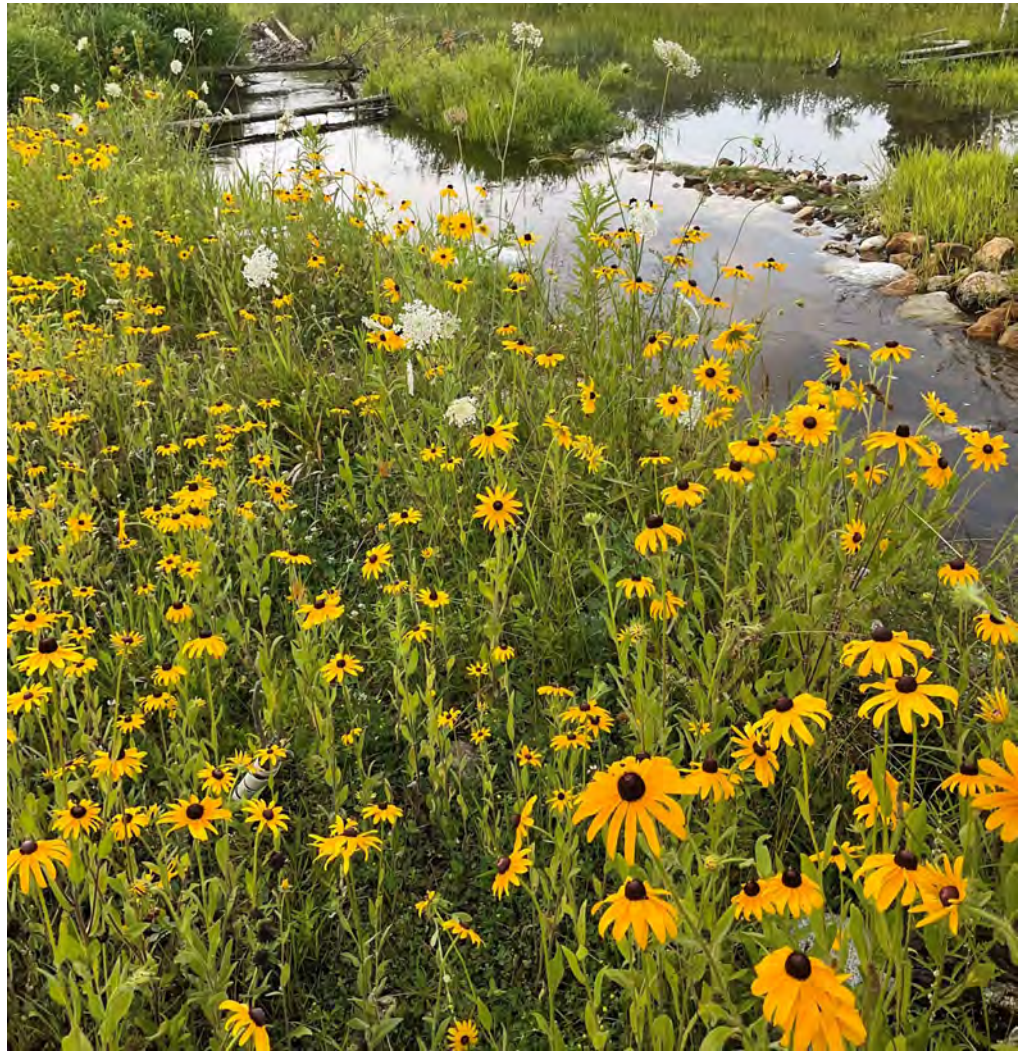
Recycled Christmas trees made excellent sediment mats and were biodegradable.

Adjoining artesian springs were cleared adding cold water from deep underground into the creek.

Before

After

Before



After

Before

After

Nature flourished in the restored wetlands. (video)

FUTURE PLANS:

- ✓ **Obtain "Provincially Significant" designation on the entire wetlands**
- ✓ **Obtain Federal Protection with the reintroduction of the endangered Redside Dace minnow into the pristine habitat**
- ✓ **Encourage a buffer of diverse established trees along the riparian buffer**


Special thanks to Conservation Halton

Conservation Halton Board Meeting Minutes
Conservation Halton
November 23, 2023, at 1:00 PM EST
@ Zoom Webinar

1. Roll Call

Members Present	Sara Bailey Rob Burton Cathy Duddeck (Vice Chair) Allan Elgar Jane Fogal Chantal Garneau Dave Gittings Gordon Krantz Gerry Smallegange (Chair) Kristina Tesser Derksen
Absent	Sameera Ali Cameron Kroetsch Shawna Stolte Alvin Tedjo Alex Wilson Maureen Wilson
Absent with Regrets	Sammy Ijaz Sue McFadden Marianne Meed Ward Rory Nisan
Staff Present	Hassaan Basit, President & CEO Garner Beckett, Executive Director, Conservation Halton Foundation Adriana Birza, Senior Advisor, Office of the President & CEO Craig Machan, Director, Parks & Operations Kellie McCormack, Director, Planning & Regulations Marnie Piggot, Director, Finance Plezzie Ramirez, Director, Human Resources Barb Veale, Senior Director, Watershed Strategies & Climate Change Mark Vytvytskyy, Chief Operating Officer Shelly Datseris, Manager, Communications & Marketing Martin Keller, Senior Manager, Watershed Planning & Source Protection Robyn Koutrouliotis, Admin. Assistant, Office of the President & CEO

The Chair called the meeting to order at 1:12 p.m.

2. Disclosure of Pecuniary Interest

There were **no disclosures of pecuniary interest.**

3. Acceptance of Agenda

CH 09 01 Moved by: Chantal Garneau
Seconded by: Sara Bailey

THAT the Agenda **be accepted as distributed.**

Carried

4. CEO Verbal Update

The CEO provided an update on various areas of the organization.

Financial

2024 Budget

Conservation Halton's (CH) 2024 budget was presented to Halton Region Council on November 15, 2023. Final budget approval is scheduled for December 13, 2023. The other funding municipalities did not request budget presentations.

Financial Update Report

The Budget Variance Report listed on the agenda as Item 5.9 notes a slowdown in planning applications and revenue. Staff is monitoring the situation and reviewing a mitigation strategy for any impacts to the 2024 budget.

Planning and Regulatory Policy/Mapping Matters

Conservation Halton Environmental Registry (ERO) Comments (Item 5.7)

Staff noted the formal comment period for the ERO has closed. However, municipalities still have the option to advocate to Provincial representatives.

Watercourse Realignment

Staff provided an overview of regulatory policy and major floodplain regulations governing tributary realignment.

Memorandum of Understanding for Conservation Halton's Watershed Programs and Services

The Memorandum of Understanding (MOU) agreements have been approved by all participating municipal councils and will be posted to the CH website.

Watershed Strategy

Survey

The Board was invited to provide insight regarding the key resource issues within CH's jurisdiction. Background information along with a survey is available on CH's website.

People

Hamilton-Niagara's Top Employers Award

CH was named one of Hamilton-Niagara's top employers for the second consecutive year.

Organized by the editors of Canada's Top 100 Employers, the annual competition recognizes employers based in Hamilton, Burlington, and Niagara that stand out as progressive and forward-thinking leaders in their sectors. The award recognizes our staff's passion and dedication.

The 2024 winners were announced in the Hamilton Spectator as part of a special feature and other posts on CH's social media platforms.

Parks

- The Request for Proposal (RFP) for the Crawford Lake boardwalk project has been awarded.
- The RFP for the Crawford Lake visitors' centre has now closed.
- The Kelso/Glen Eden Road paving project is complete.
- The Christmas Town event at Mountsberg Conservation Area has begun. Upcoming events include Winterlit and Maple Town.
- Hazard tree removal will begin at Clappison and Waterdown in December and continue through Spring 2024.

5. Consent Items

5.1. Approval of AMENDED September 21, 2023, Conservation Halton Board Meeting Minutes

5.2. Approval of DRAFT October 19, 2023, Conservation Halton Board Meeting Minutes

5.3. Approval of DRAFT November 9, 2023, Governance & Risk Committee Meeting Minutes

5.4. Purchasing Activity – August 1, 2023, to September 30, 2023 (CHB 09 23 01)

5.5. Permits & Letters of Permission Issued under Ontario Regulation 162/06 from July 1 to September 30, 2023 (Q3 2023) (CHB 09 23 02)

5.6. Conservation Halton Environmental Registry (ERO) Comments (CHB 09 23 03)

5.7. Partnership with Halton Region Federation of Agriculture (CHB 09 23 04)

5.8. Budget Variance Report for the Period Ended September 30, 2023, and 2023 Projected Year End Amounts (CHB 09 23 05)

6. Action Items

6.1. Proposed 2024 Planning and Permit Review Fees (CHB 09 23 06)

CH 09 02 Moved by: Kristina Tesser Derksen
Seconded by: Chantal Garneau

THAT the Conservation Halton Board **approves the proposed 2024 fees outlined in the staff report entitled "Proposed 2024 Planning and Permit Review Fees" dated November 23, 2023, with an effective date of January 1, 2024;**

And

THAT the Conservation Halton Board **directs staff to provide appropriate notice to municipalities and neighbouring conservation authorities and post the revised fee schedules to Conservation Halton's website.**

Carried

7. In Camera

CHB 09 03 Moved by: Jane Fogal
Seconded by: Gordon Krantz

THAT the Conservation Halton Board **move In Camera.**

Carried

7.1. Legal Matter (CHB 09 23 07)

7.2. Legal Matter (CHB 09 23 08)

7.3. Personnel Matter (CHB 09 23 09)

CHB 09 04 Moved by: Allan Elgar
Seconded by: Cathy Duddeck

THAT the Conservation Halton Board **reconvene in public forum**.

Carried

8. Other Business

There was **no other business.**

9. Adjournment

CHB 09 05 Moved by: Allan Elgar

THAT the Conservation Halton Board meeting **be adjourned at 2:13 p.m**.

Carried

Signed by: Hassaan Basit, President & CEO/Secretary-Treasurer

Date: February 15, 2024

REPORT TO: **Conservation Halton Board**

REPORT NO.: # CHB 01 24 01

FROM: Mark Vytvytskyy, Chief Operating Officer

DATE: February 15, 2024

SUBJECT: **Purchasing Activity – October 1, 2023, to December 31, 2023**

Recommendation

THAT the Conservation Halton Board **receives for information the Purchasing Activity report for the period of October 1, 2023, to December 31, 2023, in accordance with the Conservation Halton Purchasing Policy.**

Report

The following report summarizes purchases to be reported during the period of October 1, 2023, to December 31, 2023.

The Conservation Halton (CH) Purchasing Policy requires single or sole source purchases greater than $25,000 (not including taxes) and Requests for Proposals (RFPs)/Requests for Quotations (RFQs)/Requests for Tenders (RFTs) awarded up to a value of $500,000 (not including taxes) to be reported to the CH Board for information. Requests for Proposal and Tender award recommendations that exceed $500,000 (not including taxes) will be subject to Board approval prior to award.

Single or Sole Source Purchases (above $25,000 excl. HST):

Vendor	Amount	Details
Rocky Mountain Conveyor & Equipment Inc.	$45,712	Vendor awarded November 30, 2023, to provide carpet belting for Kelso carpet lift following a Technical Standards and Safety Authority (TSSA) inspection indicating a replacement was required.
Stantec Consulting Inc.	$34,602	Consultant awarded November 10, 2023, to provide design and tendering preparation services for the Scotch Block intake and sluice gate refurbishment due to existing familiarity with the project scope, including previous provision of the initial condition assessment.

Request for Proposals/Quotations (less than $500,000 excl. HST reported to the Board for information):

Vendor	Amount	Details
WSP Canada Inc.	$229,722	Consultant awarded November 14, 2023, via publicly solicited RFP 092223 to provide Crawford Lake boardwalk reconstruction, design, and contract administration services.
Matrix Solutions Inc.	$148,706	Consultant awarded August 4, 2023, via publicly solicited RFQ 23707 to provide watershed climate change vulnerability and risk assessment services.
Roth IAMS Ltd.	$29,927	Consultant awarded November 2, 2023, via publicly solicited RFP 092123 to provide accessibility audit and reporting services.

Request for Tenders (less than $500,000 excl. HST reported to the Board for information):

Vendor	Amount	Details
R.A. Electrical	$61,280	Contractor awarded October 4, 2023, via publicly issued RFT 090823 to secure electrical infrastructure upgrades at Mountsberg CA.
N1 Construction Ltd.	$81,800	Contractor awarded November 7, 2023, via publicly issued RFT 101123 to secure the field office roof replacement.

Impact on Strategic Priorities

This report supports the Momentum priority of Organizational Sustainability by ensuring consistent and transparent processes are in place for reporting large purchases.

Financial Impact

There is no financial impact to this report.

Signed & respectfully submitted:

Mark Vytvytskyy
Chief Operating Officer

Approved for circulation:

Hassaan Basit
President & CEO/Secretary-Treasurer

FOR QUESTIONS ON CONTENT: Mark Vytvytskyy, Chief Operating Officer
mvytvytskyy@hrca.on.ca, 905-336-1158 x 1228

PREPARED BY: Pavan Seth, Procurement Manager

TO: **Conservation Halton Board**

MEMO: # CHB 01 24 02

FROM: Kellie McCormack, Director, Planning & Regulations

DATE: February 15, 2024

SUBJECT: **Status of Conservation Halton's Regulatory, Spill Flood Hazard, and Land Use Planning Policy Reviews**
CH File Nos. ADM 330, ADM 343, ADM 365

MEMO

This memorandum is to provide a status update on the review and update to Conservation Halton's (CH) regulatory, land use planning, and spill flood hazard policies. The updates to CH's spill flood hazard policies and land use planning policies were last outlined in staff reports CHBD 07 22 11 and CHBD 05 22 02. A proposed update to regulatory allowance policies is presented in the February 2024 report CHB 01 24 07.

Following the introduction of Bill 23, *More Homes Built Faster Act, 2022*, CH continued to advance policy projects, but public and stakeholder engagement was paused as new regulations under Section 28 of the *Conservation Authorities Act* (CA Act) and updated Provincial Policy Statement (PPS) were anticipated (CHB 03 23 06). While these changes could impact how Conservation Authorities (CAs) regulate and manage hazards in the future, the timing for release of these items is unknown. As such, the following policy work will be advanced by CH staff in 2024:

- Delivery of draft spill flood hazard policies to the CH Board for public consultation and engagement by Q2 2024.
- Delivery of draft land use policies to the CH Board for public consultation and engagement by Q3 2024.
- Continue with ongoing background and internal review on remaining regulatory policies. Staff anticipates returning to the CH Board with a high-level work plan to update remaining regulatory policies in spring 2024 (pending Provincial changes).

February
2024

REPORT TO: **Conservation Halton Board**

REPORT NO.: # CHB 01 24 03

FROM: Kellie McCormack, Director, Planning & Regulations

DATE: February 15, 2024

SUBJECT: **Permits & Letters of Permission issued under *Ontario Regulation 162/06* from October 1 to December 31, 2023 (Q4 2023)**
CH File No.: AADM-420

Recommendation

THAT the Conservation Halton Board **receives for information the staff report entitled "Permits and Letters of Permission issued under *Ontario Regulation 162/06* from October 1 to December 31, 2023 (Q4 2023)".**

Report

Between October 1, 2023, and December 31, 2023, Conservation Halton (CH) staff issued eighty-one (81) Permits and eight (8) Letters of Permission (see Attachment 1: Table of Permits & Letter of Permission Issued). All approvals were reviewed and approved in accordance with Board-approved policies contained in CH's *Policies and Guidelines for the Administration of Ontario Regulation 162/06 and Land Use Planning Policy Document* dated April 27, 2006, last amended, November 26, 2020, or through a site-specific policy exception as approved by the CH Board.

Impact on Strategic Priorities

This report supports the Momentum priority of Natural Hazards and Water.

Financial Impact

CH staff works with permit applicants to address their needs while meeting Board-approved policies for administering *Ontario Regulation 162/06*. Fees for permits are based on staff time and effort required to process different types of applications, as approved by the Board.

Signed & respectfully submitted:

Kellie McCormack
Director, Planning and Regulations

Approved for circulation:

Hassaan Basit
President & CEO/Secretary-Treasurer

FOR QUESTIONS ON CONTENT: Kellie McCormack, Director, Planning & Regulations
kmcormack@hrca.on.ca, 905-336-1158 x 2228

PREPARED BY: Michelle Caissie, Service Coordinator,
Planning & Regulations

Attachments: Attachment 1: Table of Permits & Letters of Permission Issued

Permits & Letters of Permission 1 OCT 2023 TO 31 DEC 2023

Municipality	Permit	LOP	Total
Burlington	33	0	32
Halton Hills	4	0	4
Hamilton	13	6	19
Milton	12	1	13
Mississauga	2	0	2
Oakville	17	0	17
Puslinch	0	1	1
	81	8	88

Municipality	CAID	Permit No.	Address	Proposed Works	Permit	LOP	Complete	Issued	CH Staff Member
Burlington	RAPP-9109	8744	3339 No. 1 Sideroad	Replacement of a 1000mm culvert with a 1500mm culvert requiring the construction of a concrete headwall and channel alterations including the addition of subangular stone and grading within the flooding and erosion hazards associated with a tributary of Appleby Creek.	YES		Dec 07 2023	Dec 11 2023	Karen Reis
	RAPP-8432	8046 – REVISED	3000 Lakeshore Road (Port Nelson Park)	REVISED - Re-construction of shoreline protection works involving the placement of two levels of armourstone placed along the lakebed, a reinforced concrete pad and headwall, and capstone.	YES		Sep 28 2023	Oct 19 2023	Cassandra Connolly
	RAPP-8431	8045 - REVISED	0 Green Street	REVISED - Re-construction of shoreline protection works involving the placement of two levels of armourstone placed along the lakebed, a reinforced concrete pad and headwall, and capstone	YES		Sep 28 2023	Oct 19 2023	Cassandra Connolly
	RAPP-4686	8050 - REVISED	0 Waterdown Road (South of Flatt Rd)	REVISED - Construction of a stormwater outfall to Grindstone Creek including excavation and grading within the valley and 15m regulatory allowance as part of the Waterdown Road Widening municipal project.	YES		Oct 10 2023	Nov 21 2023	Cassandra Connolly

Municipality	CAID	Permit No.	Address	Proposed Works	Permit	LOP	Complete	Issued	CH Staff Member
	RAPP-270	8244 - REVISED	556 North Shore Boulevard	REVISED - Re-construction and expansion of a dwelling, construction of a garage, patios, retaining walls, and site grading, meeting setbacks applicable for habitable and non-habitable development, within the erosion hazard associated with the shoreline of Lake Ontario	YES		Nov 03 2023	Nov 14 2023	Cassandra Connolly
	RAPP-8943	8577 - REVISED	Martha Street (James Street to Pine Street)	REVISED - Installation of ± 142.2m of 1-4" Rogers Communications conduit and two vaults via directional bore within the floodplain associated with Rambo Creek Martha Street - From James St. to Pine St.	YES		Dec 11 2023	Dec 14 2023	Cassandra Connolly
	RAPP-8968	8602 - REVISED	52 Old York Road	REVISED - Construction of a one-storey addition to a dwelling between 6-15m from the meanderbelt erosion hazard of Grindstone Creek.	YES		Nov 02 2023	Nov 08 2023	Cassandra Connolly
	RAPP-9059	8672	2619 Bluffs Way	Construction of a new dwelling, two (2) detached garages, driveway, septic system, patio, cabana, and pool between 15-120 metres of a Provincially Significant Wetland within an approved Plan of Subdivision.	YES		Oct 12 2023	Oct 25 2023	Cassandra Connolly
	RAPP-9056	8676	312 North Shore Blvd., West	Construction of a new dwelling with rear terrace, driveway, swimming pool, patio, and hardscaping within the erosion hazard of the shoreline of Lake Ontario, maintaining minimum setback requirements for habitable and non-habitable development.	YES		Sep 13 2023	Oct 02 2023	Cassandra Connolly

Municipality	CAID	Permit No.	Address	Proposed Works	Permit	LOP	Complete	Issued	CH Staff Member
	RAPP-9065	8677	818 Belhaven Crescent	Installation of ± 23.0 meters of new NPS 1 ¼" natural gas pipeline via horizontal directional drill within the valley of a tributary within the West Aldershot Creek watershed, to accommodate residential servicing.	YES		Sep 20 2023	Oct 04 2023	Cassandra Connolly
	RAPP-9085	8689	0 Guelph Line (Colling Rd to Britannia Rd)	Installation of curb and gutter (subdrain) outlets and ditch re-grading along Guelph Line partially within the flooding and erosion hazard associated with Bronte Creek.	YES		Oct 12 2023	Oct 16 2023	Ben Davis
	RAPP-8997	8691	4420 Guelph Line	Installation of 210 metres of new natural gas line crossing beneath Bronte Creek and a wetland less than 2 hectares using HDD method.	YES		Oct 18 2023	Oct 19 2023	Karen Reis
	RAPP-9068	8695	446 Indian Road	Construction of a detached seasonal sunroom within the erosion hazard of the shoreline of Lake Ontario (Hamilton Harbour/Burlington Bay), meeting setback requirements for non-habitable accessory structures.	YES		Sep 26 2023	Oct 20 2023	Cassandra Connolly
	RAPP-416	8697	1786 Snake Road	Re-construction and expansion of a dwelling and septic replacement located within the valley of Grindstone Creek.	YES		Sep 06 2022	Oct 23 2023	Cassandra Connolly
	RAPP-263	8702	0 Appleby Place	Construction of a revetment and toe protection for shoreline protection works and construction/reconstruction of park space amenities within the erosion hazard of the shoreline of Lake Ontario.	YES		Sep 28 2023	Oct 30 2023	Cassandra Connolly

Municipality	CAID	Permit No.	Address	Proposed Works	Permit	LOP	Complete	Issued	CH Staff Member
	RAPP-7733	8703	0 Cedar Springs Road (adj. to 6097)	Minor creek alteration including installation of toe protection, wing deflectors, and rock weirs within a tributary of Bronte Creek for erosion protection and bank stability.	YES		Oct 17 2023	Oct 30 2023	Cassandra Connolly
	RAPP-9092	8708	3430 Regal Road	Enbridge integrity dig requiring temporary excavation and regrading within the flooding and erosion hazards and 7.5m regulatory allowance associated with Tuck Creek	YES		Oct 24 2023	Nov 06 2023	Cassandra Connolly
	RAPP-9099	8709	No. 1 Sideroad (Cedar Springs to Millar Cres - crossing 1)	Installation of a new natural gas line crossing beneath Grindstone Creek and Provincially Significant Wetlands using Horizontal Directional Drilling method.	YES		Nov 01 2023	Nov 06 2023	Karen Reis
	RAPP-9084	8710	1584 Frontenac Place	Re-construction of a rear deck, no closer than existing development, within the valley of Upper Rambo Creek.	YES		Oct 17 2023	Nov 07 2023	Cassandra Connolly
	RAPP-9091	8713	658 North Shore Blvd East	Construction of patios/terraces, swimming pool, and hardscaping retaining walls within the erosion hazard of the shoreline of Lake Ontario, maintaining setback requirements for non-habitable development.	YES		Oct 25 2023	Nov 08 2023	Cassandra Connolly
	RAPP-9096	8719	Lemonville Road Bridge (60m east of Hidden Valley Road)	Reconstruction and repair to the Lemonville Road Bridge which conveys a tributary of Grindstone Creek.	YES		Oct 31 2023	Nov 13 2023	Cassandra Connolly
	RAPP-9089	8726	865 Danforth Place	Installation of ±13m of new NPS 1 ¼" natural gas pipeline, partially within the erosion hazard associated with the Lake Ontario, for residential servicing.	YES		Nov 14 2023	Nov 21 2023	Cassandra Connolly

Municipality	CAID	Permit No.	Address	Proposed Works	Permit	LOP	Complete	Issued	CH Staff Member
	RAPP-9106	8729	4184 Inglewood Drive	Installation of ± 23m of new NPS 1 ¼" natural gas pipeline, partially within the erosion hazard associated with the Lake Ontario, for residential servicing.	YES		Nov 14 2023	Nov 22 2023	Cassandra Connolly
	RAPP-9113	8730	2126 Orchard Road	Installation of ± 26m of new NPS 1 ¼" natural gas pipeline, within the 7.5m regulatory allowance from the floodplain of Sheldon Creek, for residential servicing.	YES		Nov 15 2023	Nov 22 2023	Cassandra Connolly
	RAPP-401	8732	5101 Mount Nemo Crescent	Construction of a second-storey addition to a dwelling located within 30m of a Provincially Significant Wetland (PSW).	YES		Nov 14 2023	Nov 29 2023	Cassandra Connolly
	RAPP-9103	8736	Kerns Road (adj to 616 Dundas St E to adj. to 2108 Salisbury Court)	Installation of four (4) temporary crossings of Upper Hager Creek along an Enbridge pipeline Right-of-Way.	YES		Nov 21 2023	Nov 30 2023	Cassandra Connolly
	RAPP-9108	8742	3330 Milburough Line	Replacement of a 300mm culvert with a 375mm culvert requiring a new concrete headwall, channel alterations including grading within the flooding and erosion hazards associated with a tributary of Grindstone Creek.	YES		Dec 07 2023	Dec 08 2023	Karen Reis
	RAPP-9119	8743	2263 Ingersoll Drive	Construction of an addition to a dwelling located partially within the 7.5m regulatory allowance associated with Roseland Creek.	YES		Nov 23 2023	Dec 08 2023	Cassandra Connolly
	RAPP-9134	8745	1509 Norwood Avenue	Installation of ± 10m of new NPS 1 ¼" natural gas pipeline partially within the 15m regulatory allowance associated with the valley of Grindstone Creek, for residential servicing of a dwelling.	YES		Dec 07 2023	Dec 11 2023	Cassandra Connolly

Municipality	CAID	Permit No.	Address	Proposed Works	Permit	LOP	Complete	Issued	CH Staff Member
	RAPP-9095	8747	2058 Mckerlie Crescent	Re-construction of second-storey deck and construction of an on grade lower deck within the 7.5m regulatory allowance from the flooding and erosion hazards associated with Appleby Creek.	YES		Dec 06 2023	Dec 13 2023	Cassandra Connolly
	RAPP-9090	8750	5318 Cedar Springs Road	Replacement of a septic system within the valley associated with Bronte Creek and within 30 metres of a Provincially Significant Wetland (PSW).	YES		Dec 21 2023	Dec 21 2023	Karen Reis
	RAPP-9072	8751	1300 Kilbride Street	Installation of 32 metres of new natural gas line within 15 metres of a wetland less than 2 hectares.	YES		Dec 21 2023	Dec 21 2023	Karen Reis
	RAPP-9115	8752	2506 Britannia Road	Installation of 140 metres of new natural gas line crossing beneath a tributary of Bronte Creek.	YES		Dec 22 2023	Dec 28 2023	Karen Reis

Municipality	CAID	Permit No.	Address	Proposed Works	Permit	LOP	Complete	Issued	CH Staff Member
Halton Hills	RAPP-9093	8704	10757 Fifth Line	Installation of an NPS 1-inch pipeline, NPS 2-inch pipeline and regulator within the floodplain associated with a tributary of Sixteen Mile Creek.	YES		Oct 23 2023	Oct 30 2023	Justin McArthur
	RAPP-9107	8723	11387 Fifth Line	Construction of an addition to a dwelling between 6 and 15 metres of the floodplain associated with a tributary of Sixteen Mile Creek.	YES		Nov 10 2023	Nov 20 2023	Justin McArthur
	RAPP-9064	8728	0 Fifth Line (650m north-west of Brigden Gate)	Construction of a vegetated rock buttress, riprap spillway and concrete repairs to protect and repair an existing crossing that conveys a tributary of Sixteen Mile Creek.	YES		Sep 21 2023	Nov 22 2023	Justin McArthur
	RAPP-8910	8739	13168 Steeles Avenue	Construction of a sanitary sewer service line within the floodplain associated with a tributary of Sixteen Mile Creek and between 30 and 120 metres from a wetland greater than 2 hectares in size.	YES		Nov 28 2023	Dec 06 2023	Justin McArthur
Hamilton	RAPP-9082	8680	845 Centre Road	Construction of an addition to a dwelling located within 30m of a wetland less than 2 hectares in size, no closer toward the wetland than existing development.	YES		Sep 26 2023	Oct 06 2023	Cassandra Connolly
	RAPP-9038	8681	Fifth Concession Road W (Highway 6 to Palmer Lane)	Excavation and grading within the floodplain and 15m regulatory allowance associated with Grindstone Creek associated with municipal ditching/maintenance.	YES		Sep 29 2023	Oct 06 2023	Cassandra Connolly
	RAPP-9036	8682	825-859 Millgrove Sideroad (inclusive of park entrance)	Municipal culvert replacements and excavation and grading within the floodplain of Grindstone Creek and within 120m of a Provincially Significant Wetland (PSW).	YES		Sep 27 2023	Oct 06 2023	Cassandra Connolly

Municipality	CAID	Permit No.	Address	Proposed Works	Permit	LOP	Complete	Issued	CH Staff Member
	RAPP-9037	8683	550 Tenth Concession Road E. (adj to 1617 Milburough Line)	Municipal culvert replacements and excavation and grading within the floodplain of Grindstone Creek and within 120m of a Provincially Significant Wetland (PSW).	YES		Sep 27 2023	Oct 06 2023	Cassandra Connolly
	RAPP-9073	8693	879 Centre Road	Installation of ±32 m of new NPS 1¼" pipeline via horizontal directional drill method, partially within the 7.5m regulatory allowance associated with Grindstone for residential servicing.	YES		Sep 29 2023	Oct 19 2023	Cassandra Connolly
	RAPP-9071	8694	240 Concession Rd 6 East	Installation of ±2 m of new NPS 1¼" pipeline via horizontal directional drill method, within flooding and erosion hazards of Grindstone Creek and within Provincially Significant Wetland, for residential servicing.	YES		Sep 29 2023	Oct 19 2023	Cassandra Connolly
	RAPP-9087	8698	240 Concession 6 Road East	Replacement of a septic system located partially within the 15m regulatory allowance associated with the erosion hazard of Grindstone Creek and within 15m of a wetland less than 2ha in size	YES		Oct 17 2023	Oct 20 2023	Cassandra Connolly
	RAPP-8954	8706	1039 Regional Road 97	Removal of a culvert located within a Provincially Significant Wetland and conveying a tributary of Bronte Creek, and the construction of a new pedestrian bridge which will span the watercourse.	YES			Nov 03 2023	Cassandra Connolly

Municipality	CAID	Permit No.	Address	Proposed Works	Permit	LOP	Complete	Issued	CH Staff Member
	RAPP-9098	8712	544 Evans Road	Reconstruction and expansion of a 1.5 storey garage including a new loft and foyer, new covered back porch and extension of the front porch within the floodplain associated with Grindstone creek and within 30-120m of a wetland greater than 2 hectares.	YES		Nov 01 2023	Nov 07 2023	Karen Reis
	RAPP-9100	8733	Centre Road (1044 Garden Lane & 1048 Centre Road)	Installation of a temporary crossing of a tributary of Grindstone Creek, and temporary access routes within a Provincially Significant Wetland along an Enbridge pipeline Right-of-Way.	YES		Nov 21 2023	Nov 29 2023	Cassandra Connolly
	RAPP-9101	8734	Concession 5 East (513 Concession 5 E to 573 Parkside Drive)	Installation of a temporary crossing of a tributary of Grindstone Creek, and temporary access routes within a Provincially Significant Wetland along an Enbridge pipeline Right-of-Way.	YES		Nov 21 2023	Nov 29 2023	Cassandra Connolly
	RAPP-9102	8735	Parkside Drive (596 Parkside Drive & 582 Parkside Drive)	Installation of two (2) temporary crossings of Grindstone Creek, and temporary access routes within a Provincially Significant Wetland along an Enbridge pipeline Right-of-Way.	YES		Nov 21 2023	Nov 29 2023	Cassandra Connolly
	RAPP-9126	8737	367 Concession 5 East	To construct a stormwater management pond, farm lane, and greenhouse within 30-120 of a wetland greater than 2 hectares, and to complete minor grading works within the floodplain associated with Grindstone creek.	YES		Nov 29 2023	Dec 05 2023	Karen Reis

Municipality	CAID	Permit No.	Address	Proposed Works	Permit	LOP	Complete	Issued	CH Staff Member
	RAPL-1041	Letter of Permission	1067 Milburough Line	REVISED – Reconstruction and expansion of a dwelling, detached garage, extension of an existing asphalt driveway, and septic system replacement/relocation within 30 metres and 120 meters of a Provincially Significant Wetland (PSW).		YES		Oct 31 2023	Cassandra Connolly
	RAPL-1044	Letter of Permission	39 Palomino Drive	Construction of a detached accessory building within 30 and 120 metres of a Provincially Significant Wetland (PSW).		YES	Sep 21 2023	Oct 04 2023	Cassandra Connolly
	RAPL-1049	Letter of Permission	1020 Regional Road 97	Construction of an addition to an existing dwelling located within 30 metres and 120 meters of a Provincially Significant Wetland (PSW).		YES	Oct 31 2023	Nov 06 2023	Cassandra Connolly
	RAPL-1050	Letter of Permission	233 Carlisle Road	Construction of an addition to a dwelling, new porches, and replacement of a septic system located within 30-120m from a wetland greater than 2ha in size.		YES	Dec 02 2023	Dec 08 2023	Cassandra Connolly
	RAPL-1051	Letter of Permission	1165 Highway Six North	Construction of an addition to a dwelling located within 30-120m from a Provincially Significant Wetland (PSW).		YES	Dec 04 2023	Dec 06 2023	Cassandra Connolly
	RAPL-1053	Letter of Permission	99 Concession 7 Road East	Construction of an addition, covered porch, and septic system between 30 and 120 metres of a wetland greater than 2 hectares in size.		YES	Dec 15 2023	Dec 19 2023	Karen Reis
Milton	RAPP-9034	8642 - REVISED	1860 Thomspon Road South	REVISED - Reconstruction and expansion of an existing pavilion between 6 and 15 metres of the valley associated with a tributary of Sixteen Mile Creek.	YES			Oct 30 2023	Justin McArthur

Municipality	CAID	Permit No.	Address	Proposed Works	Permit	LOP	Complete	Issued	CH Staff Member
	RAPP-9003	8679	1211 Fourth Line	Construction of a sanitary sewer crossing beneath a tributary of Sixteen Mile Creek and the extension of a sanitary sewer and watermain within the floodplain.	YES		Jul 21 2023	Oct 05 2023	Justin McArthur
	RAPP-822	8688	0 Fourth Line MLS III (realignment)	Realignment of a tributary of Sixteen Mile Creek and its associated hazards within the MLSIII-75 Subdivision.	YES		Oct 04 2022	Oct 16 2023	Justin McArthur
	RAPP-8856	8699	6712 Fifth Line	Site alteration including grading to construct a wetland within 15 metres of the flooding and erosion hazards associated with a tributary of Sixteen Mile Creek, as well as the temporary placement of a crossing of the tributary.	YES		Aug 23 2023	Oct 24 2023	Justin McArthur
	RAPP-9078	8701	11374 Nassagaweya Esquesing Townline	Replacement of a flow control structure within 30 metres of a Provincially Significant Wetland (PSW).	YES		Oct 20 2023	Oct 27 2023	Justin McArthur
	RAPP-814	8705	150 Steeles Avenue	Site alteration including grading and placement of fill to construct a new wetland within 120 metres of an existing wetland greater than 2 hectares in size.	YES		Nov 01 2023	Nov 01 2023	Justin McArthur
	RAPP-9041	8721	1334 Fourth Line	Construction of an outfall and emergency spillway within the floodplain associated with a tributary of Sixteen Mile Creek.	YES		Oct 23 2023	Nov 15 2023	Justin McArthur
	RAPP-9117	8724	0 Britannia Road (160m West of Sixth Line)	Replacement of an existing structural bridge (Crossing 15), channel restoration and installation of a 1500mm sanitary sewer within the floodplain associated with Sixteen Mile Creek and associated with the reconstruction and widening of Britannia Road.	YES		Nov 20 2023	Nov 21 2023	Ben Davis

Permits LOP, FROM 1 OCT 2023 TO 31 DEC 2023

Municipality	CAID	Permit No.	Address	Proposed Works	Permit	LOP	Complete	Issued	CH Staff Member
	RAPP-9118	8725	0 Britannia Road (540m West of Eighth Line)	Replacement of an existing structural culvert (Crossing 17) and installation of a 400mm watermain within the floodplain associated with Sixteen Mile Creek and associated with the reconstruction and widening of Britannia Road.	YES		Nov 20 2023	Nov 21 2023	Ben Davis
	RAPP-9120	8740	1501 Fourth Line	Construction of a temporary erosion and sediment control pond outlet and emergency spillway within the flooding and erosion hazards associated with a tributary of Sixteen Mile Creek.	YES		Dec 04 2023	Dec 06 2023	Justin McArthur
	RAPP-9137	8746	1334 Fourth Line	Installation of an 8-inch and 4-inch natural gas pipeline crossing beneath a tributary of Sixteen Mile Creek.	YES		Dec 13 2023	Dec 13 2023	Justin McArthur
	RAPP-9123	8749	0 Derry Road (James Snow Pkwy to Hwy 407)	Road rehabilitation including 1.5m shoulder road widening and storm sewer repair partially within the floodplain of Sixteen Mile Creek.	YES		Dec 18 2023	Dec 19 2023	Ben Davis
	RAPL-1047	Letter of Permission	7548 Sixth Line	Construction of a new septic system located between 30 and 120 metres of a wetland greater than 2 hectares in size.		YES	Oct 03 2023	Oct 05 2023	Justin McArthur

Municipality	CAID	Permit No.	Address	Proposed Works	Permit	LOP	Complete	Issued	CH Staff Member
Mississauga	RAPP-8990	8687	0 Doug Leavens Blvd (behind 6607 Alderwood Trail)	Construction of a below grade concrete wet well, gravity sewer, forcemain, three submersible pumps, access road, parking area within the flooding and erosion hazards associated with Sixteen Mile Creek.	YES		Oct 25 2023	Oct 25 2023	Adam Heizer
	RAPP-9063	8741	5320 Ninth Line	The construction of a tennis dome, parking lot, and temporary sediment basin within 15 metres of the floodplain associated with Sixteen Mile Creek, and works associated with a stormwater management pond including the replacement of a headwall and installation of culverts and storm sewers within the floodplain.	YES		Dec 06 2023	Dec 08 2023	Karen Reis
Oakville	RAPP-9076	8678	1276 Cambridge Drive	Installation of approximately 30m of new NPS 1¼ inch natural gas pipeline within the floodplain and erosion hazards associated with Lower Morrison Creek.	YES		Oct 04 2023	Oct 05 2023	Adam Heizer
	RAPP-8808	8684	2340 Ontario Street	Maintenance of the outer Bronte Harbour involving dredging of 5000m3 of sediment to maintain navigation.	YES		Sep 15 2023	Oct 11 2023	Adam Heizer
	RAPP-8809	8685	2508 Lakeshore Road	Maintenance of the inner Bronte Harbour involving dredging of 15,100m3 of sediment to maintain navigation.	YES		Sep 15 2023	Oct 11 2023	Adam Heizer
	RAPP-9083	8686	1538 Bayview Road	Installation of approximately 30m of new NPS 1¼ inch natural gas pipeline within the erosion hazard associated with Lake Ontario.	YES		Oct 11 2023	Oct 12 2023	Adam Heizer

Municipality	CAID	Permit No.	Address	Proposed Works	Permit	LOP	Complete	Issued	CH Staff Member
	RAPP-9001	8690	1360 Lakeshore Road West	Partial reconstruction of a single-family dwelling including covered terrace within the erosion hazard associated with the shoreline of Lake Ontario.	YES		Jul 20 2023	Oct 18 2023	Adam Heizer
	RAPP-8974	8692	84 Ridge Drive	Reconstruction and expansion of two storey dwelling within the 7.5m regulated allowance associated with the valley of the Morrison-Wedgewood Diversion Channel.	YES		Oct 17 2023	Oct 17 2023	Adam Heizer
	RAPP-1128	8696	306 Trafalgar Road	Reconstruction and expansion of a dwelling and upper and lower deck replacement within the valley associated with Sixteen Mile Creek.	YES		Jun 02 2022	Oct 20 2023	Adam Heizer
	RAPP-9040	8711	213 Willowridge Court	Construction of a covered porch and addition on a dwelling that is within the valley and within 7.5 metres of the floodplain associated with Fourteen Mile Creek.	YES		Nov 03 2023	Nov 06 2023	Adam Heizer
	RAPP-8941	8714	0 McCraney Street (Richmond Rd to Montclair Dr) and Surrounding Streets	Replacement of 3.3km of watermain and 4.3km of wastewater main partially within the floodplain associated with Munn's Creek and regulatory allowance associated with Sixteen Mile Creek.	YES		Nov 08 2023	Nov 09 2023	Ben Davis
	RAPP-7777	8715	0 Dundas Street (Preserve Phase 4) - CWP 2 Street	Construction of a clean water pipe outlet and associated grading within 120m of a Provincially Significant Wetland and within 7.5m of the floodplain associated with Upper West Morrison Creek.	YES		Mar 10 2023	Nov 08 2023	Adam Heizer
	RAPP-7782	8716	0 Dundas Street (Preserve Phase 4) - CWP 1 Street	Construction of a clean water pipe outlet, trail and associated grading within 120m of a Provincially Significant Wetland (PSW).	YES		Mar 10 2023	Nov 08 2023	Adam Heizer

Municipality	CAID	Permit No.	Address	Proposed Works	Permit	LOP	Complete	Issued	CH Staff Member
	RAPP-7783	8717	0 Dundas Street (Preserve Phase 4) - Carding Mill Trail Street	Construction of a municipal road and multi-use pathway within 120m of a Provincially Significant Wetland (PSW).	YES		Mar 10 2023	Nov 08 2023	Adam Heizer
	RAPP-9104	8718	North Park Blvd & Sixth Line	Installation of approximately 610m 2-inch NPS and 196m of 4-inch NPS of natural gas pipeline crossing a tributary of Sixteen Mile Creek and flooding and erosion hazards associated with that watercourse.	YES		Nov 15 2023	Nov 15 2023	Adam Heizer
	RAPP-9075	8727	Culvert near 68 West River Street	Culvert replacement and associated roadway, curb and sidewalk repair within the flooding and erosion hazards associated with a tributary of Bronte Creek.	YES		Nov 17 2023	Nov 21 2023	Adam Heizer
	RAPP-9112	8731	2264 Fairbairn Court	Construction of a deck within the floodplain associated with Fourteen Mile Creek.	YES		Nov 14 2023	Nov 22 2023	Adam Heizer
	RAPP-8982	8738	0 Dundas Street (Dunoak Subdivision)	Construction of a trail, swale, inlet, headwall and associated grading within 30m of a Provincially Significant Wetland (PSW).	YES		Oct 04 2023	Dec 06 2023	Adam Heizer
	RAPP-9128	8753	448 Drummond Road	Construction an inground swimming pool and deck within the floodplain and within the 7.5m regulated allowance associated with the valley associated with Lower Wedgewood Creek.	YES		Dec 06 2023	Dec 27 2023	Adam Heizer
Puslinch	RAPL-1048	Letter of Permission	17 Calfass Road	Replacement of a front deck with an enclosed addition on a residence located between 30 meters and 120 metres of a Provincially Significant Wetland (PSW).		YES	Oct 11 2023	Oct 11 2023	Charles Priddle

February
2024

TO: **Conservation Halton Board**

MEMO: # CHB 01 24 04

FROM: Kellie McCormack, Director, Planning & Regulations

DATE: February 15, 2024

SUBJECT: **Reid Road Reservoir Quarry Update**
CH File: AMPR-971

MEMO

In August 2018, James Dick Construction Limited (JDCL) filed an *Aggregate Resources Act* (ARA) application with the Ministry of Natural Resources and Forestry (MNRF) for a licence to establish a new aggregate operation at a site just west of Twiss Road at the intersection with Reid Side Road, Town of Milton. The subject site is traversed by tributaries of Bronte Creek and contains the flooding and erosion hazards associated with that watercourse. The property also contains portions of the Guelph Junction Provincially Significant Wetland Complex.

Conservation Halton (CH) worked closely with Halton Region staff, their retained consultants, and Town of Milton staff to undertake a technical review of the ARA application as part of a Joint Agency Review Team (JART). CH is not a decision-making body with respect to the ARA application and staff's review through the JART process primarily focused on wetland and natural hazard-related matters. Based on the information submitted through the ARA application (e.g., Flood Impact Analysis, Level 2 Natural Environmental Technical Report), staff was satisfied that CH's natural hazard-related comments had been addressed and the applicant was working to resolve the remaining wetland-related comments.

In January 2021, an Environmental Registry of Ontario (ERO) proposal #019-2876 was released, seeking public feedback on the potential for designating the project as an undertaking under the *Environmental Assessment Act* (EA Act). This was only the second-known instance of such a proposal in Ontario. In July 2021, the Province released *Ontario Regulation 539/21*, requiring JDCL to undertake a scoped, individual Environmental Assessment (EA) for the proposed aggregate extraction operation. As detailed in staff report CHBD 07 21 01, no decisions have been made by the MNRF on the ARA licence application as it is on hold until the EA requirements are met.

On October 16, 2023, a formal Notice of Commencement of EA was issued by JDCL. *Ontario Regulation 539/21* establishes the required components of the EA study including studies that address all the effects of the project on the environment as well as a door-to-door well survey, water quality monitoring, assessment of the effects of groundwater from blasting below the water table, dust study, haul routes, and social impact study.

JART members will participate on a Government Review Team to provide comments and input, within their mandated areas of responsibility, that the proponent should consider as part of the EA process. CH is not a decision-making body with respect to the EA. Approval of the EA resides with the Ministry of the Environment, Conservation and Parks (MECP). CH staff will review the EA to confirm if any new technical information is provided and based on CH's responsibilities to comment on risks related to natural hazards arising from the proposal, as-per *Ontario Regulation 686/21*, and regulatory matters where applicable.

Staff will provide additional updates to the CH Board once available.

REPORT TO: **Conservation Halton Board**

REPORT NO.: # CHB 01 24 05

FROM: Barbara J. Veale, Senior Director, Watershed Management & Climate Change

DATE: February 15, 2024

SUBJECT: **Advancing Natural Asset Management Practices in the Grindstone Creek Watershed**

Recommendation

THAT the Conservation Halton Board **receives for information the staff report entitled "Advancing Natural Asset Management Practices in the Grindstone Creek Watershed."**

Executive Summary

Conservation Halton (CH) completed a study to better understand barriers that prevent the uptake of information from the Natural Asset Management project for the Grindstone Creek watershed and explore best practices for CH and partner municipalities to advance natural asset management in the Grindstone Creek watershed.

The study identified several general challenges including jurisdictional issues, a lack of definitions for and standardized approaches to integrate natural assets into municipal asset management planning, valuation challenges for natural assets that often appreciate over time, benefits and services that originate or extend beyond municipal boundaries, and how to recognize and account for multifaceted benefits and services of natural assets.

The study was funded by the Greenbelt Foundation. CH, in partnership with City of Hamilton, City of Burlington, Halton Region, Royal Botanical Gardens, and Natural Asset Initiative, engaged and worked with a consultant (Matrix Solutions Inc.) to complete the study. Study participants agreed that natural assets are important and showed a clear commitment to advance natural asset management within the context of asset management planning. Continued collaboration between municipalities, CH, and other levels of government will be needed to address and overcome the challenges identified.

Report

Background

CH, with funding from the Greenbelt Foundation and in partnership with City of Hamilton, City of Burlington, Halton Region, Royal Botanical Gardens, and Natural Asset Initiative, engaged and worked with Matrix Solutions Inc. to complete a study to explore best practices for asset management planning, including natural assets, in the Grindstone Creek watershed. This study follows the completion of the watershed-scale Natural Asset Management project in the Grindstone Creek

watershed in November 2022, the results and recommendations of which were presented to and endorsed by the CH Board on November 17, 2022 (CHBD 07 22 05).

This study had two goals:

- to better understand barriers that prevent the uptake of information from the Natural Asset Management project to be integrated into municipal natural asset management plans, and
- to identify best practices for CH and partner municipalities to overcome these barriers.

Ontario Regulation 588/17: Asset Management Planning for Municipal Infrastructure, requires municipalities to have a comprehensive Asset Management Plan for all core municipal infrastructure by July 1, 2025. This includes the incorporation of "green infrastructure", which is defined as "an infrastructure asset consisting of natural or human-made elements that provide ecological and hydrological functions and processes and includes natural heritage features and systems, parklands, stormwater management systems, street trees, urban forests, natural channels, permeable surfaces and green roofs." Thus, as part of asset management planning, a municipality is required to establish an inventory of natural assets and consider levels of service, vulnerabilities, and mitigation approaches to climate change, among other matters.

The study was undertaken with input from the study partners. It included an engagement session with partner representatives to gain insights and facilitate a broad and in-depth discussion on the concept of natural assets, their management, and their incorporation into municipal financial and asset management plans.

Findings

The following provides a high-level summary of key study findings that are also highly applicable to other watersheds and municipalities within Ontario.

Redundancy and Shared Responsibility

Natural resources are not often quantified by the local municipality but at the watershed level. There may be redundancies in natural asset inventories across different municipalities in the same watershed. Compiling, cross-referencing, and allocating the watershed-level inventory across the municipalities in the watershed is a key first step. Some natural resources, e.g., watercourses, may be difficult to allocate to a single municipality, resulting in shared responsibilities for asset management. This results in challenges associated with allocating costs and managing natural assets among multiple municipal jurisdictions.

Planning and Collaboration

Successful natural asset management planning involves an in-depth understanding of the functioning of natural assets, the benefits and services they provide to the community, and how they may be impacted; for example, by climate change. Conservation Authorities (CAs) have extensive expertise in identifying and managing natural assets at the watershed scale. As natural assets are part of a watershed-wide natural system that functions beyond municipal boundaries, planning and collaboration between municipalities and CAs and engagement with local communities and stakeholder groups are needed to support the development of municipal asset management plans.

Available Funding and Resources

Natural asset management is a relatively new initiative. As such, there may not be sufficient funds available and allocated through municipal budgeting to maintain or restore natural assets identified in natural asset inventories. Securing additional funding may be a challenge if financial constraints exist.

Winter Performance

The performance of natural assets varies throughout the year as the seasons change and the condition of the natural asset changes. For example, the lack of tree canopy in winter and early spring may reduce or eliminate the benefits trees otherwise can provide by intercepting and transpiring water runoff. The seasonal change in level of service may be difficult to quantify.

Definition and Types of Natural Assets

There is lack of consensus on defining what constitutes a natural asset and how to classify and distinguish between natural assets (e.g., forests, wetlands, meadows), enhanced assets (e.g., raingardens, green roofs, bioswales), and engineered assets (e.g., permeable pavement, rain barrels, infiltration trenches). Watercourses present a distinct challenge with respect to how they are represented and classified because of their complex nature. Specifically, defining the boundaries of watercourses and distinguishing between natural and enhanced assets remains a challenge. Study participants expressed the need for clarity and precision in defining natural assets.

Scale

Municipalities typically include assets that they own or have control over within their jurisdiction. For natural assets, the benefits they provide likely extend or originate beyond municipal boundaries, creating challenges as to which municipality should include which natural assets into their asset management plans.

Valuation

Grey infrastructure typically depreciates and there are well-known and standardized approaches to valuing grey infrastructure assets over time. Natural asset values may appreciate over time, e.g., a mature forest providing higher level of services than a newly planted forest. Established wetlands may provide long-term benefits of carbon sequestration. There are no standardized approaches to determining natural asset values over time.

Multiple Benefits

In addition to core benefits and services, natural assets typically provide multiple benefits. A forest or wetland provides core benefits and services such as stormwater management, i.e., peak flow reduction and attenuation. A healthy wetland also provides multiple benefits such as recreation and tourism, soil retention and erosion control, carbon sequestration for climate mitigation, habitat preservation and biodiversity, and atmospheric regulation. Recognition and jurisdiction of the range of benefits and services natural assets offer often cross municipal boundaries and thus fall beyond the scope of the municipal asset management plan.

Conclusion

There are many challenges associated with incorporating green infrastructure into municipal asset management plans for many reasons. Coordination and collaboration among municipalities and CAs will help address some of these challenges. Municipal asset management best practices and approaches will evolve as they mature over time.

In undertaking, supporting, and participating in this study, partners have demonstrated their willingness and commitment to advance natural asset management in the Grindstone Creek watershed. To overcome some of the challenges identified by this study, partners recognized and emphasized the importance of well-managed data and detailed inventories of natural assets, as well as continued collaboration among neighbouring municipalities, CH, other partners, and other levels of government.

Next Steps

CH will continue to engage partners to advance the implementation of recommendations from the Natural Asset Management project for the Grindstone Creek watershed and will support partner municipalities as they develop municipal asset management plans.

Impact on Strategic Priorities

This report supports four (4) Momentum priorities including Natural Hazards and Water; Science, Conservation and Restoration; Education, Empowerment and Engagement; and Nature and Parks.

Financial Impact

There is no financial impact to this report.

Signed & respectfully submitted:

Barbara Veale, Senior Director,
Watershed Management & Climate Change

Approved for circulation:

Hassaan Basit
President & CEO/Secretary-Treasurer

FOR QUESTIONS ON CONTENT: Barbara Veale, Senior Director,
Watershed Management & Climate Change
bveale@hrca.on.ca, 905-336-1158 x 2273

PREPARED BY: Martin Keller, Senior Manager,
Watershed Planning & Source Protection

REPORT TO: **Conservation Halton Board**

REPORT NO.: # CHB 01 24 06

FROM: Kellie McCormack, Director, Planning & Regulations

DATE: February 15, 2024

SUBJECT: **Proposed reconstruction and expansion of a two-storey dwelling within 7.5 metres of the floodplain associated with Lower Wedgewood Creek, 466 Drummond Road, Town of Oakville**
CH File No. RAPP-9058

Recommendation

THAT the Conservation Halton Board **approves the issuance of a permit for the reconstruction and expansion of a two-storey dwelling within 7.5 metres of the floodplain associated with Lower Wedgewood Creek, 466 Drummond Road, Town of Oakville (CH File No. RAPP-9058)**

And

THAT the Conservation Halton Board **receives the staff report entitled "Proposed reconstruction and expansion of a two-storey dwelling within 7.5 metres of the floodplain associated with Lower Wedgewood Creek, 466 Drummond Road, Town of Oakville (CH File No. RAPP-9058)".**

Executive Summary

Conservation Halton (CH) received an application to reconstruct and expand a two-storey dwelling at 466 Drummond Road, Town of Oakville. As part of the CH permit application, the applicant submitted a topographic survey to confirm the location of the floodplain in relation to existing development. The existing dwelling was confirmed to be partially located within the 7.5 metre regulatory allowance associated with the floodplain of Lower Wedgewood Creek. The applicant and their agent worked with CH staff to design the proposed reconstructed dwelling so that it would be located no closer to the floodplain than the existing development. However, the proposed works do not meet CH's Board-approved policy which states that, even if existing development is closer than six (6) metres to the floodplain, no new development is permitted within six (6) metres of the floodplain. Staff are only authorized to issue permits that meet Board-approved policies. Staff recommends approval of the proposed works, as the proposed works are not located within the flood hazard and risk to life and property on the site is no greater than the existing dwelling.

Report

Background/Proposal

The subject property is located at 466 Drummond Road, Town of Oakville, as shown in Attachment 1 (Attachment 1: Figure 1 – Key Map). The property is traversed by Lower Wedgewood Creek and

contains a portion of the floodplain associated with that watercourse. CH regulates 7.5 metres from the limit of the floodplain associated with Lower Wedgewood Creek.

The proposed works involve the reconstruction and expansion of a two-storey dwelling as shown in Attachment 2 (Figure 2 –Existing and Proposed Dwelling within the Regulatory Allowance). A topographic survey confirmed the existing dwelling is located within the 7.5 metre regulatory allowance associated with the floodplain of Lower Wedgewood Creek. The applicant and their agent worked with CH staff to design the proposed reconstructed dwelling so that it will be located no closer to the flood hazard than the existing development with the exception of the proposed rear porch, which meets CH's policies for non-habitable structures within the regulatory allowance. Given municipal requirements related to front yard setbacks, options to move the development further from the floodplain are limited. The proposed works will be located approximately 4.18 metres from the floodplain at its closest point.

Conservation Halton Policy Review

CH has regulatory policies that allow for redevelopment or expansions of existing uses within CH's regulatory allowances. CH Policy 2.27.1 allows for reconstruction, alterations, and additions to existing buildings within the 7.5 metre regulatory allowance from the floodplain, subject to specific criteria.

Policy 2.27 *Minor Valley Systems - Development within 7.5 metres of Floodplain* of Conservation Halton's *Policies and Guidelines for the Administration of Ontario Regulation 162/06 and Land Use Planning Document,* amended November 2020, states:

> 2.27.1 Existing Development Within 7.5 metres of Flood Plain
>
> Where buildings and structures already exist within 7.5 metres of the flood plain, reconstruction, alteration, or additions may be permitted subject to the following:
>
> a) The reconstruction, alteration or addition does not encroach any closer to the flood plain than the existing development at its closest point;
> b) Even if existing development is closer than 6 metres to flood plain, no new development is permitted within 6 metres in order to provide for an access allowance as per the Provincial Policy Statement; and,
> c) In cases where the building or structure can be reasonably relocated outside of the setback the applicant will be encouraged to do so.

The intent of Policy 2.27.1 is to limit development in CH regulated lands if reasonable alternatives for redevelopment are possible onsite and to provide for an access allowance (six (6) metres from the flood hazard based on the Provincial Policy Statement).

The proposed works are located outside of the flood hazard and will be located no closer to the floodplain than the existing development, except the proposed rear porch which meets CH's policies for non-habitable structures within the regulatory allowance. Strict adherence to CH's regulatory policies for development within the regulatory allowance would limit redevelopment of this site. Options to redevelop the subject property and maintain a six (6) metre setback from the floodplain are limited due to the size of the lot, location of the floodplain, and municipal requirements. CH staff can

only issue permits that meet CH's Board-approved regulatory policies and policy exceptions require Board approval.

Recommendation

The applicant has demonstrated through the information submitted that the applicable regulatory tests (i.e., the control of flooding) can be met. The applicant has confirmed that:

a) The proposed development is located outside of the flood hazard;
b) Development of the site is unlikely to affect the control of flooding or to create a condition or circumstance that, in the event of a natural hazard, might jeopardize the health or safety of persons or result in damage or destruction of property; and
c) The proposed works do not encroach closer to the floodplain than existing development at its closest point.

In light of the information noted above, staff recommends that the Board approves the reconstruction and expansion of a two-storey dwelling within 7.5 metres of the floodplain associated with Lower Wedgewood Creek, 466 Drummond Road Drive, Town of Oakville (CH File No. RAPP-9058).

Impact on Strategic Priorities

This report supports the Momentum strategic priority of Natural Hazards and Water.

Financial Impact

There is no financial impact resulting from this proposal.

Signed & respectfully submitted:

Kellie McCormack
Director, Planning and Regulations

Approved for circulation:

Hassaan Basit
President & CEO/Secretary-Treasurer

FOR QUESTIONS ON CONTENT: Kellie McCormack, Director, Planning & Regulations
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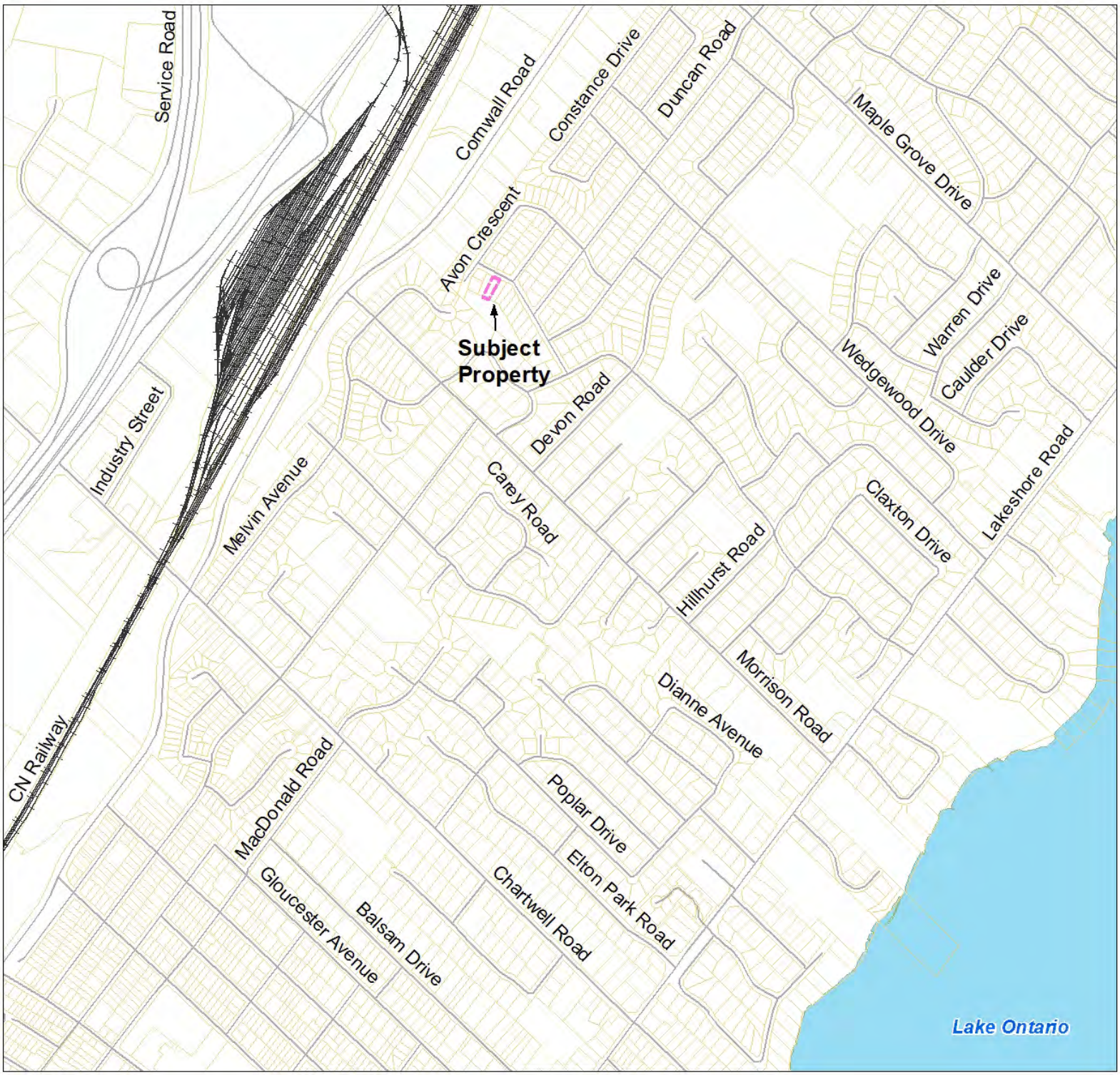
PREPARED BY: Charles Priddle, Manager, Regulations

Attachments:

Attachment 1: Figure 1 – Key Map

Attachment 2: Figure 2 – Existing and Proposed Dwelling within the Regulatory Allowance

Figure 1: Key Map of 466 Drummond Road, Oakville

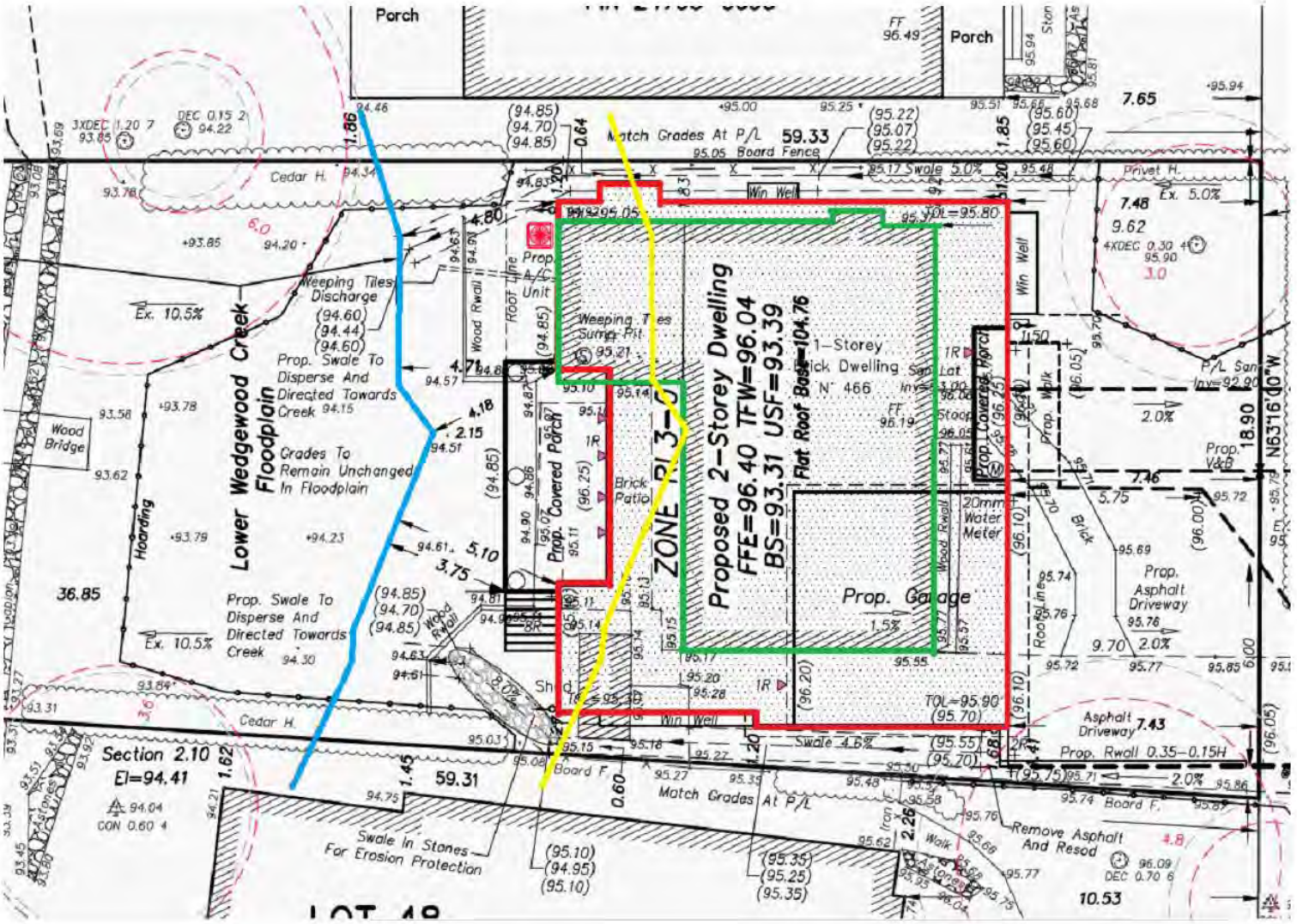


Legend

- Subject Property: 466 Drummond Road, Oakville
- Parcel
- Road
- Railway

0 0.15 0.3 0.6 Kilometres

Figure 2: Existing and Proposed Dwelling within the Regulatory Allowance



Legend

- Regulatory Allowance
- Existing Dwelling
- Proposed Dwelling
- Regulatory Floodplain

Map not to scale

REPORT TO: **Conservation Halton Board**

REPORT NO.: # CHB 01 24 07

FROM: Kellie McCormack, Director, Planning & Regulations

DATE: February 15, 2024

SUBJECT: **Regulatory Allowance Policy Update**
CH File No.: AADM-431

Recommendation

THAT the Conservation Halton Board **endorses the draft policies for public release and engagement, as presented in the staff report entitled "Regulatory Allowance Policy Update";**

And

THAT the Conservation Halton Board **receives the staff report entitled "Regulatory Allowance Policy Update".**

Executive Summary

This report provides background information on Conservation Halton's (CH) current policies for development in regulatory allowances and presents the rationale for undertaking a review and update to CH's regulatory allowance policies; an overview of other Conservation Authority (CA) policy approaches; and recent Provincial legislative, regulatory, and policy changes. Staff is seeking the Board's endorsement to enable staff to commence public engagement on the proposed draft policies. All input received will be documented and incorporated in further revisions to the draft policies, where appropriate. Staff anticipates making recommendations to the CH Board on the approval of regulatory allowance policies later in Q2 2024.

Report

The purpose of this report is to:

- Provide an overview of CH's current policies related to development in regulatory allowances and past site-specific Board-approved exceptions to CH's regulatory allowance policies, as well as background on other policy approaches to development within regulatory allowances used by other CAs and recent Provincial legislative, regulatory, and policy changes; and
- Present the rationale for undertaking an update to CH's regulatory allowance policies, as well as present draft policies recommended for public release and consultation.

Background

Ontario Regulation 162/06, Regulatory Allowances, and CH's Regulatory Allowance Policies

Section 28 (1) of the *Conservation Authorities Act* (CA Act) allows CAs to make regulations prohibiting development in hazardous lands. CH administers *Ontario Regulation 162/06* which regulates development, interference with wetlands and watercourses, and interference with shorelines within CH's jurisdiction. The purpose of the regulation is to protect life and property from natural hazards such as flooding and erosion. If, in the opinion of the Board, the regulatory tests (i.e., control of flooding, erosion, pollution, conservation of land, and dynamic beaches) are not affected, permission may be granted.

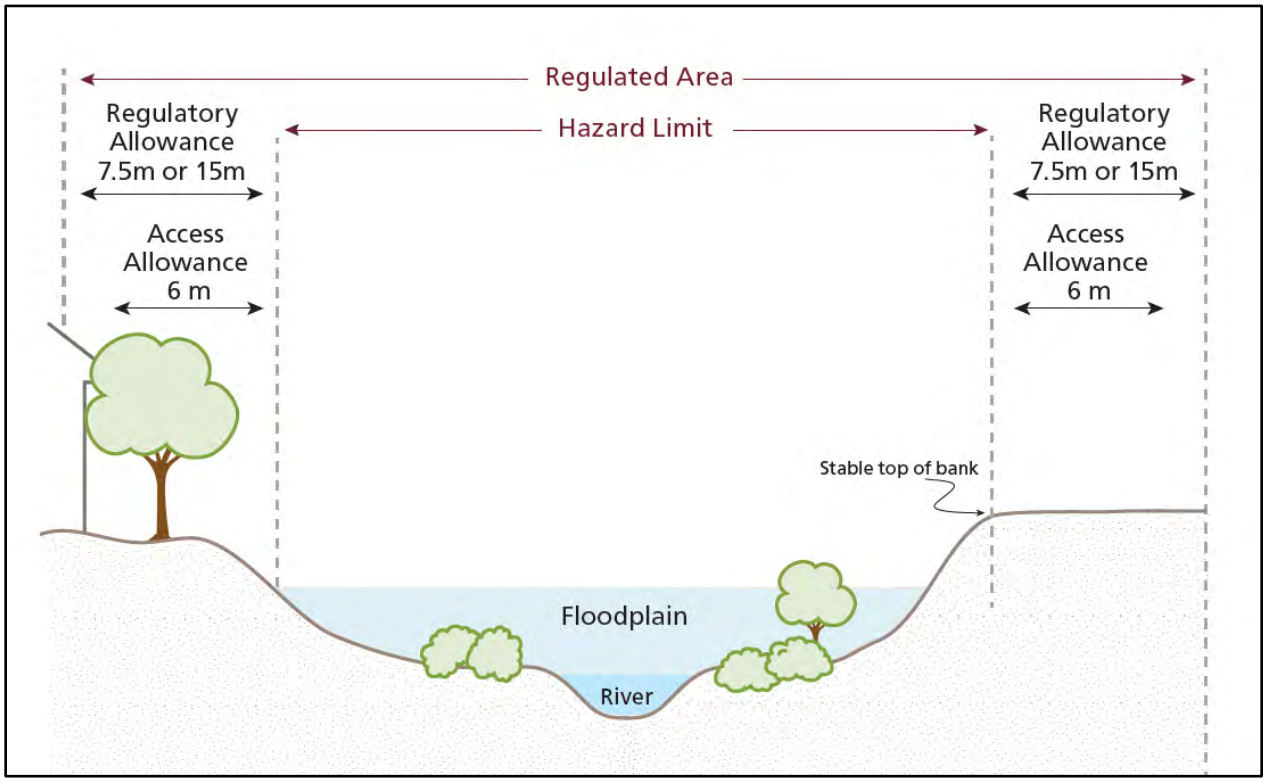
Section 2(1) of *Ontario Regulation 162/06* establishes that CH regulates flooding and erosion hazards, as well as an allowance "not to exceed 15 metres" from the limit of the greatest hazard (i.e., greater of the flooding or erosion hazard). In CH's watershed, a 7.5 metre regulatory allowance is applied from the greatest hazard associated with a minor valley system (i.e., urban creeks) and a 15 metre regulatory allowance is applied adjacent to the greatest hazard associated with a major valley system (i.e., Bronte, Sixteen Mile & Grindstone Creeks). The regulatory allowance serves multiple purposes, including providing a "buffer" to the hazard, protecting access for emergency purposes, repair, and maintenance, and ensuring development applications within the regulatory allowance are evaluated to determine if regulatory tests can be met.

CH's Board has approved regulatory policies which outline the circumstances under which permission may be granted and that must be followed by CH staff when granting permission (*Policies and Guidelines for the Administration of Ontario Regulation 162/06 and Land Use Planning Document*, approved April 27, 2006, last revised November 26, 2020). If, after review, it is determined that the Board-approved policies can be met, staff that have been delegated approval authority by the CH Board may issue a permit.

CH's regulatory allowance policies were last updated in 2006 and contain direction on the types of development that are permitted within the regulatory allowances. CH's policies permit limited types of development within the regulatory allowance (e.g., the reconstruction of existing buildings, building additions, pools, decks, grading, and non-habitable accessory structures) but the policies otherwise restrict all other types of development within the regulatory allowance.

Figure 1 below depicts the regulatory allowance described above, as well as a 6 metre access allowance. Provincial technical guides (e.g., *Technical Guide, River & Stream Systems: Erosion Hazard Limit; Technical Guide, River & Stream Systems: Flooding Hazard Limit*) that support the implementation of the natural hazard policies of the Provincial Policy Statement (PPS) and CA regulations state that a 6-metre access allowance is necessary to provide access for emergency purposes and regular access to a site in the event of a hazard or failure/repair of a structure, and to protect against unforeseen conditions. The access allowance is considered a component of the erosion hazard, as defined by the PPS.

Figure 1: CH's Regulatory Allowance and Access Allowance



Provincial Legislative, Regulatory and Policy Changes

There have been significant changes to the CA and planning landscape since *Ontario Regulation 162/06* came into force and CH's regulatory allowance policies were approved in 2006. Among other changes, the PPS and Provincial Plans have been updated and numerous legislative changes have introduced changes to the *CA Act* and the *Planning Act* including, most recently, Bill 229 and Bill 23. Many of the recent CA-related changes (e.g., Ontario Regulation 686/21 and 596/22) are intended to focus or narrow the scope of CAs' involvement in the planning and development process to mandatory (Category 1) programs and services related to natural hazards.

Bill 23 introduced updates to Section 28 of the *CA Act*, related to CA regulatory / permitting roles and responsibilities. While some of these updates are yet to be proclaimed, the regulatory "tests" that are considered in CA permit decisions will be amended to remove the "conservation of land" and "pollution" tests and to include a new "unstable soils and bedrock" test. The "control of flooding, erosion, and dynamic beaches" tests are to remain. This aligns with other Provincial changes that focus CAs on natural hazards, as the "conservation of land" test was generally thought to support the protection of the ecological features and their functions, and the "pollution" test was generally thought to support the protection of water quality.

CAs are still awaiting updated draft regulations under Section 28 of the CA Act. In Fall of 2022, the Province signaled through consultation documents that CAs can expect to see several changes to

Section 28 regulations, including changes to CA regulation limits. However, they did not explicitly indicate whether changes are contemplated to the regulatory allowances.

In addition to CA related changes, natural heritage protection and planning has evolved considerably over the past couple of decades, from a feature-based protection approach to a systems-based approach. Municipalities are now solely responsible for the implementation of the natural heritage-related policies of the PPS and Provincial Plans through their Official Plans and Zoning Bylaws (except where it is shared within the Niagara Escarpment Plan Area) and the establishment of buffers or development setbacks from natural areas or systems that may be required to protect natural features and their functions. CA regulatory policies should complement provincial and municipal natural heritage policies rather than duplicate.

Other Conservation Authority Allowance Policies

A jurisdictional scan was completed to confirm how other CAs in Ontario are approaching development within the regulatory allowance. Most CAs include policies regarding development setbacks from the limit of the hazard (typically ranging between 6-10 metres), with policies that allow for closer encroachment for some types of development and/or require a technical study providing the rationale for a reduced setback. No CAs surveyed employ the policy approach that CH currently uses, which is to restrict any other types of development in the allowance that are not explicitly outlined in policy even if the tests of the regulation can be met.

Policy Exception Reports to CH's Board

CH's 2006 policies were written at a time when a significant share of new development in CH's watershed was accommodated through greenfield development in new secondary plan areas. Since that time, there has been a shift to direct more development within existing urban areas through re-development, infill, and intensification. As a result of these development trends, CH has seen an increase in the number of requests for policy exceptions to allow for encroachments within the regulatory allowance on previously developed lots in urban areas, including through appeals of *Planning Act* applications at the Ontario Lands Tribunal (OLT). CH staff anticipate that the demand for policy exceptions will continue to increase due to the provincial priority to build more homes, particularly through re-development and intensification.

Further, there have been significant advances in the tools and technologies used to model and delineate hazards since CH's regulatory policies were approved in 2006. These tools have enabled CH and professionals to delineate hazards more accurately, reduce uncertainties regarding the limit of the hazard, as well as better understand the level of risk that may be associated with a development proposal.

Since CH staff can only issue permits that meet Board-approved policies, each policy exception requires approval from CH's Board. While staff works with applicants to adjust their proposals to meet CH's Board approved policies, there are some cases where this can be challenging, and not feasible or reasonable. Staff recommends policy exceptions to the Board for approval when the regulatory tests have been addressed. Since 2017, the CH Board has approved 24 policy exceptions and 15 of these were to allow development within the regulatory allowance. Obtaining Board approval requires additional time and can lead to project delays for applicants.

Increased requests and Board approval of policy exceptions over the past several years indicates that gaps exist in CH's current regulatory allowance policies. Opportunities exist to amend CH's policies to address this gap and to allow for development within CH's regulatory allowance where it is outside of the access allowance and the tests of the regulation and technical requirements can be met. The Provincial priority to build more homes has increased the pressure for faster approvals and risk-based decision-making. Updated regulatory allowance policies would support improved customer service delivery and faster approvals for applicants who no longer require a policy exception approval from the Board. Updated policies would also enable more efficient use of resources, including reduced staff time and legal costs.

Land Use Planning Policies

Staff does not recommend any substantive changes to CH's land use policies (i.e., Section 3 of CH's policy document) related to the regulatory allowance. Staff will continue to make recommendations consistent with CH's existing land use policies as they apply to *Planning Act* applications in greenfield/Secondary Plan areas, large infill subdivisions, and other sites that are large enough to accommodate re-development and a municipally owned Natural Heritage System/creek block. In these scenarios CH will continue to recommend the municipality place the full regulatory allowance of 15 or 7.5 metres from the limit of the greatest hazard into public ownership and designate/zone the lands Natural Heritage System/Open Space. Full public ownership and designating and zoning the full extent of the regulated area in these types of development are the best practice to avoid land use conflicts. For instance, including the entire regulated area within the creek block will help to limit encroachments into hazard lands and reduce unauthorized development and related enforcement challenges. Including all CH regulated lands in a creek block also aligns with municipal policies regarding natural heritage system buffers and secures space for municipal trails and essential infrastructure. In addition, individual landowners would not be subject to CH regulation, which simplifies the process for obtaining building permits, minor variances, etc. for the landowner and also allows CH to stay out of these processes and focus its resources elsewhere.

Regulatory Allowance Policy Amendment

CH has initiated policy reviews and updates over the past several years, but these were delayed in anticipation of forthcoming regulatory changes from the Province. As a result, a comprehensive update to CH's regulatory policies has not occurred since 2006. The CA and planning landscape has evolved considerably since *Ontario Regulation 162/06* and CH's regulatory policies were introduced, including changes to provincial legislation, regulations and policies, and CA roles and responsibilities. Based on current development trends, the demand for development within existing urban areas will likely accelerate, necessitating more Board approvals for policy exceptions regardless of if the proposed development meets the regulatory tests.

Based on the policy gaps and reasons described above, staff recommends updates to CH's regulatory allowance policies. Proposed draft regulatory policies are outlined in detail in Appendix A. Board endorsement of the draft policies presented in this report will enable staff to commence public engagement on the proposed policies. Under the proposed draft regulatory allowance policies, staff recommends development be permitted according to the following general direction:

i. New buildings and accessory structures must be setback a minimum of 6 metres from the limit of the greatest hazard to provide an access allowance, consistent with the PPS and provincial technical guidance.

ii. Reconstruction, alteration or additions to existing buildings and accessory structures must be setback a minimum of 6 metres from the limit of the greatest hazard if the existing building/structure is located outside of the 6 metre access allowance; however, if the existing building or structure is within the 6 metre access allowance it may remain provided it is for the same use, any additions are minor in nature, and the building does not encroach closer to the hazard than existing development at its closest point.

iii. In all instances the development must be designed to mitigate risks, not create new hazards or aggravate existing hazards on neighbouring properties, and the applicant is encouraged to relocate the development outside of the 7.5 metre or 15 metre regulatory allowance where reasonable.

iv. The precise limit of the hazard may need to be delineated through a technical assessment (e.g., slope stability assessment, flood plain mapping and/or modeling, topographic survey, etc.), as outlined in CH's general policies.

With the above policy changes, the required CA regulatory tests would still be met. New buildings would need to be setback a minimum of 6 metres from the limit of the greatest hazard to provide for access during emergencies and maintenance/repairs of structures, and to protect against unforeseen circumstances. Where buildings and structures already exist within the 6 metre access allowance, reconstructions, alterations and additions may be permitted within the access allowance in recognition that access has already been impeded. However, applicants would need to demonstrate that new hazards are not created and existing hazards are not aggravated on neighbouring properties and that risks to life and property are mitigated.

Next Steps

Following endorsement of this report, CH staff will engage with municipalities, members of the public, and other stakeholders on the proposed draft policies. CH staff will assess the input received and make recommendations to the Board on the approval of new policies for incorporation into CH's *Policies and Guidelines for the Administration of Ontario Regulation 162/06 and Land Use Planning Policy Document*. All input received will be documented. The projected timeline to return to the board with a final set of policies for approval is late Q2 2024.

Recommendation

Staff is seeking Board endorsement of the draft policies presented in this report to enable staff to commence public engagement on the proposed draft policies. All input received will be documented and staff anticipates making recommendations to the Board on the approval of regulatory allowance policies by late Q2 2024. Updated regulatory allowance policies will provide the public and stakeholders with greater clarity on CH's requirements for development in the regulated allowance and enable consistent and efficient review of development proposals by staff.

Impact on Strategic Priorities

This report supports the Momentum priority of Natural Hazards and Water.

Financial Impact

No costs are associated with this report. It is anticipated that the proposed policy update will reduce legal fees and result in more efficient use of staff time.

Signed & respectfully submitted:

Kellie McCormack
Director, Planning and Regulations

Approved for circulation:

Hassaan Basit
President & CEO/Secretary-Treasurer

FOR QUESTIONS ON CONTENT: Kellie McCormack, Director, Planning & Regulations
kmcormack@hrca.on.ca, 905-336-1158 x 2228

PREPARED BY: Leah Smith, Policy & Special Initiatives Lead, Planning & Regulations

Attachments: Appendix A: Regulatory Allowance Policy Update

Policy Section	Existing Policies Proposed to be Deleted or Amended (~~strikethrough~~ for deletions, red text for additions)	Proposed New or Amended Policies (~~strikethrough~~ for deletions, red text for additions)	Commentary
General Policies 2.4.2. Stable Top of Bank (Valleylands and Shoreline)	2.4.2.1 Valleylands ~~The stable top of bank is to be established by a professional, geotechnical engineer utilizing the guidelines and manuals outlined in Section 5, to the satisfaction of Conservation Halton staff. Where no geotechnical assessment has been undertaken, a minimum 8 to 15 metre toe erosion allowance (depending on soil type) and 3:1 stable slope allowance will be utilized. In addition to the requirements outlined in Section 5, the geotechnical assessment must take into consideration, and make recommendations pertaining to: construction equipment/access; limit of work area; vegetation protection; sediment and erosion controls; drainage; etc.~~	2.4.2.1 Valleylands For any *development* adjacent to a valley slope, a slope stability assessment may be required to verify the limit of the stable top of bank, to demonstrate that erosion hazard risks have been mitigated, and to demonstrate that the proposal does not create new or aggravate existing hazards on neighbouring properties . The slope stability assessment must be completed by a qualified professional(s) following the most current versions of Conservation Halton and Provincial guidelines and to the satisfaction of Conservation Halton. Where no geotechnical assessment has been undertaken, a minimum 8 to 15 metre toe erosion allowance (depending on soil type) and 3:1 stable slope allowance is required.	Updates general policy to require that the slope stability assessment demonstrates that erosion hazard risks are mitigated. The existing policy has also been amended to remove recommendations related to limit of work area, drainage, etc., that are now addressed by CH's Board approved Slope Stability Assessment Guidelines.
2.24.2 Swimming Pools	Above and below ground swimming pools will only be considered within the *flood plain* where an alternative site outside of the *flood plain* is not available and where it is not within a confined valley in a natural state. Pools are not permitted within the *meander belt allowance* and the 6-metre erosion access allowance. There must be no loss of flood storage or flood conveyance due to the pool's construction, fencing or associated grading. Electrical facilities must be *dry floodproofed*. An assessment of potential hydrostatic pressures under both normal and *regulatory storm* conditions may be required for below ground pools. It must be shown that on-going maintenance of the pool can be achieved without any *adverse environmental impacts.*	Above and below ground swimming pools will only be considered within the *flood plain* where an alternative site outside of the *flood plain* is not available and where it is not within a confined valley in a natural state. Pools are not permitted within the *meander belt allowance* and the 6- metre erosion access allowance or within the 6 metre access allowance adjacent to the *stable top of bank*. There must be no loss of flood storage or flood conveyance due to the pool's construction, fencing or associated grading. Electrical facilities must be *dry floodproofed*. An assessment of potential hydrostatic pressures under both normal and *regulatory storm* conditions may be required for below ground pools. It must be shown that on-going maintenance of the pool can be achieved without any *adverse environmental impacts.*	Text added to existing swimming pools policy to clarify that swimming pools must also be a minimum of 6 metres from the stable top of bank, consistent with proposed policy direction.
2.24.3.2 Agriculture	The construction of farm buildings and structures (excluding residences, commercial greenhouse operations and large- scale enclosed equestrian or livestock facilities) may be considered within the *flood plain*, where: a) It is not located within a confined valley in a natural state; b) It is not located within the *meander belt allowance* and 6 metre access allowance of an unconfined system; c) No site can be reasonably utilized for the proposed works outside of the *flood plain*; and, d) The structures and buildings will be *wet floodproofed*.	The construction of farm buildings and structures (excluding residences, commercial greenhouse operations and large- scale enclosed equestrian or livestock facilities) may be considered within the *flood plain*, where: a) It is not located within a confined valley in a natural state or within the 6 metre access allowance adjacent to the *stable top of bank*; b) It is not located within the *meander belt allowance* and 6 metre access allowance of an unconfined system; c) No site can be reasonably utilized for the proposed works outside of the *flood plain*; and, d) The structures and buildings will be *wet floodproofed*.	Text added to existing agriculture policy to clarify that farm buildings and structures must also be a minimum of 6 metres from the stable top of bank, consistent with the PPS Erosion Hazard definition and Provincial technical guides.
2.24.5.1 Stormwater Management Facilities	A stormwater management facility may be permitted within the *Regional Storm flood plain* if there is sufficient technical justification and it meets the following requirements: a) The facility will not be located within a confined valley; b) The facility will be located outside of the 1:100-year *flood plain*; c) The facility will be located outside of the 1:100-year *meander belt allowance* and a 6-metre erosion access allowance;	A stormwater management facility may be permitted within the *Regional Storm flood plain* if there is sufficient technical justification and it meets the following requirements: a) The facility will not be located within a confined valley or the 6 metre access allowance adjacent to the *stable top of bank;* b) The facility will be located outside of the 1:100-year *flood plain*;	Text added to existing stormwater management facilities policy to clarify that the SWM facility must also be a minimum of 6 metres from the stable top of bank, consistent with the PPS Erosion Hazard definition and Provincial technical guides.

	d) There will be no loss of *flood plain* storage or conveyance, achieved by the removal of fill from the *flood plai*n or through an incremental balanced cut and fill analysis. Flood storage provided by the facility itself is excluded from the *flood plain* storage; and, e) All other recommended Ministry of Environment, Conservation and Parks guidelines (see Section 4).	c) The facility will be located outside of the 1:100-year *meander belt allowance* and a 6-metre erosion access allowance; d) There will be no loss of *flood plain* storage or conveyance, achieved by the removal of fill from the *flood plai*n or through an incremental balanced cut and fill analysis. Flood storage provided by the facility itself is excluded from the *flood plain* storage; and, e) All other recommended Ministry of Environment, Conservation and Parks guidelines (see Section 4).	
2.25 All Major Valley Systems – Development within 15 metres of Flood Plain	~~**2.25.1 Existing Development Within 15 metres of Flood Plain**~~ ~~Where buildings and structures already exist within 15 metres of the flood plain, reconstruction, alteration or additions may be permitted subject to the following:~~ ~~a) The reconstruction, alteration or addition does not encroach any closer to the flood plain than the existing development at its closest point;~~ ~~b) Even if existing development is closer than 6 metres to the flood plain, no new development is permitted within 6 metres in order to provide for an access allowance as per the Provincial Policy Statement; and,~~ ~~c) In cases where the building or structure can be reasonably relocated outside of the flooding hazard setback the applicant will be encouraged to do so.~~		Replaced by proposed new policy 2.33.
2.25 All Major Valley Systems – Development within 15 metres of Flood Plain	~~**2.25.2 New Development Within 15 metres of Flood Plain**~~ ~~**2.25.2.1** Where there is an existing lot of record and residential dwelling in existence prior to May 11, 2006, and where no land exists outside of the 15 metre area adjacent to the flood plain, decks, sheds and other non-habitable accessory structures that are less than 20 square metres in size may be permitted. Generally, non-habitable accessory structures under 10 square metres in size, that do not require a building permit from the municipality, will not require a Permit and Conservation Halton will issue a clearance letter for approvals.~~		Replaced by proposed new policy 2.34.
2.25 All Major Valley Systems – Development within 15 metres of Flood Plain	~~**2.25.2.2** Works that would be considered or permitted under Policies 2.24.2 to 2.24.6 would also be considered or permitted within 15 metres of the flood plain.~~ ~~**2.25.2.3** Non-structural development, such as grading works, may be permitted if all general policies have been met. Minor grading works may only require the issuance of a clearance letter but major grading works would require that a Permit be obtained.~~		Replaced by proposed new policy 2.36. Replaced by proposed new policy 2.35.

2.25 All Major Valley Systems – Development within 15 metres of Flood Plain	~~**2.25.2.4** Except as provided for in Policies 2.25.2.1 – 2.25.2.3, no new development is permitted within 15 metres of the flood plain.~~		Propose to no longer restrict all new development within the regulatory allowance but rather a new building policy has been added to address the requirements for any new construction in the regulatory allowance. See new policy 2.32.
2.26 Unconfined Major Valley Systems - Development within 15 metres of Meander Belt Allowance	~~**2.26.1 Existing Development Within 15 Metres of Meander Belt Allowance**~~ ~~Where buildings and structures already exist within 15 metres of the meander belt allowance, reconstruction, alteration or additions may be permitted subject to the following:~~ ~~a) The reconstruction, alteration or addition does not encroach any closer to the meander belt allowance than the existing development at its closest point;~~ ~~b) Even if existing development is closer than 6 metres to the meander belt allowance, no new development is permitted within 6 metres in order to provide for an access allowance as per the Provincial Policy Statement; and,~~ ~~c) In cases where the building or structure can be reasonably relocated outside of the erosion hazards limits the applicant will be encouraged to do so.~~		Replaced by proposed new policy 2.33.
2.26 Unconfined Major Valley Systems–- Development within 15 metres of Meander Belt Allowance	~~**2.26.2 New Development Within 15 metres of Meander Belt Allowance**~~ ~~**2.26.2.1** Where there is an existing lot of record and residential dwelling in existence prior to May 11, 2006, and where no land exists outside of the 15 metre area adjacent to the flood plain, decks, sheds and other non-habitable accessory structures less than 20 square metres in size may be permitted between 6 and 15 metres from the meander belt allowance. Structures permitted within the meander belt allowance as per Policy 2.24.1€) may be permitted throughout the 15-metre allowance. Generally, non-habitable accessory structures under 10 square metres in size, that do not require a building permit from the municipality, will not require a Permit and Conservation Halton will issue a clearance letter for approvals.~~		Replaced by proposed new policy 2.34.
2.26 Unconfined Major Valley Systems - Development within 15 metres of Meander Belt Allowance	~~**2.26.2.2** Works that would be considered or permitted under Policies 2.24.2 to 2.24.6 would also be considered or permitted within 15 metres of the meander belt allowance.~~ ~~**2.26.2.3** Non-structural development, such as grading works, may be permitted if all general policies have been met. Minor grading works may only require the issuance of a clearance letter but major grading works would require that a permit be obtained.~~		Replaced by proposed new policy 2.36. Replaced by proposed new policy 2.35.
2.26 Unconfined Major Valley Syst–ms - Development within 15 metres of Meander Belt Allowance	~~**2.26.2.4** Except as provided for in Policies 2.26.–.1 - 2.26.2.3, no new development is permitted within 15 metres of the meander belt allowance.~~		Propose to no longer restrict all new development within the regulatory allowance but rather a new building policy has been added to address the requirements for any new construction in the regulatory allowance. See new policy 2.32.

2.27 Minor Valley Systems – Development within 7.5 metres of Flood Plain	~~**2.27.1 Existing Development Within 7.5 metres of Flood Plain**~~ ~~Where buildings and structures already exist within 7.5 metres of the flood plain, reconstruction, alteration or additions may be permitted subject to the following:~~ ~~a) The reconstruction, alteration or addition does not encroach any closer to the flood plain than the existing development at its closest point;~~ ~~b) Even if existing development is closer than 6 metres to flood plain, no new development is permitted within 6 metres in order to provide for an access allowance as per the Provincial Policy Statement; and,~~ ~~c) In cases where the building or structure can be reasonably relocated outside of the setback the applicant will be encouraged to do so.~~		Replaced by proposed new policy 2.33.
2.27 Minor Valley Systems – Development within 7.5 metres of Flood Plain	~~**2.27.2 New Development Within 7.5 metres of Flood Plain**~~ ~~**2.27.2.1** Where there is an existing lot of record and residential dwelling in existence prior to the adoption of these policies, and where no land exists outside of the 7.5 metre area adjacent to the flood plain, decks, sheds and other non- habitable accessory structures less than 20 square metres in size may be permitted. Generally, non-habitable accessory structures under 10 square metres in size, that do not require a building permit from the municipality, will not require a Permit and Conservation Halton will issue a clearance letter for approvals.~~		Replaced by proposed new policy 2.34.
2.27 Minor Valley Systems – Development within 7.5 metres of Flood Plain	~~**2.27.2.2** Works that would be considered or permitted under Policies 2.24.2 to 2.24.6 would also be considered or permitted within 7.5 metres of the flood plain.~~ ~~**2.27.2.3** Non-structural development, such as grading works, may be permitted if all general policies have been met. Minor grading works may only require the issuance of a clearance letter but major grading works would require that a permit be obtained.~~		Replaced by proposed new policy 2.36. Replaced by proposed new policy 2.35.
2.27 Minor Valley Systems – Development within 7.5 metres of Flood Plain	~~**2.27.2.4** Except as provided for in Policies 2.27.2.1 - 2.27.2.3, no new development is permitted within 7.5 metres of the flood plain.~~		Propose to no longer restrict all new development within the regulatory allowance but rather a new building policy has been added to address the requirements for any new construction in the regulatory allowance. See new policy 2.32.
2.28 Unconfined Minor Valley Systems - Development within 7.5 metres of Meander Belt Allowance	~~**2.28.1 Existing Development Within 7.5 metres of Meander Belt Allowance**~~ ~~Where buildings and structures already exist within 7.5 metres of the meander belt allowance, reconstruction, alteration or additions may be permitted subject to the following:~~ ~~a) The reconstruction, alteration or addition does not encroach any closer to the meander belt allowance than the existing development at its closest point;~~ ~~b) Even if existing development is closer than 6 metres to the meander belt allowance, no new development is permitted within 6 metres in order to provide for an access allowance as per the Provincial Policy Statement; and,~~		Replaced by proposed new policy 2.33.

	~~c) In cases where the building or structure can be reasonably relocated outside of the erosion hazards limits the applicant will be encouraged to do so.~~		
2.28 Unconfined Minor Valley Systems – Development within 7.5 metres of Meander Belt Allowance	~~**2.28.2 New Development Within 7.5 metres of Meander Belt Allowance**~~ ~~**2.28.2.1** Where there is an existing lot of record and residential dwelling in existence prior to the adoption of these policies, and where no land exists outside of the 7.5 metre area adjacent to the meander belt allowance, decks, sheds and other non-habitable accessory structures less than 20 square metres in size may be permitted between 6 and 7.5 metres from meander belt allowance. Structures permitted within the meander belt allowance as per Policy 2.24.1 € may be permitted throughout the 7.5 metre allowance. Generally, non-habitable accessory structures under 10 square metres in size, that do not require a building permit from the municipality, will not require a Permit and Conservation Halton will issue a clearance letter for approvals.~~ ~~**2.28.2.2** Works that would be considered or permitted under Policies 2.24.2 to 2.24.6 would also be considered or permitted within 7.5 metres of the meander belt allowance.~~		Replaced by proposed new policy 2.34.
2.28 Unconfined Minor Valley Systems - Development within 7.5 metres of Meander Belt Allowance	~~**2.28.2.2** Works that would be considered or permitted under Policies 2.24.2 to 2.24.6 would also be considered or permitted within 7.5 metres of the meander belt allowance.~~ ~~**2.28.2.3** Non-structural development, such as grading works, may be permitted if all general policies have been met. Minor grading works may only require the issuance of a clearance letter but major grading works would require that a Permit be obtained.~~		Replaced by proposed new policy 2.36. Replaced by proposed new policy 2.35.
2.28 Unconfined Minor Valley Systems - Development within 7.5 metres of Meander Belt Allowance	~~**2.28.2.4** Except as provided for in Policies 2.28.2.1 - 2.28.2.3, no new development is permitted within 7.5 metres of the meander belt allowance.~~		Propose to no longer restrict all new development within the regulatory allowance but rather a new building policy has been added to address the requirements for any new construction in the regulatory allowance. See new policy 2.32.
2.35 Major Valley Systems - Development within 15 metres of Stable Top of Bank	~~**2.35.1** Where there is a 7.5 metre publicly owned access adjacent to the stable top of bank, neither a Permit nor a clearance letter will be required from Conservation Halton, pursuant to Ontario Regulation 162/06, for any development between 7.5 metres and 15 metres of the stable top of bank.~~		The existing policy was intended to provide flexibility in permitting requirements for development between 7.5-15 metres of the stable top of bank where a 7.5 metre publicly owned access exists. No longer required as the proposed new policy provides flexibility to allow development within this area.
2.35 Major Valley Systems - Development within 15 metres of Stable Top of Bank	~~**2.35.2** Where buildings and structures already exist within 15 metres of the stable top of bank of major valley systems, and a 7.5 metre publicly owned access is not provided adjacent to the stable top of bank the following policies will apply:~~		Replaced by proposed new policy 2.33.

	~~**2.35.2.1** Any replacement (same size and use) or additions, to the existing buildings and structures may be permitted subject to the following:~~ ~~a) the replacement or addition does not encroach any closer to the stable top of bank than the existing development at its closest point;~~ ~~b) even if existing development is closer than 6 metres to the stable top of bank, no new development is permitted within 6 metres of the stable top of bank in order to provide for an erosion access allowance as per the Provincial Policy Statement;~~ ~~c) a geotechnical assessment by a qualified engineer (at the expense of the applicant), may be required to determine the location of the stable top of bank and to determine if the proposed development would have a negative impact on slope stability. See Policy 2.4.2 and Section 4 for study requirements; and,~~ ~~d) In cases where the building or structure can be reasonably relocated outside of the setback the applicant will be encouraged to do so.~~		
2.35 Major Valley Systems - Development within 15 metres of Stable Top of Bank	~~**2.35.2.2** Pools, decks and non-habitable accessory structures may be permitted subject to:~~ ~~a) no reasonable alternative exists outside of the 15 metres from the stable top of bank;~~ ~~b) no development permitted within 6 metres of the stable top of bank in order to provide for an erosion access allowance as per the Provincial Policy Statement;~~ ~~c) a geotechnical assessment by a qualified engineer (at the expense of the applicant), may be required to determine the location of the stable top of bank and to determine if the proposed development would have a negative impact on slope stability. See Policy 2.4.2 and Section 4 for study requirements.~~		Replaced by proposed new policy 2.34. Building Code permit exemption has been added to the stable top of bank policies to be consistent with the approach taken adjacent to flood plains and meander belts.
2.35 Major Valley Systems - Development within 15 metres of Stable Top of Bank	~~**2.35.3** Except as provided for in Policies 2.35.1 and 2.35.2, no new development or redevelopment is permitted within 15 metres of the stable top of bank of major valley features.~~		Propose to no longer restrict all new development within the regulatory allowance but rather a new building policy has been added

			to address the requirements for any new construction in the regulatory allowance. See new policy 2.32.
2.36 Minor Valley Systems – Development within 7.5 metres of Stable Top of Bank	~~**2.36.1** Where buildings and structures already exist within 7.5 metres of the stable top of bank of minor valley systems, any replacement (same size and use) or additions may be permitted subject to the following:~~ ~~a) the replacement or addition does not encroach any closer to the stable top of bank than the existing development at its closest point;~~ ~~b) even if existing development is closer than 6 metres to the stable top of bank, no new development is permitted within 6 metres of the stable top of bank in order to provide for an erosion access allowance as per the Provincial Policy Statement;~~ ~~c) a geotechnical assessment may be required (at the expense of the applicant, by a qualified geotechnical engineer) to determine the location of the stable top of bank and to determine if the proposed development will have a negative impact on slope stability. See Policy 2.4.2 and Section 4 for study requirements; and,~~ ~~d) In cases where the building or structure can be reasonably relocated outside of the setback the applicant will be encouraged to do so.~~		Replaced by proposed new policy 2.33.
2.36 Minor Valley Systems - Development within 7.5 metres of Stable Top of Bank	~~**2.36.2** Where there is an existing lot of record and residential dwelling, in existence prior to May 11, 2006, and where no reasonable alternative exists outside of the 7.5 metre area adjacent to the stable top of bank, pools, decks and non-habitable accessory structures may be permitted within three (3) metres of the stable top of bank. A geotechnical assessment by a qualified engineer (at the expense of the applicant) may be required to determine the location of the stable top of bank and to determine if the proposed development will have a negative impact on slope stability. See Policy 2.4.2 and Section 4 for study requirements.~~		Replaced by proposed new policy 2.34. The existing 3 metre setback was established as a transitionary policy to recognize approved minor valley creek block systems in new subdivisions prior to 2006 that did not contain a regulatory allowance in order to allow landowners some potential to have accessory structures in their rear yards. Since this transitionary policy has been in place for 17 years, propose removal of this direction to align with all other hazards and require a minimum 6 metre setback unless the landowner is replacing an existing structure within 6 metres of the hazard.
2.36 Minor Valley Systems - Development within 7.5 metres of Stable Top of Bank	~~**2.36.3** Except as provided for in Policies 2.36.1 - 2.36.2, no new development or redevelopment is permitted within 7.5 metres of the stable top of bank of minor valley systems.~~		Propose to no longer restrict all new development within the regulatory allowance but rather a new building policy has been added to address the requirements for any new construction in the regulatory allowance. See new policy 2.32.
NEW **Regulatory Allowance - Preamble**		REGULATORY ALLOWANCE- Flood Plains, Meander Belts and Valleylands Ontario Regulation 162/06 establishes that CH may regulate an allowance from the limit of the greater of the *flood plain, stable top of bank*, physical top of bank and/or *meander belt allowance* associated with a *watercourse*, depending on the hazards present on site. In CH's	This section describes the limits and size of the regulatory allowance. Proposed policy continues to encourage applicants to relocate development out of the regulatory allowance to eliminate the need for future permits and to enhance protection of the watercourse system, where feasible.

		watershed, a 7.5 metre regulatory allowance is applied from the limit of each hazard associated with a *minor valley system* and a 15 metre regulatory allowance is applied adjacent to each hazard associated with a *major valley system*. The following policies guide *development* within the regulatory allowance. Wherever reasonable, the applicant is encouraged to relocate development outside of the regulatory allowance.	
NEW **2.32** **Regulatory Allowance – New Buildings**		2.32 New Buildings New buildings may be permitted within 15 metres of any hazard in *major valley systems* or within 7.5 metres of any hazard in *minor valley systems*, provided: a) The building and site grading is designed to mitigate hazard risks and does not create new hazards or aggravate existing hazards on neighbouring properties; and, b) The building and any associated structures are located a minimum of 6 metres from all hazards.	New buildings are required to be setback the minimum 6 m access allowance. The building and site must be designed to mitigate hazard risks (e.g., stabilizing disturbed areas, providing appropriate freeboard, stormwater management measures to prevent an increase downstream flooding, etc.).
NEW **2.33** **Regulatory Allowance – Reconstruction Alteration or Additions to Existing Buildings**		2.33 Reconstruction, Alteration or Additions to Existing Buildings Where there is no proposed change to the building or structure that would have the effect of altering the use or potential use of the building or structure, and where buildings already exist within 15 metres of any hazard in *major valley systems* or within 7.5 metres of any hazard *in minor valley systems*, reconstruction, alteration, and/or additions may be permitted subject to the following: a) The building and site grading is designed to mitigate hazard risks and does not create new hazards or aggravate existing hazards on neighbouring properties; and, b) If the existing building is within the 6 metre access allowance, the proposed works do not encroach closer to each hazard than the existing building at its closest point and the proposed change, including any reconstruction, alteration or addition is minor in nature; or, c) If the existing building is located outside of the 6 metre access allowance, the proposed works must be located a minimum of 6 metres from all hazards. The applicant is encouraged to provide sufficient space to allow for future accessory structures. Policy 2.34 applies to decks, sheds, and other non-habitable accessory structures. Building reconstruction, alteration, and additions that do not meet the above policy will be assessed as a new building under policy 2.32.	This policy is intended to recognize the reconstruction, alteration, or additions to existing buildings. Buildings must be a minimum of 6 metres from all hazards, except for properties with existing buildings within the 6 metre access allowance, which are offered some flexibility in recognition that access has already been impeded, and provided the development is the same use and any additions are minor in nature. Any proposals that do not meet these criteria are subject to the new building policy, 2.32. The proposed policies ensure that all proposed development is not at a greater risk than existing development and will provide for reconstruction that may improve risk. The same use provision ensures no higher risk uses (e.g., vulnerable uses, higher density residential) are permitted within the 6 metre access allowance to ensure any change of use is consistent with the PPS Erosion Hazard definition and Provincial technical guides. The proposed flexibility within the 6 metre access allowance recognizes reconstruction scenarios where the development is a second story addition or addition to a building that is already in the access allowance; and/or, the redevelopment can take the building out of the hazard but not out of the allowance entirely. Proposals must mitigate risks where necessary and to the extent possible (e.g., stabilizing disturbed areas, providing appropriate freeboard through grading, etc.) This approach would eliminate the need for commonly requested policy exceptions.

NEW **2.34** **Regulatory Allowance - Decks, Sheds, and Other Non-habitable Accessory Structures**		2.34 Decks, Sheds, and Other Non-habitable Accessory Structures Decks, sheds, and other non-habitable accessory structures may be permitted within 15 metres of any hazard in *major valley systems* or within 7.5 metres of any hazard in *minor valley systems*, subject to the following: a) The structure and site grading are designed to mitigate hazard risks and do not create new hazards or aggravate existing hazards on neighbouring properties; and, b) The structure is located a minimum of 6 metres from all hazards; or, c) If there is an existing building or structure within the 6 metre access allowance, the proposed structure does not encroach closer to each hazard than the existing structure at its closest point. Non-habitable accessory buildings and structures under a total of 15 square metres in size that do not require approval under the Building Code do not require a Conservation Halton Permit within the regulatory allowance adjacent to the hazard.	New decks, sheds and other non-habitable accessory structures must be a minimum of 6 metres from all hazards, except for properties with existing non-habitable accessory structures which are offered flexibility within the 6 metre allowance. In April 2022 the Building Code was amended to exempt sheds under 15 square meters in size. New policy proposes exemption of structures under 15 square meters to be consistent with the Building Code.
NEW **2.35** **Regulatory Allowance – Non-structural Development and Grading**		2.35 Non-structural Development and Grading Non-structural development, such as grading works, may be permitted within 15 metres of any hazard in *major valley systems* or within 7.5 metres of any hazard within *minor valley systems*, subject to the following: a) The non-structural development and site grading are designed to mitigate hazard risks and do not create new hazards or aggravate existing hazards on neighbouring properties.	Maintains policy direction from existing policies 2.25.2.3, 2.26.2.3, 2.27.2.3, and 2.28.2.3, with a minor editorial change to remove reference to clearance letters which have not been required in practice for minor grading as it is typically proposed in conjunction with other permitted works. Revised policy also clarifies that hazard risks must be mitigated, new hazards are not created or aggravated.
NEW **2.36** **Regulatory Allowance – Other Works**		2.36 Works that would be permitted under Policies 2.24.2 to 2.24.6 may be permitted within 15 metres of any hazard in *major valley systems* or within 7.5 metres of any hazard in *minor valley systems*, subject to the requirements of policies 2.24.3 to 2.24.6	Maintains policy direction from existing policies 2.25.2.2, 2.26.2.2, 2.27.2.2, and 2.28.2.2.
Land Use Policies **3.2 Flood and Erosion Hazard Limits**	3.2.2 Through the review of planning applications, staff will work with the applicant and watershed municipalities to ensure no new development, including lot creation, or site alteration is permitted within the flooding and erosion hazard limits, that would be contrary to the Provincial Policy Statement and/or Conservation Halton regulatory policies. For major valley systems, a minimum lot line setback of 15 metres from the greater of the limit of the flooding and erosion hazard limit. For minor valley systems a minimum lot line setback of 7.5 metres from the greater of the limit of the flooding and erosion hazard limit will be recommended.	3.2.2 Through the review of planning applications, staff will work with the applicant and watershed municipalities to ensure no new development, including lot creation, or site alteration is permitted within the flooding and erosion hazard limits, that would be contrary to the Provincial Policy Statement and/or Conservation Halton regulatory policies. For major valley systems, a minimum lot line setback of 15 metres from the greater of the limit of the *flooding hazard, stable top of bank* and ~~erosion hazard~~ *meander belt allowance* limit will be recommended. For minor valley systems a minimum lot line setback of 7.5 metres from the greater of the limit of the flooding and erosion hazard limit will be recommended.	Housekeeping edits to clarify that CH's existing policies to recommend a 15 m or 7.5 m lot line setback from the greatest hazard will continue to apply through the review of *Planning Act* applications where new lots including new creek blocks are created.
Land Use Policies	3.3.2 Through the review of planning applications, staff will work with the applicant and watershed municipalities to ensure no new development,	3.3.2 Through the review of planning applications, staff will work with the applicant and watershed municipalities to ensure no new	

3.2 Flood and Erosion Hazard Limits	including lot creation, or site alteration is permitted within valleylands and the associated erosion hazard limits that would be contrary to the Provincial Policy Statement and/or Conservation Halton policies. Where the flooding hazard limit is contained within the valley, the lot line setbacks are a minimum of 15 metres from the greater of the physical or stable top of bank adjacent to major valley systems and 7.5 metres from the greater of the physical or stable top of bank adjacent to minor valley systems. Conservation Halton will recommend to municipalities, through the provision of conditions of draft plan approval, that applications for a plan of subdivision adjacent to valleylands, be required to include protection of the valleyland and adjacent tableland in perpetuity. It is Conservation Halton's preference that this be done through dedication to the municipality however there may be other acceptable methods to ensure that these areas are protected by a public agency.	development, including lot creation, or site alteration is permitted within valleylands and the associated erosion hazard limits that would be contrary to the Provincial Policy Statement and/or Conservation Halton policies. Where the flooding hazard limit is contained within the valley, ~~the lot line setbacks are~~ a minimum lot line setback of 15 metres from the greater of the physical or stable top of bank adjacent to major valley systems and 7.5 metres from the greater of the physical or stable top of bank adjacent to minor valley systems will be recommended. Conservation Halton will recommend to municipalities, through the provision of conditions of draft plan approval, that applications for a plan of subdivision adjacent to valleylands, be required to include protection of the valleyland and adjacent tableland in perpetuity. It is Conservation Halton's preference that this be done through dedication to the municipality however there may be other acceptable methods to ensure that these areas are protected by a public agency.	Housekeeping edits to clarify that CH's existing policies to recommend a 15 m or 7.5 m lot line setback from the greatest hazard will continue to apply through the review of *Planning Act* applications where new lots including new creek blocks are created.

REPORT TO: **Conservation Halton Board**

REPORT NO.: # CHB 01 24 08

FROM: Kellie McCormack, Director, Planning & Regulations

DATE: February 15, 2024

SUBJECT: **Updated Conservation Halton Technical Submission Guidelines**

Recommendation

THAT the Conservation Halton Board **approves the updated versions of the technical submission guidelines entitled "Conservation Halton Guidelines for Landscaping and Rehabilitation Plans, 2024", "Conservation Halton Guidelines for Stormwater Management Engineering Submissions, 2024", and "Conservation Halton Guidelines for Slope Stability Assessments for Valleys, 2024"**;

And

THAT the Conservation Halton Board **receives for information the staff report entitled "Updated Conservation Halton Technical Submission Guidelines, 2024"**.

Report

After extensive stakeholder and public engagement in 2021 and 2022, the Conservation Halton (CH) Board approved technical submission guidelines for:

- Landscaping and Rehabilitation Plans (CHBD 05 21 03)
- Stormwater Management Engineering Submissions (CHBD 08 21 13)
- Slope Stability Assessments for Valleys (CHBD 06 22 09)

Technical submission guidelines provide applicants with a clear and transparent understanding of CH's requirements and expectations for technical submissions as they provide direction and outline approaches that can be used to satisfy CH's regulatory requirements and Board-approved policies. Guidelines lead to better quality submissions, quicker and more consistent reviews, fewer resubmissions, and faster approval times. These guidelines are specific to CH and do not replace or supersede federal, provincial, or municipal requirements.

After Bill 23 (*More Homes, Built Faster Act*) received Royal Assent (November 28, 2022) and *Ontario Regulation 596/22* came into force and effect (January 1, 2023), Conservation Authorities (CAs) can no longer provide technical review services for planning and development applications previously provided via Memorandums of Understanding (MOUs) with municipalities (e.g., technical reviews related to natural heritage and select aspects of stormwater management). As such, minor updates to CH's technical submission guidelines were needed to reflect CH's current roles and responsibilities. Minor housekeeping amendments were also needed to reflect feedback received and staff's experience with implementing the guidelines over the past few years.

The above-noted Board approved guidelines have been updated to:

- Insert references to *Ontario Regulation 686/21 Mandatory Programs and Services Regulation*;
- Remove water quality, groundwater, and baseflow-related references; and
- Remove landscaping/rehabilitation advice for non-regulated features.

No other substantive changes were made to the document. The updated guidelines will be posted to CH's website and shared with key stakeholders.

Ontario Regulation 596/22 does not affect CH's mandatory programs or services and CH continues to provide technical review services as a regulatory agency, as a body with delegated authority for Section 3 (Natural Hazards) of the Provincial Policy Statement, and as an authority mandated to understand and manage risks related to natural hazards. CH's guidelines reflect these mandatory roles and responsibilities.

Impact on Strategic Priorities

This report supports the Momentum priorities of Science, Conservation and Restoration and Natural Hazards and Water.

Financial Impact

There is no financial impact to this report.

Signed & respectfully submitted:

Kellie McCormack
Director, Planning and Regulations

Approved for circulation:

Hassaan Basit
President & CEO/Secretary-Treasurer

FOR QUESTIONS ON CONTENT: Kellie McCormack, Director, Planning & Regulations
kmcormack@hrca.on.ca, 905-336-1158 x 2228

Attachments:

Attachment 1: Conservation Halton Guidelines for Landscaping and Rehabilitation Plans, 2024

Attachment 2: Conservation Halton Guidelines for Stormwater Management Engineering Submissions, 2024

Attachment 3: Conservation Halton Guidelines for Slope Stability Assessments for Valleys, 2024

Conservation Halton Guidelines for Landscaping and Rehabilitation Plans

DRAFT

January 2024

Version 4

Conservation Halton

CONSERVATION HALTON GUIDELINES

Conservation Halton (CH) protects, manages, and enhances the area within its jurisdiction through the delivery of a range of programs and services, including mandatory programs and services related to managing the risks associated with natural hazards. In the planning and development process, CH exercises its roles and responsibilities in accordance with Section 21.1 of the *Conservation Authorities Act* and Ontario Regulation 686/21, including as:

- A regulatory agency under Section 28 of the *Conservation Authorities Act*;
- A body with delegated responsibility to represent the Provincial interest and ensure that development applications are consistent with the natural hazards policies of the Provincial Policy Statement (PPS), but not including those policies related to hazardous forest types for wildland fire;
- A public commenting body under the *Planning Act, Clean Water Act* and other Acts and Provincial Plans;
- A resource management agency operating on a local watershed basis; and
- A landowner in the watershed.

CH's Planning and Regulations staff (i.e., environmental planners, regulations officers, planning ecologists, water resource engineers, technologists, and hydrogeologists) work together on interdisciplinary teams to deliver timely and comprehensive reviews and advice to provincial agencies, municipalities and landowners across CH's jurisdiction.

Section 28 (1) of the *Conservation Authorities Act* allows conservation authorities to make regulations to protect life and property from natural hazards. CH's regulation is Ontario Regulation 162/06. Under Ontario Regulation 162/06, CH regulates:

- All development in or adjacent to river or stream valleys, wetlands and surrounding lands where development could interfere with the hydrologic function of the wetland, Lake Ontario shorelines, and hazardous lands such as karst and any prescribed allowances;
- Alterations to a river, creek, stream or watercourse; and
- Interference with wetlands.

Permission is required from CH for undertaking the above noted works within regulated areas. CH's Board-approved Policies and Guidelines for the Administration of Ontario Regulation 162/06 and Land Use Planning Policy Document outlines the policies and technical requirements which must be met before permission may be granted. As part of a CH permit application, an applicant must demonstrate that CH's Board-approved policies and technical standards can be met.

CH also provides technical advice and support to its municipal partners on planning and development applications where it relates to CH's mandatory programs and services, as well as a public commenting body and a resources management agency.

These Guidelines provide clear expectations regarding the criteria and approaches that are acceptable to CH and are used by staff to assess the technical merits Landscape and Rehabilitation Plans. By using these guidelines more efficient and consistent reviews, fewer resubmissions, and faster approvals are anticipated.

These Guidelines are specific to CH and do not replace or supersede any other federal, provincial, or municipal requirement.

OBJECTIVE	The purpose of the **Guidelines for Landscaping and Rehabilitation Plans** is to: • **Identify CH's** regulatory and technical requirements for a landscaping and rehabilitation plan submission • **Outline CH's** key expectations for landscaping and rehabilitation design
APPLICATION & USE	Applies to all landscaping and rehabilitation plan submissions associated with Ontario Regulation 162/06 permit applications. These Guidelines have been developed for: • **Qualified professionals** such as landscape architects and ecologists tasked with preparing landscaping and rehabilitation plans • **CH** staff to assess the technical merits of a landscaping and rehabilitation plan and to facilitate quicker and more consistent reviews
ADDITIONAL REFERENCE MATERIALS (to be read in conjunction with this document)	• Ontario Regulation 162/06 Halton Region Conservation Authority: Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses, 2006 • Ontario Regulation 686/21 Mandatory Programs and Services • Policies and Guidelines for the Administration of Ontario Regulation 162/06 and Land Use Planning Policy Document November 2020 • Conservation Halton Native Species List, August 2018 • Conservation Halton Seed Mixes, October 2020 • Conservation Halton Guidelines for Stormwater Management Engineering Submissions, November 2021
VERSION	**Version 4.0** This version of the Guidelines for Landscaping and Rehabilitation Plans was presented to and endorsed by the CH Board of Directors in DATE, 2023. The Guidelines may be updated from time to time. For more information, visit https://www.conservationhalton.ca/policies-and-guidelines or call 905-336-1158.

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Section 1 Introduction

Conservation Halton (CH) strives to protect life and property from natural hazards such as flooding and erosion. Natural assets and green infrastructure are critical for mitigating risks. Landscaping and planting native vegetation, including trees, shrubs and ground cover, are particularly helpful in mitigating soil erosion due to their extensive root systems which stabilizes the soil. In addition, successful vegetation establishment enhances infiltration rates, minimizes runoff, diminishes erosion, and lowers flood risks.

When development or alteration is proposed within regulated areas such as floodplains, wetlands, valleys or watercourses, CH requires that a Landscape and Rehabilitation Plan be prepared and implemented.

The purpose of the Guidelines for Landscaping and Rehabilitation Plans is to:

- Identify CH's regulatory and technical requirements for a landscaping and rehabilitation plan submission for a permit within CH's regulated areas; and
- Outline CH's key expectations for landscaping and rehabilitation design.

This document focuses on CH's expectations related to Landscaping and Rehabilitation Plans for regulated areas, with a specific emphasis on reducing risks related to natural hazards.

Complex permit applications for larger scale works may require a Landscaping and Rehabilitation Plan completed by a qualified professional. Single landowner residential development will be encouraged to adopt the principles in these guidelines, where possible, for simple permit applications for smaller scale works where soil erosion or slope stability are of concern. Consultation with CH is advised to ensure the appropriate sections of the guidelines are used.

1.1 Guideline Outline

This document is divided into five sections and a supporting appendix. For all projects requiring CH's permission, the General Standards must be followed. In addition to the General Standards, the Project Specific Standards also apply to those identified in Section 3.

- **Section 1 – Introduction** – Outlines the purpose of CH's Guidelines for Landscaping and Rehabilitation Plans.
- **Section 2 – General Standards** – Outlines the general requirements for Landscaping and Rehabilitation Plans for works proposed in CH's regulated areas.
- **Section 3 – Project Specific Standards** – Outlines CH's standards for planting and provides direction for specific landscaping or rehabilitation works, such as:
    - Rehabilitation in floodplains, along watercourses and/or in valleys;
    - Stabilizing temporary channels;
    - Planting plans for stormwater management outlets; and,
    - Planting plans in regulated natural areas (e.g. valleylands, floodplains, wetlands and shoreline).
- **Section 4 - Submission Requirements** – Provides a project summary checklist to include with all submissions.

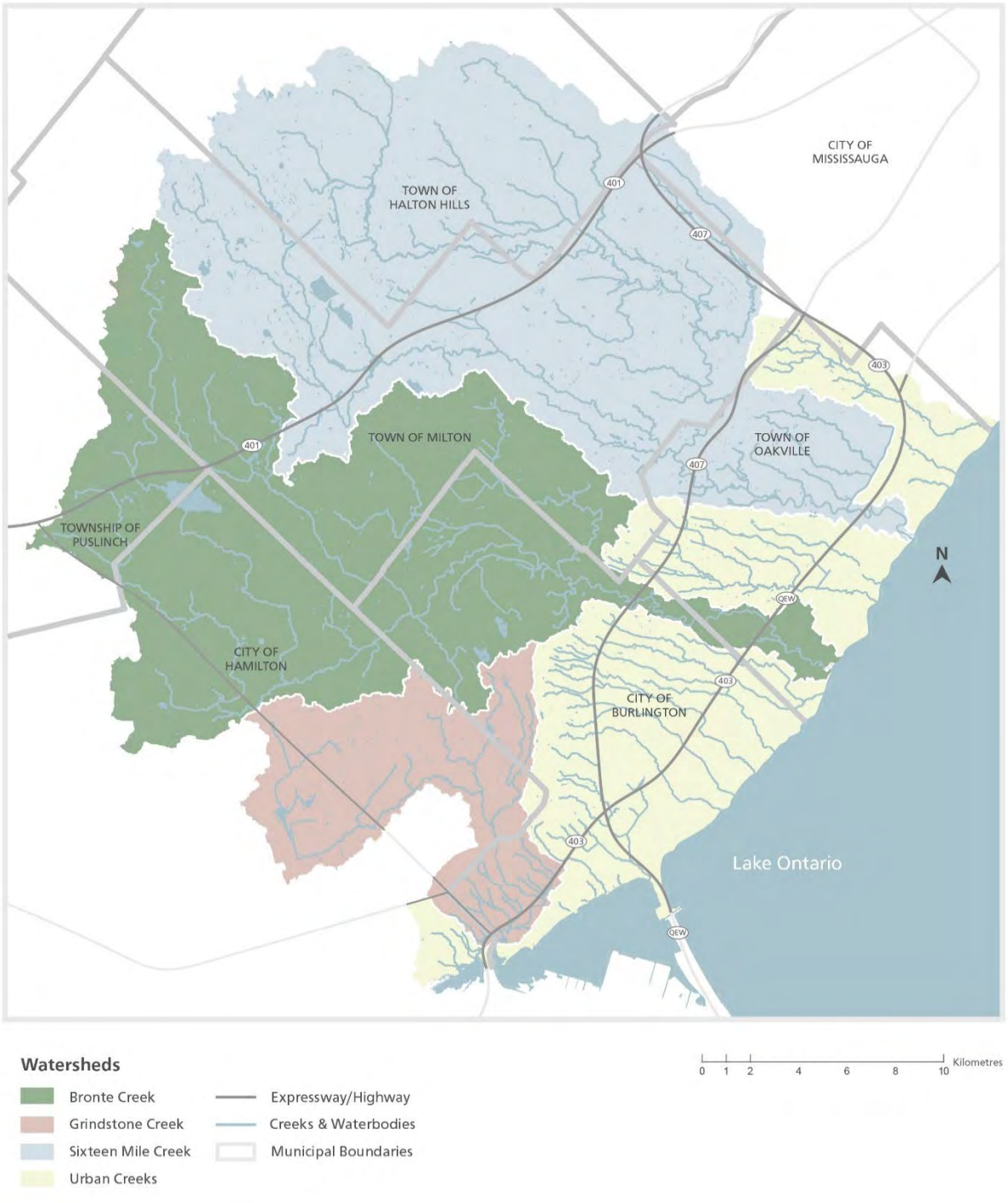
- **Appendix 1 – Supplemental Information** – Provides information and considerations that are not required as part of a submission to CH but are encouraged.

These Guidelines are specific to CH and do not replace or supersede any other federal, provincial or municipal requirement. Pre-consultation with CH and municipal agency staff is encouraged in conjunction with the use of this document.

1.2 Conservation Halton's Role in Reviewing Landscaping and Rehabilitation Plans

CH protects, manages, and enhances the area within its jurisdiction (see Figure 1-1) through a wide variety of programs and services, including the administration of regulations.

FIGURE 1-1: CONSERVATION HALTON WATERSHED



Under *Ontario Regulation 162/06* (*O. Reg. 162/06*), CH regulates:

- All development in or adjacent to river or stream valleys, wetlands and surrounding lands where development could interfere with the hydrologic function of the wetland, Lake Ontario shorelines, or hazardous lands such as karst and any associated allowances;
- Alterations to a river, creek, stream, or watercourse; and
- Interference with wetlands.

Permission is required from CH for undertaking any development within regulated areas. "Development" means,

a) the construction, reconstruction, erection or placing of a building or structure of any kind,
b) any change to a building or structure that would have the effect of altering the use or potential use of the building or structure, increasing the size of the building or structure or increasing the number of dwelling units in the building or structure,
c) site grading, or
d) the temporary or permanent placing, dumping or removal of any material, originating on the site or elsewhere.

CH's Board-approved *Policies and Guidelines for the Administration of Ontario Regulation 162/06 and Land Use Planning Policy Document* (2020) outlines the policies and technical requirements which must be met before permission may be granted. As part of a CH permit application, an applicant must demonstrate that CH's Board-approved policies and technical requirements can be met to the satisfaction of CH.

CH's review of Landscaping and Rehabilitation Plans provides for a streamlined and integrated assessment of the merits of the proposal that is linked to CH's roles and responsibilities.

Section 2 General Standards

This section outlines landscaping and rehabilitation requirements for works proposed in CH's regulated areas, such as floodplains, watercourses, valleys, wetlands and regulated lands adjacent to these features. Additional project specific guidance is provided in Section 3.

Landscaping and rehabilitation are required when development or alterations to floodplains or watercourses are proposed within a regulated area to mitigate risks associated with natural hazards. Landscaping and Rehabilitation Plans may be a component of an overall CH permit. Applicants are encouraged to consult with CH staff prior to submitting a plan.

Drawing or Submission Requirements

When preparing a Landscaping and Rehabilitation Plan, each plan must include and/or show the following:

- ☐ Written and graphic scale on all drawings (e.g., 1:200)
- ☐ North arrow
- ☐ Property boundary
- ☐ Full area of disturbance, including all grading works
- ☐ Air photo(s) with proposed works overlaid (digital submission only)
- ☐ Vegetation protection measures and erosion control measures (if not provided on other drawings)
- ☐ Stamp of a qualified professional (if applicable) and drawing date
- ☐ CH's Approximate Regulated Limit or confirmed regulated area by CH staff (e.g., CH staff staking)
- ☐ Plantable area in square metres (m^2)
- ☐ Description of the proposed approaches for topsoil, timing of work, species selection, tree and shrub plantings, groundcover and stabilization of soils
- ☐ Identify if a fence is necessary to deter encroachment into the planting area.

Before drawings are drafted, review all higher-level plans and policies (e.g. site-specific environmental impact assessments/studies, subwatershed studies, subwatershed impact studies, etc.) that pertain to the proposed development and associated permit. These high-level policies and plans may identify goals that should be achieved through landscaping or rehabilitation works in the regulated areas. They may also provide direction on the expected outcome of landscaping or rehabilitation works.

Understanding existing site context and conditions is a critical consideration for plan preparation. Professionals preparing the plan are encouraged to visit the site early in the planning stage to familiarize themselves with the site. The existing or adjacent natural environment can be used as a reference to identify appropriate species selection and composition for planting.

A suite of factors will influence the survival of the proposed plantings. Species suited to the environmental conditions, the current and anticipated stresses due to development, and the anticipated uses of the site should be selected. Depending on these factors, additional measures may be recommended by staff as part of the landscaping works.

Use the checklist provided in Section 4 to ensure all applicable requirements are included in the submission.

2.1 Site Preparation

There are several steps that can be completed to minimize material needs and reduce the footprint of disturbance on a given site. Simple notes on plans can provide clear direction on how to clear the site of vegetation and protect areas identified for preservation.

When preparing a Landscaping and Rehabilitation Plan, each plan must:

- ☐ Demarcate the limits of construction with erosion and sediment fencing and/or tree protection fencing to avoid encroachment into the regulated area to minimize risk and disturbance, as well as preserve the quality of the topsoil.
- ☐ Undertake any required tree removals without grubbing the soil, to the extent feasible to minimize risk and disturbance to the soil.

2.2 Topsoil

Healthy soils are essential for establishing vegetation, elevating the success rates of landscaped or rehabilitated sites, while also reducing costs associated with ongoing maintenance or the need for replanting. This in turn can support the formation of stable slopes, bolsters the hydrological function of wetlands, increases infiltration rates, curbs runoff, and aids in mitigating risks associated with natural hazards.

Outlined below are CH's requirements related to topsoil application and the stockpiling of materials. These requirements are based on industry best practices and CH's experience with successful landscaping and rehabilitation projects.

When preparing a Landscaping and Rehabilitation Plan, each plan must:

Topsoil

- ☐ Indicate if the existing topsoil is viable and if there is enough depth for anticipated plantings and seeding.
- ☐ Specify aeration and/or adding compost, compost tea, leaf mulch and/or locally sourced mycorrhizal inoculant if the existing soil is compacted or degraded.
- ☐ Ensure a minimum depth of 20 cm of clean topsoil is specified unless the area has been compacted or soil is sterile, and a minimum of 45 cm of clean topsoil where soil has been compacted. Confirm the proposed topsoil depths are supported by engineering studies.
- ☐ Specify mixing imported soil with native soil to ensure soil microorganisms are adapted to the site.
- ☐ Specify clean topsoil in a consistent depth throughout the area.
- ☐ Phase works during construction to the extent possible to minimize disturbance. Care should be taken so as not to place fill within regulated areas or unnecessarily use heavy equipment.
- ☐ Show how compaction will be minimized and mitigated in instances where encroachment into the natural area cannot be prevented. Consider application of a medium such as woodchips in locations where vehicle movement is proposed in natural areas.

Stockpile

- ☐ Show all topsoil stockpile locations on site outside of CH's regulated limits, where possible. Stockpiles permitted in the regulated area should have a recommended maximum specified

height limit of 130 cm. Indicate that compost will be added to stockpiles greater than 120 cm for soils remaining for periods longer than six months.

- ☐ Seed stockpiles with nurse crop or alternative winter cover to help retain the quality of the topsoil and minimize erosion.
- ☐ Install appropriate erosion and sediment control measures around the topsoil pile and other exposed areas to prevent sediment-laden runoff from reaching watercourses and wetlands.
- ☐ Keep stockpiled topsoil separate from subsoil.

2.3 Species Selection

A well-designed landscape incorporating native species will function and adapt better to the local environment. Native species play a crucial role in preventing soil erosion, primarily due to their deep-rooted systems that stabilize the soil. The successful establishment of vegetation through landscaping or rehabilitation efforts contribute significantly to maintaining stable slopes, increasing infiltration rates, reducing runoff, mitigating erosion, and minimizing flood risk.

When preparing a Landscaping and Rehabilitation Plan, each plan must:

- ☐ Illustrate transplanting, planting or salvaging of only native species.
- ☐ Include locally common and/or uncommon species as per CH's Native Plant List.
- ☐ Ensure that no invasive species or plant associations that support the lifecycle of pests are proposed (e.g., do not plant the hosts of blister rust together: *Ribes* and *Pinus* species).
- ☐ Include a minimum of five species per targeted plant type (e.g., tree, shrub, forbs, graminoid, aquatic, etc.).
- ☐ Avoid species with allelopathic effects to ensure the optimal growth of other species (or ensure tolerance of species planted in association).
- ☐ Incorporate bioengineering measures where appropriate.
- ☐ Include locally native species representative of existing vegetation or edge habitat communities when planting adjacent to vegetation communities or in natural areas.
- ☐ Integrate early successional species.
- ☐ Incorporate companion plantings for shading, where appropriate.
- ☐ Use CH's Native Species List for a list of suitable species.

2.3.1 Trees and Shrubs

Trees and shrubs provide important services and critical hydrological functions in the landscape. Trees and shrubs reduce the rate of erosion by protecting the soil from rain impacts and holding soil in place with their roots. Trees and shrubs also reduce flooding by increasing infiltration.

When preparing a Landscaping and Rehabilitation Plan, each plan must:

- ☐ Identify individual trees proposed for removal and replace with at least 3 native trees unless otherwise directed by higher level studies, policies and/or by-laws.
- ☐ Propose no fewer than five tree species and five shrub species in areas currently or intended to be forested.

- ☐ Include a variety of tree sizes and successional species to accelerate establishment of a natural vegetation structure. Specific size variations are provided in the project specific standards subsections.
- ☐ Select species representative of natural plant associations and appropriate successional stage.
- ☐ Use adjacent vegetation communities, where applicable, as examples of vegetation associations.
- ☐ Mimic a natural, rather than geometric layout to the greatest extent possible in the planting plan to ensure maximum soil stabilization coverage.
- ☐ Design cover structure and layering (e.g., groundcover, understory canopy, heterogeneous canopy height, etc.) to maximize structural complexity.
- ☐ Install plant species not susceptible to ice/storm damage as well as spreading, suckering vegetation away from structures.
- ☐ Transplant/salvage only non-invasive woody vegetation that is under 20 cm diameter at breast height (DBH).
- ☐ Include larger stock and/or fast-growing shrubs and trees near or adjacent to streams and ponds to provide immediate stabilization (i.e. *Acer saccharinum*, *Salix spp*., *Sambucus canadensis*, *Populus* spp.).
- ☐ Consider contingency measures for animal damage during species selection and post-planting care.
- ☐ Provide a tree planting detail on the drawings showing the stakes, wrap, mulch, soil amendments and size of hole.

Due to factors such as area of disturbance, stock availability, and survivability, CH may support planting of younger and smaller stock on a case-by-case basis. Consultation with staff is recommended.

Whips can be substituted for caliper stock at a 10 to 1 ratio, where appropriate.

- 1 deciduous caliper stock is >4 cm DBH
- 1 conifer is >150 cm in height

2.3.2 Ground Cover/Stabilization

Ground cover and stabilization measures are key in preventing immediate erosion and sedimentation, while significantly contributing to restoration efforts. When preparing plans, it is key to consider the application, composition and timing of the ground cover/stabilization proposed.

When preparing a Landscaping and Rehabilitation Plan, each plan must:

Application

- ☐ Specify application of ground cover in a nutrient rich medium using Terraseeding, hydroseeding or similar techniques that incorporates both seed mix and growth media during the application process or with weed-free "sod blocks", where appropriate.
- ☐ Limit mulch to a depth of 5 cm and only in planting nodes.
- ☐ Avoid broadcasting the entire watercourse corridor or natural area with mulch.
- ☐ Select plastic-free mulch.

Composition

- ☐ Include plugs or potted stock for immediate stabilization, and plants grown from seed for target community composition, where possible.
- ☐ Plant deep rooting native graminoids and wildflowers for soil stabilization. Do not use conventional sod in naturalized regulated areas.
- ☐ Provide the seed mix species composition and application rate on plans. CH recommends a seeding rate of 25-30 kg/ha to achieve soil stabilization. Verify species-appropriate quantities with a qualified professional.
- ☐ Salvage seed depending on site conditions and existing vegetation. Areas with invasive species or dominated by non-native species are not suitable salvage sites.
- ☐ Use more than one nurse crop to prolong coverage over multiple seasons.

Timing

- ☐ Optimize timing of works and germination of nurse crops.
- ☐ Apply a combination of nurse crops to establish quick vegetative cover over various seasons.
- ☐ Avoid seeding during the drought-prone periods, unless additional maintenance measures can be completed (i.e. frequent watering).
- ☐ Stabilize topsoil with approved nurse crop seed mixes for groundcover.
- ☐ Add additional stabilization measures (e.g., hydroseeding in combination with engineered methods such as erosion matting and nurse crops) if required due to seasonal conditions and depending on timing of work. Re-evaluate the depth of the topsoil prior to planting if not stabilized immediately.
- ☐ Delay spreading of topsoil until following spring if topsoil cannot be stabilized within the current year's growing season.

Additional Considerations

- ☐ Use biodegradable erosion matting such as plant fibre blankets for short-term stabilization.
- ☐ Ensure the nurse crop is certified and does not contain any invasive species.

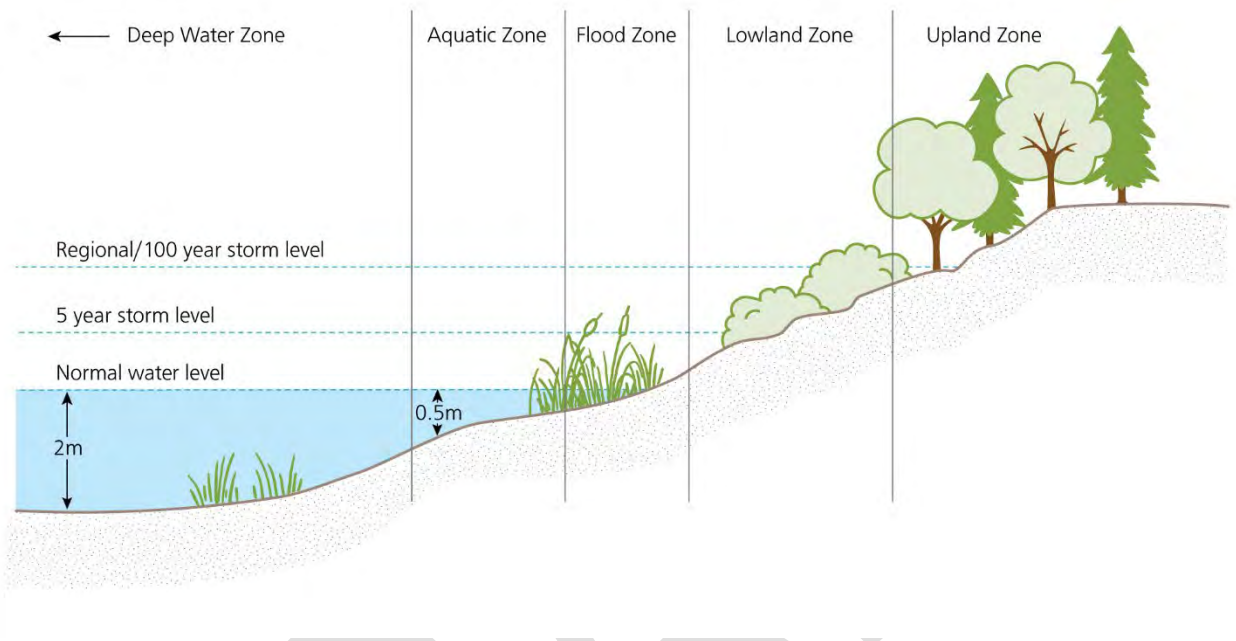
2.4 Planting According to Moisture Regime

To achieve a successful outcome, it is necessary to consider the site's moisture regime when determining what to plant in which location. Many plants have specific needs as it relates to moisture level and will not thrive if these needs are not met. The five zones describe typical conditions encountered. The hydrologic/moisture zones represent the tolerance of plants to differing degrees of water inundation (Figure 2-2: Moisture Zones). Consider and include moisture zones when developing plans.

- **Deep Water Zone:** water depth 0.5 m to 2 m below surface.
- **Aquatic Zone:** depth from 0.5 m to the normal water level.
- **Flood/Shoreline Zone** depth from normal water level to 5-year storm.
- **Lowland Zone:** depth from the 5-year storm to the Regional / 100 year storm level or based on vegetation community present or suitability.

- **Upland Zone:** Area above the Regional / 100 year storm level or based on vegetation community present or suitability.

FIGURE 2-1: MOISTURE ZONES



The Figure 2-2 is provided for schematic purposes only. Plantings in each zone are subject to the type of rehabilitation project.

CH's Native Species List provides a list of native species suitable for each hydrologic/moisture zone based on the coefficient of wetness is available online at www.conservationhalton.ca.

Section 3 Project Specific Standards

This section outlines project specific requirements for landscaping and restoration associated with works within regulated areas such as floodplains and watercourses, wetlands and the regulated areas adjacent to these features. These requirements are in addition to the general requirements outlined in Section 2.

3.1 Floodplains, Watercourses and Valleys

Plantings associated with floodplains watercourses alterations and valleys are intended to stabilize the adjacent side slopes and floodplain of the creek, while simultaneously preventing erosion on the meander bends. The planting requirements for these areas are outlined below.

3.1.1 Planting Requirements

Floodplain, watercourse alteration and valley requirements apply to the entire width of the creek block, including floodplain and side slopes (excluding trails), or valley. Appropriate species selection is essential to ensure long term viability and success of the plantings.

When preparing a Landscaping and Rehabilitation Plan, each plan must:

- ☐ Include a variety of pioneer, successional and late successional species for rehabilitation works. Pioneer species ensure rapid rehabilitation, while mid-successional species provide longer-term structural diversity based on growth rates and shade tolerance.
- ☐ Ensure plantings consist of 5% caliper, ball and burlap and/or wire basket material and 95% whips and/or saplings.
- ☐ Include trees at a density of 10 trees per 100m^2 and a shrub to tree ratio of 5:1, in communities dominated by trees and shrubs.
- ☐ Provide tree and shrub plantings within the first metre adjacent to the creek to maximize bank stability and soil stabilization.
- ☐ Use bioengineering along banks where possible.
- ☐ Include ground cover throughout the entire area of disturbance within the floodplain and/or valley, and where enhancement will improve the riparian/creek corridor.
- ☐ Vegetate the entire cross-section of intermittent channels and to the approximate bankfull limits of permanent channels.
- ☐ Illustrate the topsoil tapering to a thin layer near the bottom of the bank or low flow limits.

3.1.2 Bioengineering

Bioengineering is the rehabilitation technique of using dormant cuttings of hardy native plant material. It is an encouraged approach for watercourse and valley rehabilitation works as a method to stabilize or protect erodible soils. It can provide immediate mechanical stability while a vigorous root matrix establishes within the soil. As the stabilization is provided by living vegetation, the reinforcement provided grows stronger and more effective over time. Types of Bioengineering can include installing live stakes, live fascines, brush layering, live crib walls, live staking and brush mattresses.

Two factors should be considered when determining whether bioengineering is an option:

- Shear Stress: determine the shear stress that is anticipated to be enacted on the bioengineering material via precipitation, meltwater or creek flow to confirm if the approach will work.
- Timing: install bioengineering structures during the required planting timing window to ensure the survival of the planting material and the success of the bioengineering project. The collection of material and installation should occur between October 31 and March 31.

3.2 Temporary or Infrastructure Related Watercourse Works

The following section provides directions on watercourse works that are temporary in nature, such as interim watercourse realignments while the ultimate channel is being constructed, or infrastructure outlets that tie into regulated watercourses.

3.2.1 Temporary Channels

Temporary channels are used to divert flows during construction of stormwater infrastructure or permanent/ultimate watercourse realignments. It is important to quickly stabilize these channels to prevent sediment from entering downstream.

The following approaches for temporary channels in regulated areas should be considered:

- ☐ Using erosion control blankets depending on construction timing and duration.
- ☐ Lining bed with rocks and/or vegetation.

- ☐ Planting native vegetation to ensure full coverage, especially in cases where works will be completed over a longer timeframe (i.e., greater than one year).
- ☐ Using sod mats for stabilization where appropriate.

Temporary channel lined with rocks

Temporary channel bed lined with vegetation

3.2.2 SWM Pond Outlet Structures

SWM pond outlets may be designed as: swales/channels, flow spreaders, infiltration trenches, stonecore wetlands, etc. Regardless of the design, the area around the outlet should be well-vegetated to prevent erosion and maintain the form and function of the receiving watercourse / wetland. Establish a continuous band (minimum 3 m in width) of woody riparian vegetation around or along the outlet structure to facilitate stabilization. Plant a combination of fast-growing riparian pioneer species (e.g., poplars, dogwoods, alders and willows) as well as longer lived, large canopy species (e.g., silver maples). Plant the larger planting material adjacent to the outlet feature to provide a more immediate stabilization effect.

3.2.3 Temporary SWM Pond Stabilization

Temporary SWM ponds may be installed as an interim facility. It is important to quickly stabilize these temporary SWM ponds to prevent sediment from entering downstream.

The following approaches for temporary SWM ponds that outlet to regulated areas or are located in regulated areas should be considered:

- ☐ Use erosion control blankets depending on construction timing and duration.
- ☐ Plant native riparian groundcover vegetation to ensure full coverage, especially in cases where works will be completed over a longer timeframe (i.e., greater than one year).
- ☐ Use sod mats where appropriate.

3.3 Areas Adjacent to Natural Hazards and Wetlands

Plantings in the regulated allowance of natural hazards and wetlands are important for maintaining the hydrologic form and function and minimizing or mitigating erosion and flooding across the watershed. The planting area in the regulated allowance is intended to be established and maintained as native, self-sustaining vegetation. CH promotes rehabilitating sites using planting densities appropriate to the desired Ecological Land Classification (ELC) vegetation community. Appropriate planting densities should be established through consultation with CH.

It is important to consider any existing naturally occurring vegetation adjacent to a natural area when planting. The density and size requirements for planting may be reduced based on existing vegetation

provided the existing areas that are not disturbed during any phase of construction. Requirements will be determined on a site-by-site basis. The planting guidelines in the following subsections are based on the most common vegetated treatments.

Regardless of the natural hazard or wetland present, the planting area is made up of three distinct vegetated bands. The purpose of these bands is to create transitions between the natural hazard or wetland, and the proposed development. Band 1 is located closest to the natural hazard or wetland and is the most densely planted. The width of Band 1 should be a minimum of 5 m for all allowances 15 m wide or less. For all allowances greater than 15 m, the width of Band 1 is half of the total allowance width. Band 2 is made up of sparser woody plantings interplanted with groundcover plantings while Band 3 blends into the surrounding developable envelope consisting only of native herbaceous and graminoid species. The width of Band 2 and 3 will be determined on a site-by-site basis. As illustrated in Figure 3-1, the minimum planting densities are broken down into three bands to create a gradual transition between the natural hazard or wetland and the proposed development.

FIGURE 3-1: VEGETATION BANDS ADJACENT TO NATURAL HAZARDS AND WETLANDS

Wetlands and valleys (typically woodlands) are natural hazard types which require adjacent landscaping to stabilize soils, prevent erosion and minimize flood risk. Table 3-3 outlines the planting criteria by vegetation community.

TABLE 3-1: BANDS CRITERIA BY VEGETATION COMMUNITY TYPE

Vegetation Community	Band 1	Band 2	Band 3	Considerations
Woodlands and swamps	☐ Indicate tree density of 5 trees per 100 m^2 ☐ Indicate shrubs density of 5 trees/25 shrubs (for every tree planted, 5 shrubs should be planted) per 100 m^2. ☐ Locate proposed trails, if any, in other bands and/or away from the natural hazard or wetland.	☐ Indicate tree density of 3 trees per 100m^2. ☐ Indicate shrubs in this band at a shrub to tree ratio of 5:1.	☐ Indicate a ground cover mix as prescribed in the General Standards section of this document.	
Thickets and thicket swamps	☐ Plant at a density of 25 shrubs per 100 m^2. ☐ Plant appropriate groundcover/seed mix around and between shrubs.	☐ Plant Bands 2 and 3 as a gradient to transition from woody vegetation to ground cover species dominated adjacent to the development.		
Shallow marshes, meadow marshes, along wetland pond edges, wet meadows/prairies, or similar shallow aquatic habitats	☐ Plant at a density of 15 shrubs per 100 m^2 in a gradient with most shrubs located adjacent to the remaining natural area. ☐ Plant appropriate groundcover/seed mix around and between shrubs.	☐ Plant a secondary band of herbaceous cover adjacent to the proposed development.		☐ The width of bands 2 and 3 will be determined on a site-by-site basis and will vary depending on the quality of the natural area. ☐ Shrub plantings are recommended closest to herbaceous wetlands as a mitigation measure. In certain instances, planting a reverse vegetation band around an herbaceous wetland (e.g. shrubs in Band 3) may be recommended to prevent encroachment into the critical function zone of the wetland.

Shrubs are equal to or larger than 1-gallon pots or equivalent.

Provided below in Table 3-4 is an example of band plantings to be included in the submission.

TABLE 3-2: EXAMPLE BAND PLANTINGS

Band	*Area*	*Requirement Densities*	*Required Quantity of Plantings*
Band 1	*4000 m^2*	*Total Tree (5 Trees/ 100 m^2)*	*200*
		5% Caliper	*10*
		50% whip and/or sapling	*100*
		45% seedling and/or plug	*90*
		Total Shrubs (5 Shrubs per Tree)	*1000*
		Groundcover	*Refer to section or provide seed mix, percentage and application*
Band 2	*2000 m^2*	*Total Tree (3 Trees/ 100 m^2)*	*60*
		5% Caliper	*3*
		50% whip and/or sapling	*30*
		45% seedling and/or plug	*27*
		Total Shrubs (5 Shrubs per Tree)	*300*
		Groundcover	*Refer to section or provide seed mix, percentage and application*
Band 3	*2000 m^2*	*Groundcover*	*Refer to section or provide seed mix, percentage and application*

Section 4 Submission Requirements

Once the Landscaping and Rehabilitation Plan is complete and ready for submission, a copy of the Landscaping Checklist must be completed and signed by the qualified professional to be considered a complete submission. A copy of this checklist can also be found at www.conservationhalton.ca or available at the Administration Office. While not all the information below is applicable to all projects, applications must include the information in the General Section to ensure a timely review and reduce the number of resubmissions.

TABLE 4-1: DRAWING REQUIREMENTS

	1st Submission
☐	All planting plans are completed, stamped and signed by a qualified professional if applicable.
☐	Key map, written and graphic scale, north arrow, project name and location, name and contact information for applicant/owner and qualified professional are shown on the plan.
☐	Property boundary and CH regulated areas are shown clearly on all drawings.
☐	A reference to project goals and site condition/context on drawings is included.
☐	All features shown on landscaping drawings are consistent with other works (e.g. location of ESC, tree protection fencing, location of proposed structures, etc.).
☐	All seasonal design considerations are noted where appropriate on drawings.
☐	Areas of retention and/or species to be protected in the adjacent regulated areas are shown on all drawings (e.g. vegetation protection and/or erosion and sediment control measures)
☐	Extent of disturbance is shown on drawings.
☐	Location of infrastructure (above and underground) that may affect the proposed landscaping plans (e.g., utility lines, snow storage, etc.) is shown on drawings.
☐	Summary table providing the calculations in square metres for the total plantable area for the areas to be vegetated (excluding any infrastructure such as trails), and total number of trees and shrubs and seed mix in each submission.
☐	Details as outlined in the General and Project Specific standards are included.
☐	Digital and if necessary, hardcopy drawings folded to a standard letter size (8 1/2" x11").
	Additional Submissions
☐	A cover letter outlining the changes to the revised landscaping plan and highlighting the changes on the plans directly.
	Upon Completion of Works
☐	A certified letter from the qualified professional confirming that plans have been implemented as per the approved plans.
☐	Discrepancies between the proposed and as-built plans and the rationale for these are included in the certified letter. Remediation may be required where the difference is substantial.
Submission Prepared by:	Date (day/month/year)

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Glossary of Terms

Terms	Definitions
Allelopathic	A chemical emitted from certain plants that reduces some plant's ability to grow optimally. Example of allelopathic plants are: Black Walnut, *Juglans nigra*, Sumac, *Rhus Typhina* and goldenrods *Solidago spp.*
Ball and Burlap	The intact ball of earth containing the roots of nursery stock that has been hand dug, balled and wrapped in burlap.
Bioengineering	Soil bioengineering is an established method of stabilizing or protecting erodible soils using dormant cuttings of hardy, native plant material. Structures provide immediate mechanical stability while a vigorous root matrix is established within the soil. As the stabilization is provided by living vegetation, reinforcement provided grows stronger and more effective over time.
Caliper	The above ground diameter of a distinct part of a nursery stock stem, measures in accordance with the Canadian Standards for Nursery Stock. CH considers deciduous trees with a diameter of 4 cm or greater and a conifer with a height of 150 cm or greater as caliper stock. Generally supplied in 7 gallon or larger containers.
Coefficient of wetness	A measure of the tolerance of a plant species to soil moisture conditions. It is a value on a scale from -5 to +5 that represents the soil moisture regime for the plant species: These categories are defined as follows: OBL (-5) Obligate Wetland - Occurs almost always in wetlands under natural conditions (estimated > 99% probability). FACW (-2 to -4) Facultative Wetland - Usually occurs in wetlands, but occasionally found in non-wetlands (estimated 67-99% probability). FAC (-1 to +1) Facultative - Equally likely to occur in wetlands or non-wetlands (estimated 34- 66% probability). FACU (+2 to +4) Facultative Upland - Occasionally occurs in wetlands, but usually occurs in non-wetlands (estimated 1-33 % probability). UPL (+5) Obligate Upland - Occurs almost never in wetlands under natural conditions (estimated < 1 % probability).
Companion planting	A nodal planting made up of an assortment of species that mutually benefits each other. The shade intolerant species are located on the outside of the node to maximize on sunlight and provide a barrier to shade intolerant located in the middle of the node.
Crown	Part of the plant directly above where the branching begins.
Diameter at Breast Height (DBH)	Standard measurement to establish the diameter of a tree. The diameter at breast height (DBH) is measured at 137 cm above the ground.

Terms	Definitions
Ecological Land Classification	The Ontario Ministry of Natural Resources and Forestry (MNRF) system that classifies ecological units based on bedrock, climate (temperature, precipitation), physiography (soils, slope, aspect) and corresponding vegetation.
Fascine	A long bundle of overlapping live shrub cuttings held together by twine.
Forb	A non-woody flowering plant. Also referred to as an herbaceous plant.
Graminoid	A grass like plant often referring to the *Poaceae* (grasses), *Cyperaceae* (sedges) and *Juncacea* (rushes) families.
Herbaceous	An adjective representing herb like plants. More generally, herbaceous plants are non-woody flowering plants. Also referred to as a forb.
Landscaping and Rehabilitation Plan	Proposed planting plan. Throughout this document, the term landscaping and rehabilitation plans refers to all restoration, reforestation and enhancement planting plans.
Live Stake	Cuttings from live, rootable woody species.
Locally Common Species	A plant species observed in over 15 natural areas in the respective Natural Areas Inventory
Locally Native	A species identified in the Natural Area Inventory as naturally occurring within a specified jurisdiction (e.g. Halton Region).
Locally Uncommon Species	A plant species observed in 6 - 15 natural areas in the respective Natural Areas Inventory
Native	Indigenous to a region, having evolved there as part of an ecosystem over a long period.
Naturalized	Non-native species which are established in a region and able to reproduce successfully and live alongside native species in the wild. Naturalized species may be introduced intentionally or unintentionally.
Non-Native	A species that does not originate from a specified jurisdiction (e.g. Halton Region). Sometimes described as ‘Introduced’.
Nurse Crops	Fast growing annual groundcover species that establish within one growing season and provide stabilization. Typically, short lived.
Plant Type	Refers to trees, shrubs, forbs, vines, ferns and graminoids.
Plugs	A cylinder of soil in which a plant is grown, generally used for seedlings and rooted cuttings.
Potted	Plants with an intact soil ball and placed in a container, in lieu of burlap.

Terms	Definitions
Qualified Professional	A person with specific qualifications, training, and experience authorized to undertake work in accordance with the policies in accepted arboriculture, forestry, landscape architecture, ecology or scientific principles, provincial standards, criteria and guidelines, and/or to the satisfaction of the Conservation Halton.
Sapling	A young tree without branches; in some species and grades spurs may be present. Also referred to as a whip.
Seedling	A cylinder of soil in which a plant is grown. Also referred to a plug.
Self-Sustaining Vegetation	Vegetation dominated by plants that can grow and persist without direct human management, protection or tending.
Shear Stress	The force applied to the stream bank from the flowing water, which can cause the movement of soil particles.
Sod Block/Mat	A mat of existing vegetation that is removed from a site prior to works and stored to be used in the rehabilitation of the site post construction.
Stormwater Management	The control of rainfall, snowmelt and runoff from activities such as watering lawns, washing cars and draining pools, that seeps into the ground or runs off the land into storm sewers, watercourses and lakes.
Topsoil	Upper, outermost layer of soil, with the most organic matter and nutrients.
Watershed	All land and water within the confines of a drainage basin.
Whip	A young tree without branches. Also referred to as a sapling.
Woodland	Forested, treed, and woodlot areas, including cultural Vegetation Types as defined by the Ecological Land Classification system or the *Forestry Act.*

Appendix 1: Supplemental Information

Appendix 1: Supplemental Information

The information in this appendix is provided for information only. These are not CH's requirements and are intended as additional guidance and Best Management Practices only and that can be used to ensure a successful project.

Before drawings are drafted, review all higher-level policies, studies and plans that pertain to the proposed development. These high-level policies, studies and plans may identify goals that should be achieved through landscaping or rehabilitation works. They may also provide direction on the expected outcome of landscaping and rehabilitation works.

When a study has not been completed, identify and account for the form and function of natural features in the landscaping plans. In all cases, ensure consistency between the landscaping plans and other drawings (e.g., erosion and sediment control, site plan, etc.).

Appendix Outline

This document is divided into five sections:

A. **Design Considerations** – Lists factors to consider when preparing a Landscaping and Rehabilitation Plan.

B. **Edge Management Plan** – Describes a specific approach for works along the edge of a regulated natural feature.

C. **Topsoil** – Outlines additional tips for ensuring the quality of topsoil.

D. **Planting Considerations** – Lists several considerations for plant selection and planting approaches.

E. **Post-planting Care** – Lists considerations for the maintenance and monitoring required to achieve self-sustaining vegetation.

F. **Wildlife** – Describes considerations for wildlife in Landscaping and Rehabilitation Plans.

G. **Creating Wildlife Habitat Features –** Outlines a variety of wildlife habitat features and provides recommendations on how to create them.

H. **Stormwater Management Ponds –** Recommends direction on landscaping stormwater ponds adjacent and/or out letting to natural areas.

A. Design Considerations

Several factors could affect the landscaping and rehabilitation plans. While these factors do not all need to be provided on a plan, except for the Approximate Regulation Limit, the list below outlines most factors to be considered during the preparation of plans such as the site context, existing site condition, the timing of the proposed plantings and the planting plan's coordination with the development application. This list is not comprehensive but provides a starting point for typical considerations in plan preparation.

Site Context

- CH's Approximate Regulation Limit, where applicable.
- Natural Heritage System - where applicable and as defined by the regional or municipal official plan or higher planning document.
- Existing Challenges - light, noise, particulates, road salt, etc.

Site Condition

- Vegetation - existing and surrounding vegetation, species tolerances, invasive species and plants that host pests, potential for plant salvage and/or seed harvest.
- Wildlife - sensitive timing windows, colonization potential, wildlife exclusion measures, wildlife encounter protocols, etc.
- Soils and Physiography - soil composition, depth, quality, drainage, slope and aspect, wetness/dryness of site, existing erosion.
- Hydrology - fluvial geomorphology, floodplain, meander belt, low water and high-water mark, potential groundwater interactions.
- Elements - prevalent wind patterns, shade/part-shade from adjacent trees or buildings, landforms or structures, micro-climate.
- Structures - existing infrastructure and utilities located above and below ground, historic land uses that may be in or adjacent to proposed works.

Timing

- Season, duration, and phasing of proposed works.
- Native species stock availability.

Design Conditions

- Extent of proposed development and how it may impact site conditions (e.g., soil compaction, stockpiling, road salt, wind tunnels, etc.).
- Stabilization requirements.
- Grading.
- Altered hydrology, potential wetness/dryness of site.
- Post-construction or post-development use.
- Adjacent sites.

- Suitability of project for low impact development (LID).

B. Edge Management Plan

An Edge Management Plan may be recommended as part of a site-specific environmental impact study/assessment where tree, shrub or vegetation clearing/disturbance involves the existing edge of a regulated natural feature (e.g., wetland, valley). This Plan typically consists of plantings to restore functions and protect the feature from adjacent disturbances. Impacts from such disturbance can include changes to light penetration, increased air movement and associated drying effects, loss of trees/shrubs and groundcover, introduction of exotic or invasive species, decreased biodiversity, alterations of habitat form and function, overall loss of resilience, etc. An Edge Management Plan may be recommended instead of the band planting outlined in the Section 3 of the main guideline due to limited space, limited proposed vegetation removal or an already densely established regulated area adjacent to the natural hazard or wetland.

C. Topsoil

Proper topsoil application and management is key to prevent sedimentation and reduce the ecological footprint. In many instances, the quality and quantity of topsoil at the site pre and post development is unknown and consequently will affect the survivability of the plants. Determining the appropriate amount and types of amendments by completing a soil test and sourcing amendments from renewable resources are two examples of topsoil best management practices.

Soil Tests

Excessive application of soil amendments may negatively result in nutrient loading and potentially leaching into nearby waterways. Prior to completing any works, determine if the existing topsoil is salvageable and/or requires amendments by completing a soil test. Should soil amendments be deemed necessary, CH recommends sourcing soil amendments from sustainable practices such as incorporating leaf mulch, or compost from municipal compost systems that meet Category AA or A of the MECP Ontario Compost Standard Quality.

Peat Moss

Avoid using peat moss as it is a non-renewable resource. Its harvest damages the wetlands it is removed from, making its use unsustainable. Where organic content of soil needs to be amended, alternatives can include coir mulch, compost, fine-textured wood mulch or leaf mulch, which may be available from municipal leaf-collection programs.

D. Planting Considerations

Listed below are various considerations for ensuring appropriate naturalization techniques are adopted.

Species at Risk, Provincially or Regionally Rare Species

CH encourages planting of any species at risk, provincially rare or regionally rare species only under the direction of a recovery initiative. The planting of these species may lead to genetic issues as well as potential future complications for landowners by the creation of habitat for these species. Confirm current species status with federal, provincial and regional lists prior to submission. Regional rarity can be found in the Halton and Hamilton Natural Areas Inventories (NAI).

Conservation Halton's Seed Mix and Native Species List

CH developed a variety of seed mixes that are appropriate for use within our watershed and are suitable for rehabilitation purposes and naturalization projects as well as for stormwater management facilities. They are designed for use in a variety of soil and moisture conditions and are available online on CH's Policies and Guidelines webpage (www.conservationhalton.ca).

The Native Species List provides a list of acceptable species for planting plans in regulated areas. The identified species are not exhaustive as other species may be appropriate for the site, and any locally native non-invasive could be added to the seed mixture (www.conservationhalton.ca).

Establishing Long-term Native Cover

When creating a seed mix, consider including seeds that will germinate immediately the following growing season (nurse crop) and in three to five years. Keep in mind that some native seeds are hard to grow and may not bloom within the two-year warranty and monitoring period. For example, *Impatiens* sp. seeds undergo a double dormancy and may not grow until two to three years after seeding.

Ground Cover Seed Distribution

Consider the distribution method for seed application. Some native seeds may get caught or not germinate in the hydroseeding slurry. Pair the size of seed and medium (tackifier and mulch) appropriately or use an alternative method (e.g., drill seeding, Terraseeding, or broadcast spreading). Specify on the plans:

- Equipment will be seed free prior to starting a new project.
- Seeds to be hand-broadcast on the surface and ensure seed to soil contact for a small site.
- Fluffy seeds are sowed separately.
- Seed grasses with complete awns as it increases germination and buries itself.

Naturalization with Local Species

CH promotes naturalization of regulated areas by using locally native and representative vegetation.

Seed and stock collected from within CH's seed zone (Zone 34 and 37) are ideal for use, as they contain genetic traits that have evolved through long-term adaptation by the species to local micro-climates and other conditions.

Edge Plantings

Include thorny species, such as raspberries, blackberries and hawthorns, in the perimeter vegetation screen of natural area plantings to help deter encroachment and trampling by people and certain types of wildlife.

Pests

Consideration should be given to the increasing threat of pests on our native flora. CH recommends planting a diversity of species when developing a landscaping plan to ensure the site is more resilient to future pests. For more information consult the Canadian Food Inspection Agency and the Tree, Insects and Diseases of Canada from Natural Resources Canada to determine native alternatives that are not host species to various pests.

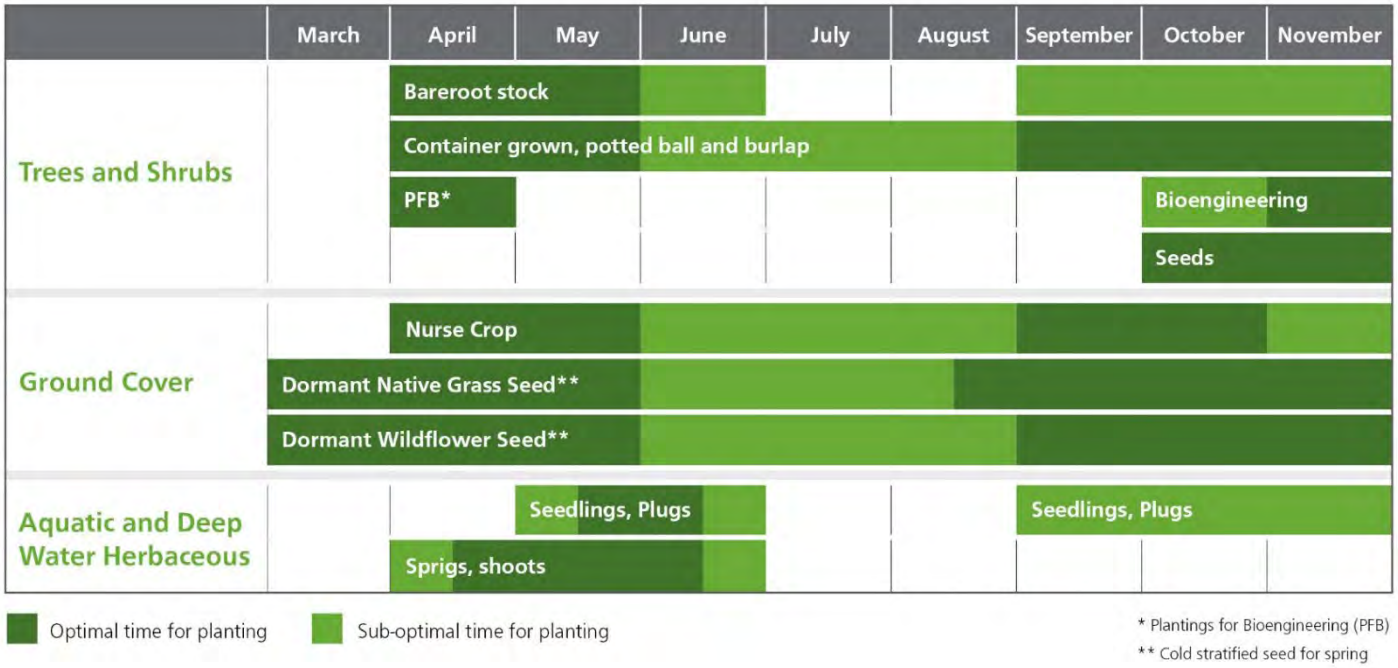
Seed/Sod Mat/Soil Salvage

Prior to construction, collect any suitable native seeds, sod mats or soil present. When development projects will take several years to complete, harvest and store local seed for post-construction rehabilitation. Depending on the extent of disturbance, the seeds harvested from these areas will likely be suitable for the conditions of the area once works are complete. Exercise care when stratifying the seeds to maintain viability during the storage period.

Timing

For landscaping and rehabilitation projects to be successful, consideration should be given to the best and most appropriate time of year to undertake the proposed works. The timing of works should be included on submitted plans, as this will determine if additional maintenance measures are required. Figure A below outlines the appropriate time to plant various vegetation types based on best practices.

FIGURE A: OPTIMAL AND SUBOPTIMAL PLANTING PERIODS FOR NEW STOCK



When planting trees and shrubs, deciduous plants should be transplanted in the fall after leaves drop or in the spring before the leaves emerge, while conifers should be planted in the spring. Some species such as oaks can only be transplanted in the spring. Bioengineering plantings should be installed when dormant. Caution should be exercised when proposing landscaping during periods when risk of freezing is high.

When preparing a landscaping or rehabilitation plan, each plan should:

- Indicate a contingency plan for seeding if works cannot be completed immediately after construction.
- Include notes on maintenance should landscaping be completed during sub-optimal periods.
- Provide an advisory note indicating that planting of herbaceous material is to be completed outside of frost period with sufficient time for plants to take root.

Caution should be used when planting during the typical high temperature summer months due to drought conditions. Survivability during non-optimal planting periods include:

- Keeping planting stock out of the sun,
- Planting during prior to or after peak sun periods, and
- Increasing the frequency of watering

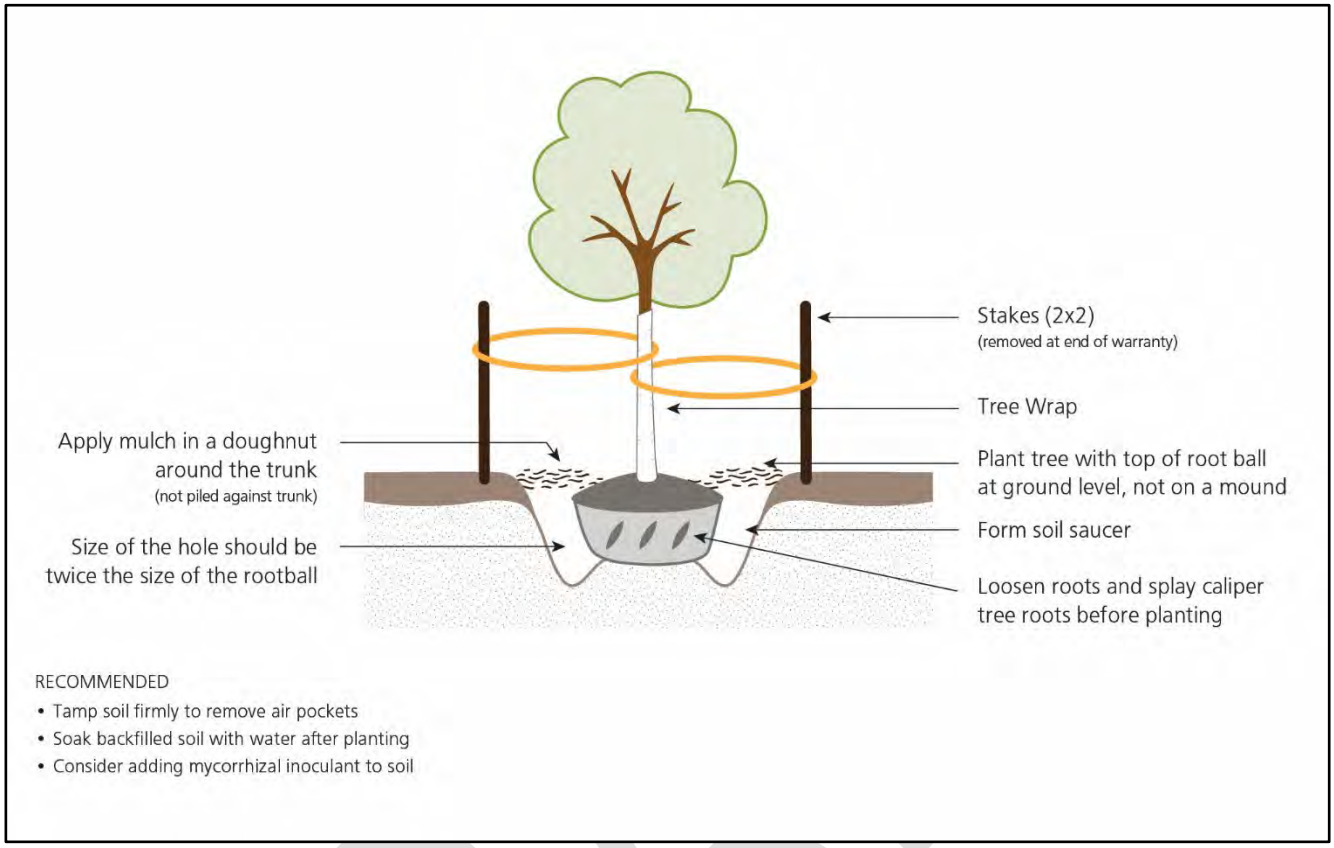
The appropriate time of sowing nurse crop depends on the species and its hardiness to frost. Confirmation of the appropriate nurse crops should be provided once the timing of works has been determined.

Trees and Shrubs Planting Notes

Additional direction in the planting notes or detail as shown on Figure A can help ensure that the plantings get installed correctly and survive. Consider the following advice when composing the landscaping notes:

- Loosen the roots of rootbound individuals and splay immediately before planting for caliper and potted stock. Rootbound plants may need their roots to be pruned. If roots need to be pruned, use only sharp tools to ensure a clean cut. Pruned ends should face obliquely downwards.
- Scarify the sides of the planting hole, when planting in clay or compacted soils, to loosen soil and allow for ease of root growth.
- Plant on firm subsoil, no deeper than the depth of the rootball.
- Plant trees at ground level, not mounded or depressed. Plant shrubs slightly above grade by no more than 2.5 cm.
- Loosen soil within the planting hole to encourage ease of root growth. Remove substantial rocks and large stones. No air pockets should be present during backfill.
- Stake and tie all caliper trees to prevent uprooting in high wind conditions. Ties should consist of tree ties, or galvanized wire in conjunction with protective material at the point of contact with the tree trunk. Ties should hold the tree firmly in place while being loose enough to allow some gentle swaying of the trunk and should not come into contact with branches.
- Specify staking and tie installation and removal.
- Apply mulch in a donut formation around tree trunk at 7.5 -10 cm in depth approximately at the dripline of the tree. Allow soil to be exposed at the base of tree, to prevent moisture from being trapped against the trunk.

FIGURE A: CALIPER TREE PLANTING DETAIL



Tree and Shrub Planting Approaches

The planting density of woody vegetation is determined based on the project goals. Outlined below and in Figure B are two effective methods of approaching landscaping: nodal planting or scatter planting.

Clustered/Nodal Plantings: Cluster plantings of trees and shrubs.

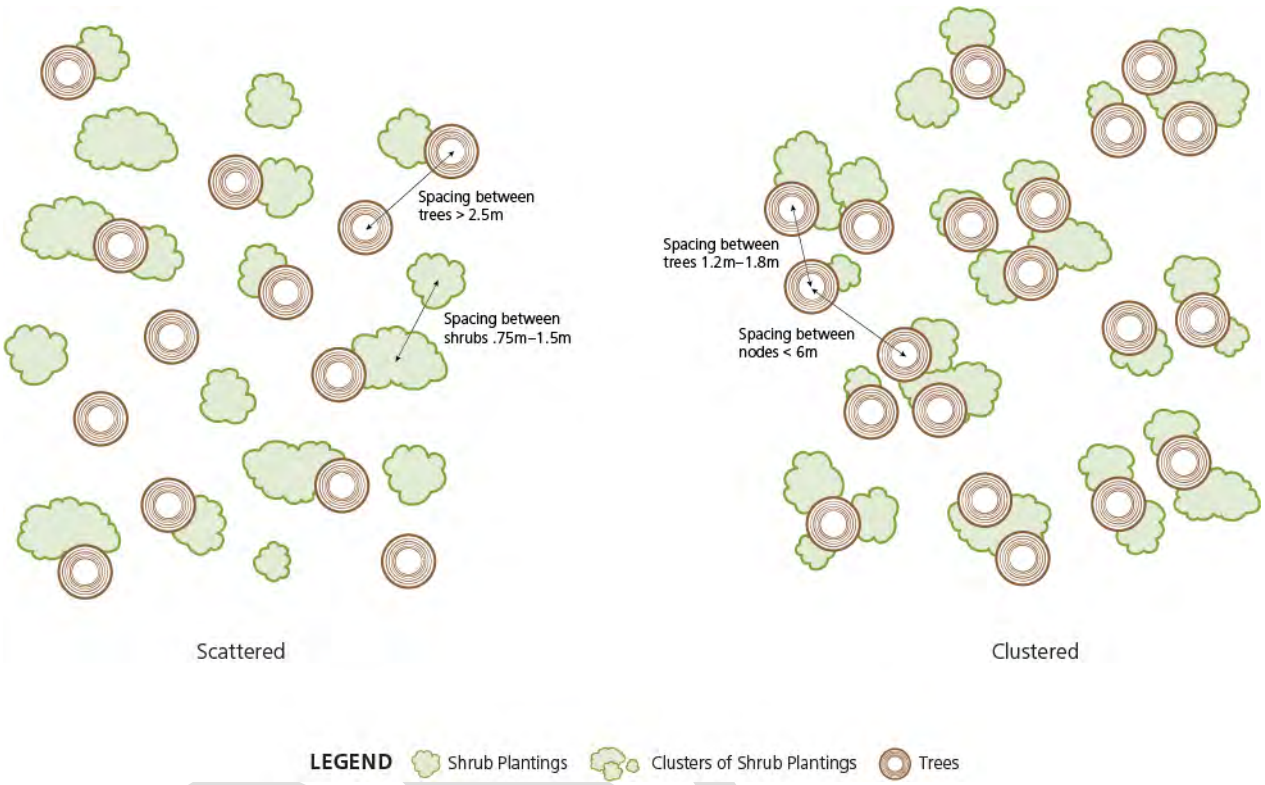
- Select node size based on site and rehabilitation goals, typically 5-30 m^2
- Space out nodes, typically no more than 6 m apart
- Provide 1.2 - 1.8 m spacing between trees (closer than 2.5 m) to promote early crown closure, shading of competing ground cover and promote vertical growth
- Cluster trees with similar growth rate together to encourage long-term survival
- Surround late successional species with adjacent early successional species
- Sow native ground cover around node plantings
- Mulch the entire bed to prevent weeds from establishing
- Locate nodes based on moisture regime zones

Scatter Plantings: Trees and shrubs are spread out in a random fashion throughout the site

- Plant trees no closer than 2.5 m on-centre
- Plant shrubs between 0.75 – 1.5 m on-centre

- Plant a diversity of ages
- Individually mulch the tree and shrub pits
- Seed and stabilize the area between the woody plantings with native groundcover

FIGURE B: PLANTING APPROACHES



Landscaping Along the Shoreline

Shoreline plantings are exposed to extreme conditions along the Lake Ontario and Hamilton Harbour shoreline. Due to this harsh environment, a qualified coastal and geotechnical engineer may need to be consulted. Not all plants are suitable for use in bioengineering and stabilization works along the shoreline and specified species need to be resistant to wind, tolerant to sun and fluctuating water levels.

It is essential to consider ground cover in the planting plan. Exposed areas are subject to erosion via wind and rain. Ground cover can protect these areas to prevent topsoil loss and sediment release into the water. A dense tree/shrub zone is beneficial along shorelines as it:

- protects against erosion in a harsh environment;
- deters geese;
- provides habitat for migrating wildlife; and,
- provides mutual support against the elements when planted near existing trees and shrubs.

It is important to design landscaping that requires minimal to no fertilizer to prevent the runoff from entering the lake and leading to algae blooms. CH recommends that 5 native trees per 100 m^2 and 5

native shrubs per 100 m^2 are planted within the band immediately adjacent to the shoreline, and native herbaceous species are planted in Bands 2 and 3.

E. Post Planting Care

Post-planting care refers to the maintenance and monitoring required to achieve self-sustaining vegetation. It can ensure survivability of the newly installed material and soil stabilization to prevent sedimentation and erosion. Specifications for frequency and duration of maintenance and monitoring will vary based on the nature of the project. Certain projects may warrant pre-installation meetings between the designer and contractor or ongoing supervision by the qualified professional to address issues as they arise. Prior to installation, a qualified professional should verify that the proper species have been sourced. Drawings should include all details regarding monitoring and maintenance for clear communication between the designer, review agencies and contractors.

Post-planting site visits should be carried out throughout the warranty period to ensure vegetation has reached a free-to-grow state. These visits may involve watering, removal of invasive and non-native species, adding mulch, removing stakes, removing litter and resolving any problems. Sites should be visited after inclement weather, especially during the period of establishment, to confirm that the proposed plantings have not been uprooted, to address erosion or ponding of water, and to determine if the approach is working satisfactorily. CH should be contacted if changes to the approved plan are necessary.

When preparing a landscaping or rehabilitation plan, each plan should:

- Outline the vegetation monitoring plans in the General Notes. The plan should include how the performance and effectiveness of interim measures (e.g., nurse crops) will be monitored, the duration and frequency of the program, and how plant health will be protected during droughts and other extreme weather (e.g., high rainfall or wind events) until plantings have reached a free-to-grow state
- Include coir disks around the base of trees and shrubs to retain water.
- Ensure mulch extends beyond the root ball and does not touch the base of the tree and shrubs.
- Indicate the removal of plant tags.
- Include tree protection measures such as rodent guards and stakes.
- Indicate all temporary stabilization measures such as rodent guards and stakes will be removed at the appropriate time after planting, generally within 2 years.
- Indicate that pruning of all dead or damaged tree and shrub branches will be done by a qualified professional.
- Include replacement of dead or dying plantings prior to the end of two years or the end of the warranty period from the nursery/contractor.

F. Wildlife

Important Bird Areas

CH's Lake Ontario and Hamilton Harbour shorelines are designated as Important Bird Areas by BirdLife International, which is supported by Bird Studies Canada and Nature Canada. It is also a migratory pathway for wildlife every spring and fall. Planting trees and shrubs along the shoreline

provides perching, resting, foraging and nesting locations. Woody vegetation also buffers noise and sound pollution from the lake and the associated wildlife.

Canada Geese

Canada Geese are typically found grazing near shorelines, beaches, lawns and other open grassed areas near water. The best way to reduce the number of Canada Geese entering a landscaping area is to make the site undesirable to them.

Canada Geese use water as an escape route from predators. To create a visual barrier between geese and their escape route:

- Plant a dense swath of vegetation along the waters edge, such as a dense shrub layer and trees.
- Include a screen of cattails or similar robust shoreline vegetation.
- Install a low fence (30 – 60 cm high) located within the shrub plantings to restrict geese access to and from the water.
- Avoid extensive areas of lawn or sod.
- Plant areas of mixed native wildflowers and other ground cover instead, as geese are more likely to move elsewhere to graze on grassy lawns.

The *Migratory Birds Convention Act,* 1994 protects Canada Geese. For more information on controlling Canada Geese, contact Canadian Wildlife Service, Ontario Region (ec.enviroinfo.ec@canada.ca).

G. Creating Wildlife Habitat Features

Landscaping and rehabilitation works can help improve the ecological function of the watershed by including the creation or enhancement of a variety of wildlife habitat features. Wildlife habitat features can foster biodiversity by supporting wildlife populations in the local ecosystem, from invertebrates like bees, butterflies and other pollinators, to amphibians, birds and many other animals. Among other benefits, a diverse ecosystem with a variety of plants and wildlife habitats can reduce the risks of pest outbreaks, provide natural balance and improve the resiliency of the ecosystem. A fundamental characteristic of ecosystems is that biological complexity and diversity requires habitat with structural complexity.

When preparing a landscaping or rehabilitation plan, each plan should:

- Include wildlife habitat features.
- Demonstrate how structure and diversity are achieved.
- List maintenance requirements, if any, of the structure (e.g., cleaning of bird and bat boxes, weed turtle nesting sites, etc.).

Types of Wildlife Habitat Features

The following subsections provide examples of various wildlife habitat feature types which can contribute to the structural complexity. While these are not requirements for all projects, incorporating them is encouraged to provide diversity and a benefit to the overall system.

Topographic Diversity

Topographic diversity creates habitat heterogeneity by creating micro-climates with varying levels of shade and moisture. To support topographic diversity:

- Incorporate small pockets of wet meadow/wetlands/shallow seasonal pools within the newly graded areas to provide greater variety in terrestrial habitat, short term water retention and in some locations, a more natural floodplain form.
- Design wetland habitat to mimic hummocky features or varied microtopography, including basking mounds, oxbows and pit-and-mound features.

Seeding during construction of pit-and-mound features

Vegetation growth post construction of pit-and-mound features

Rock Piles

Rock piles offer structures for loafing, perching basking and refuge to various wildlife. To support habitat diversity add rock piles into vegetated areas. Rock piles may vary considerably in size, shape and composition, depending on factors such as the intended purpose, target species, topography and vegetation. Materials may vary, but typically consist of flat rocks, riverstone, cobble and/or small boulders. Riprap is not appropriate for creating wildlife habitat purposes.

Brush Piles

Brush piles on the ground are important components of wildlife habitat as they provide cover and protection during various life stages. To support habitat diversity:

- Stack small piles of brush (1 to 2 m in height, 3 to 5 m in width and 5 to 10 m in length) to create hiding cover and denning sites for small mammals and nest sites and shelter for birds.
- Seed/plant native groundcover and vines under and around the brush pile to encourage vegetation to grow over and around the structure, enhancing cover for wildlife.
- Include large wood structures like logs and limbs to provide habitat for small wildlife, such as birds, salamanders, toads, frogs and invertebrates.
- Reuse native, non-invasive woody material removed on or near the site.

Example of a rock pile in a newly realigned creek corridor

Example of a brush pile

Hibernacula

Hibernacula is another important component of creating wildlife habitat. Since the creation or enhancement of hibernacula is a relatively complex project, consultation with CH staff is recommended.

Nesting Sites

Several specific criteria should be met when creating a nesting site, depending on the target species. Installing bird boxes is relatively straightforward. Fine woody debris and mulch piles can be used as basking and nesting sites for reptiles when positioned in partially shaded locations. However, for many species such as reptiles, nest site design details are critical. Consultation with CH staff is recommended.

Example of a nesting site made of mulch

Example of a snake hibernacula made of an assortment of rocks and branches built into the ground

Snags and Perching Trees

Snags and perching trees for raptor habitat ensures that habitat is available for large avian predators and similar wildlife. These in turn provide important ecosystem services and functions, including small animal control. To support raptor habitat:

- Retain tall trees for owl and raptor perches. De-limb trees and leave standing as snags for other wildlife habitat features as well (e.g. woodpeckers, owls, warblers, tree frogs).
- Install snags on tablelands away from floodplain.

- Maintain a minimum of 10 m separation distance between installed snags from prey habitat (i.e., hibernacula, brush piles and turtle nesting sites).
- To improve the snag's longevity, include a layer of gravel 15 cm deep in the post-hole, below the post as a drainage layer, reducing decay at the base of the post/tree, and mound the earth slightly around the installed snag at grade to encourage runoff to flow away from the post to reduce moisture retention against the post.
- Include boulders at grade to provide extra ballast, or support for the snag where appropriate.
- Locate snags and perching trees away from trails to be consistent with municipal hazard tree guidelines.

Example of a raptor pole

Instream Habitat

Works in or near water should consider opportunities for creating habitat heterogeneity for fish and other aquatic wildlife consistent with what is present in the referenced reach. To support fish and aquatic habitat:

- Provide cover, lunkers, vegetative overhangs such as large woody objects (e.g. logs, root wads, etc.) or boulders. Streambank vegetation plantings contribute to habitat for aquatic organisms and provide allochthonous materials to the stream.
- Coordinate design with the fluvial geomorphologist to ensure the features do not negatively affect the form and function of the stream.

Example of instream habitat built into the creek bank

Example of instream habitat anchored into an offline wetland

H. Stormwater Management Ponds

Plantings contribute significantly to the proper functioning of Stormwater Management (SWM) Ponds. SWM vegetation benefits and functions include:

- improving water quality by preventing the release of sediment into local creeks and tributaries;
- stabilizing the side slopes of the pond;
- mitigating pollution and nutrient loading of waterways;
- reducing the exchange of sediments and toxins into watercourses;
- minimizing establishment and growth of invasive species;
- reducing water temperatures through shading;
- providing aesthetic benefits; and,
- carbon capturing and cycling.

Planting Requirements

Appropriate species selection for these areas is critical for long-term survivability of the vegetation and function of the facility to achieve the abovementioned benefits and functions. When preparing a landscaping or rehabilitation plan for stormwater management facilities located in the regulated area, each plan should:

- Provide shade on the southern exposure of pond, inflow and outflow channels whenever possible to reduce warming. Plant a portion of the required caliper species on the south side of the pond and close to the permanent pool level.
- Select flood tolerant species adapted to anticipated water flow velocities.
- Protect planting nodes from waterfowl if required. Dense shrubby vegetation placed close to the permanent waterline will help to discourage loafing and nesting geese.
- Include nodes of 5 - 30m^2, spaced out no more than 6m.
- Show species in randomized patterns to mimic a natural layout, avoiding a grid layout.
- Locate woody plants in a manner that does not impede the flow of water in or out of SWM pond facilities.
- Provide no-maintenance, non-invasive species with a mix of locally native forb and grass species.

It is best practice to increase planting densities, as vegetation will have to be removed during sediment dredging operations.

The planting details provided above are also presented in Table A.

TABLE A: SWM POND PLANTING CRITERIA PER MOISTURE ZONE

Zone	Water Depth	Planting Criteria
Deep Water Zone	0.5 m to 2 m below surface	• Group aquatic plants and space them 0.5m to 1m apart. • Aim for 40% cover (at full growth) of the area as defined by the normal water level to 0.75m depth. • Include a minimum of four aquatic plant species. • Aquatic species should include at least one species of submergent and floating-leaved plant, and at least one species of robust, broadleaved and narrow-leaved emergent. • Provide cattails (*Typha latifolia*) and pioneer rush and bulrush species (e.g., *Juncus effusus, Juncus torreyi and Scirpus cyperinus*) as interim vegetation in sediment forebay to aid in sediment trapping. Limit the plantings of cattails to areas away from maintenance access areas.
Aquatic Zone	depth of 0.5 m to the permanent pool level/normal water level	
Flood/ Shoreline Zone	permanent pool/ normal water level to extended detention elevation	• Include a minimum of four aquatic forbs and graminoid plant species should be included as plugs and seeds. • Provide at least five species of shrubs • Provide at least 25 shrubs per 100 m^2
Lowland Zone	extended detention elevation to the regional storm	• Indicate a density of no less than 5 trees per 100 m^2 and 25 shrubs per 100 m^2 in the dry land area of the lowland and upland zone. • Include a variety of tree planting stock sizes and successional species to accelerate establishment of a natural vegetation structure. Use the following percentages to determine the amount of each size to plant: o 5% caliper, balled and burlap and/or wire basket material (4 cm caliper for deciduous trees; min. 150 cm for conifers), o 95% whips and/or saplings Provide larger caliper sized trees to shade SWM ponds. Place plantings immediately adjacent to pools to maximize the immediate shading and stabilizing benefits. Smaller species can be interspersed in these areas to allow for gradual growth and stabilization. • Include a variety of shrub sizes between 0.4 – 1 m in height. • At least five species of shrubs and trees should be planted. • 5 trees per 100 m^2 • 25 shrubs per 100 m^2 • Include groundcover
Upland Zone	above the regional storm elevation	

Calculation of Plant Material for Aquatic Species

The total aquatic plantable area is defined by the normal water line/permanent pool level down to 0.75 m depth. To achieve 40% cover, the quantity of aquatic plants is calculated based on 6 plants per 1 m^2.

Below is a formula to determine aquatic plant numbers to achieve at least 6 plants per 1 m^2 for the Deep Water and Aquatic Fringe Zone:

Plantable area (m^2) X 40% (cover) X 6 plugs per m^2 (plants/m^2) = proposed planting number

Sample calculation for 10,000 m^2 for area between normal water line down to 0.75 m deep:

10,000 m^2 X 40% X 6 plants/m^2 = 24,000 plants/plugs for the area.

Provided below in Table B is an example how to calculate SWM plantings.

TABLE B: EXAMPLE SWM POND PLANTING CALCULATIONS

Zone	Area	Required Densities	Required Quantity of Plantings
Deep Water Zone *Aquatic Zone*	*1200 m2*	• *Aquatic plants should be planted in groupings, spaced 0.5m to 1m apart and cover 40% (at full growth) of the area defined by the normal water level to 0.75m depth* • *(plantable area (m2) x 40% x 6 plugs per m2)*	• *2880 plugs*
Flood/Shoreline Zone	*1100 m2*	• *25 shrubs per 100 m2* • *Groundover*	• *275 shrubs* • *groundcover*
Lowland Zone *Upland Zone*	*2000 m2*	• *5 trees per 100 m2* • *25 shrubs per 100 m2* • *Groundcover*	• *100 trees* • *500 shrubs* • *groundcover*

Topsoil in SWM Ponds

The first 2 m below the permanent water level along the edge of the pond should receive 0.30 m of clean topsoil in keeping with the MECP SWM Guidelines. All areas above the permanent water level should receive 0.45 m to 1.0 m of clean topsoil. The subsoil is to be de-compacted/scarified to ensure proper integration between subsoil and topsoil.

The engineer should confirm the suitability of subsoil and topsoil material, and de-compaction options with the landscape architect.

Conservation Halton Guidelines for Stormwater Management Engineering Submissions

February 2024

Version 2.0

Conservation Halton

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CONSERVATION HALTON GUIDELINES

Conservation Halton (CH) protects, manages, and enhances the area within its jurisdiction through the delivery of a range of programs and services, including mandatory programs and services related to managing the risks associated with natural hazards. In the planning and development process, CH exercises its roles and responsibilities in accordance with Section 21.1 of the *Conservation Authorities Act* and Ontario Regulation 686/21, including as:

- A regulatory agency under Section 28 of the *Conservation Authorities Act*;
- A body with delegated responsibility to represent the Provincial interest and ensure that development applications are consistent with the natural hazards policies of the Provincial Policy Statement (PPS), but not including those policies related to hazardous forest types for wildland fire;
- A public commenting body under the *Planning Act, Clean Water Act* and other Acts and Provincial Plans;
- A resource management agency operating on a local watershed basis; and
- A landowner in the watershed.

CH's Planning and Regulations staff (i.e., environmental planners, regulations officers, planning ecologists, water resource engineers, technologists, and hydrogeologists) work together on interdisciplinary teams to deliver timely and comprehensive reviews and advice to provincial agencies, municipalities and landowners across CH's jurisdiction.

Section 28 (1) of the *Conservation Authorities Act* allows conservation authorities to make regulations to protect life and property from natural hazards. CH's regulation is Ontario Regulation 162/06. Under Ontario Regulation 162/06, CH regulates:

- All development in or adjacent to river or stream valleys, wetlands and surrounding lands where development could interfere with the hydrologic function of the wetland, Lake Ontario shorelines, and hazardous lands such as karst and any prescribed allowances;
- Alterations to a river, creek, stream or watercourse; and
- Interference with wetlands.

Permission is required from CH for undertaking the above noted works within regulated areas. CH's Board-approved Policies and Guidelines for the Administration of Ontario Regulation 162/06 and Land Use Planning Policy Document outlines the policies and technical requirements which must be met before permission may be granted. As part of a CH permit application, an applicant must demonstrate that CH's Board-approved policies and technical standards can be met.

CH also provides technical advice and support to its municipal partners on planning and development applications where it relates to CH's mandatory programs and services, as well as a public commenting body and a resources management agency.

These Guidelines provide clear expectations regarding the criteria and approaches that are acceptable to CH and are used by staff to assess the technical merits of stormwater management plans. Applicants proposing works should follow these Guidelines when preparing plans to be submitted to CH. By doing so, more efficient and consistent reviews, fewer resubmissions, and faster approvals are anticipated.

These Guidelines are specific to CH and do not replace or supersede any other federal, provincial, or municipal requirement.

OBJECTIVE	The purpose of the **Stormwater Management Engineering Submission Guidelines is to:** • **Identify CH's** requirements for a SWM submission; and • **Outline CH's** key expectations for SWM design.
APPLICATION & USE	Applies to all stormwater management engineering submissions associated with *Planning Act* and *Ontario Regulation 162/06* applications. These Guidelines have been developed for: • **Qualified professionals** such as water resource engineers and other qualified persons tasked to guide the preparation of SWM plans • **CH staff** to assess the technical merits of SWM plans and to facilitate quicker, more consistent reviews
ADDITIONAL REFERENCE MATERIALS (to be read in conjunction with this document)	• Ontario Regulation 686/21: Mandatory Programs and Services, 2021 • Ontario Regulation 162/06 Halton Region Conservation Authority: Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses, 2006 • Policies and Guidelines for the Administration of Ontario Regulation 162/06 and Land Use Planning Policy Document (November 26, 2020). • Municipal Stormwater Management/Engineering Guidelines/Standards • Conservation Halton Guidelines for Landscaping and Rehabilitation Plans, February 2024 • Conservation Halton Guidelines for Wetland Water Balance Assessments (forthcoming) • Stormwater Management Planning and Design Manual (MOE, 2003) • Low Impact Development Stormwater Management Planning and Design Wiki Guide (CVC and TRCA) • Erosion and Sediment Control Guidelines for Urban Construction (TRCA, 2019) • Approaches to Manage Regulatory Event Flow Increases Resulting from Urban Development (TRCA, 2016) • Halton-Hamilton Source Protection Plan • MECP Source Protection Information Atlas
VERSION	**Version 2.0** This version of the Stormwater Management Engineering Submission Guidelines was presented and approved by the CH Board of Directors on XXXX, 2024. The Guidelines may be updated from time to time. For more information, visit https://www.conservationhalton.ca/policies-and-guidelines.

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Tables

Figures

Abbreviations

The following table lists the various abbreviations used within this document:

TABLE 0-1: LIST OF ABBREVIATIONS

BMP	Best Management Practice	**CH**	Conservation Halton
CVC	Credit Valley Conservation	**EIR/FSS**	Environmental Impact Report/Functional Servicing Study
LID	Low Impact Development	**MECP**	Ministry of the Environment, Conservation and Parks
MESP	Master Environmental Servicing Plan	**MOE**	Ministry of the Environment
OP	Official Plan	**OPA**	Official Plan Amendment
O. Reg. 162/06	Ontario Regulation 162/06	**O.Reg. 686/21**	Ontario Regulation 686/21
SIS	Subwatershed Impact Study	**SP**	Secondary Plan
SWM	Stormwater Management	**SWMP**	Stormwater Management Pond
SWMPDM	Stormwater Management Planning and Design Manual	**SWP**	Source Water Protection
SWS	Subwatershed Study	**TRCA**	Toronto and Region Conservation Authority
WS	Watershed Study	**ZBA**	Zoning Bylaw Amendment

Section 1 Introduction

The purpose of the Guidelines for Stormwater Management (SWM) Engineering Submissions is to:

- Identify Conservation Halton's (CH) regulatory and technical requirements for a SWM submission; and
- Outline CH's key expectations for SWM design.

This document focuses primarily on CH's expectations related to water resources engineering aspects of SWM. Other disciplines may also be relevant such as hydrogeology, fluvial geomorphology, geotechnical engineering and ecology. Where this is the case, a reference to the appropriate guideline is included within the text.

1.1 Document Outline

This document has been divided into six sections and supporting appendices:

- **Section 1 – Introduction** – Outlines CH's role in hydrology and SWM review and how it relates to the planning and regulatory process.
- **Section 2 – Stormwater Management Objectives and Criteria** – Outlines CH's objectives and criteria for water quantity, stream erosion, and water balance.
- **Section 3 – Stormwater Management Practices** – Outlines requirements related to specific SWM infrastructure elements.
- **Section 4 – Hydrologic Modelling Requirements** – Outlines the technical recommendations for hydrologic modelling and associated hydraulic calculations.
- **Section 5 – Submission Requirement Checklists** – Outlines the components needed for various reports (e.g., Functional Servicing Report).
- **Section 6 – References** – Lists the various documents reviewed in preparation of this document.

These Guidelines are specific to CH and do not replace or supersede any other federal, provincial, or municipal requirement.

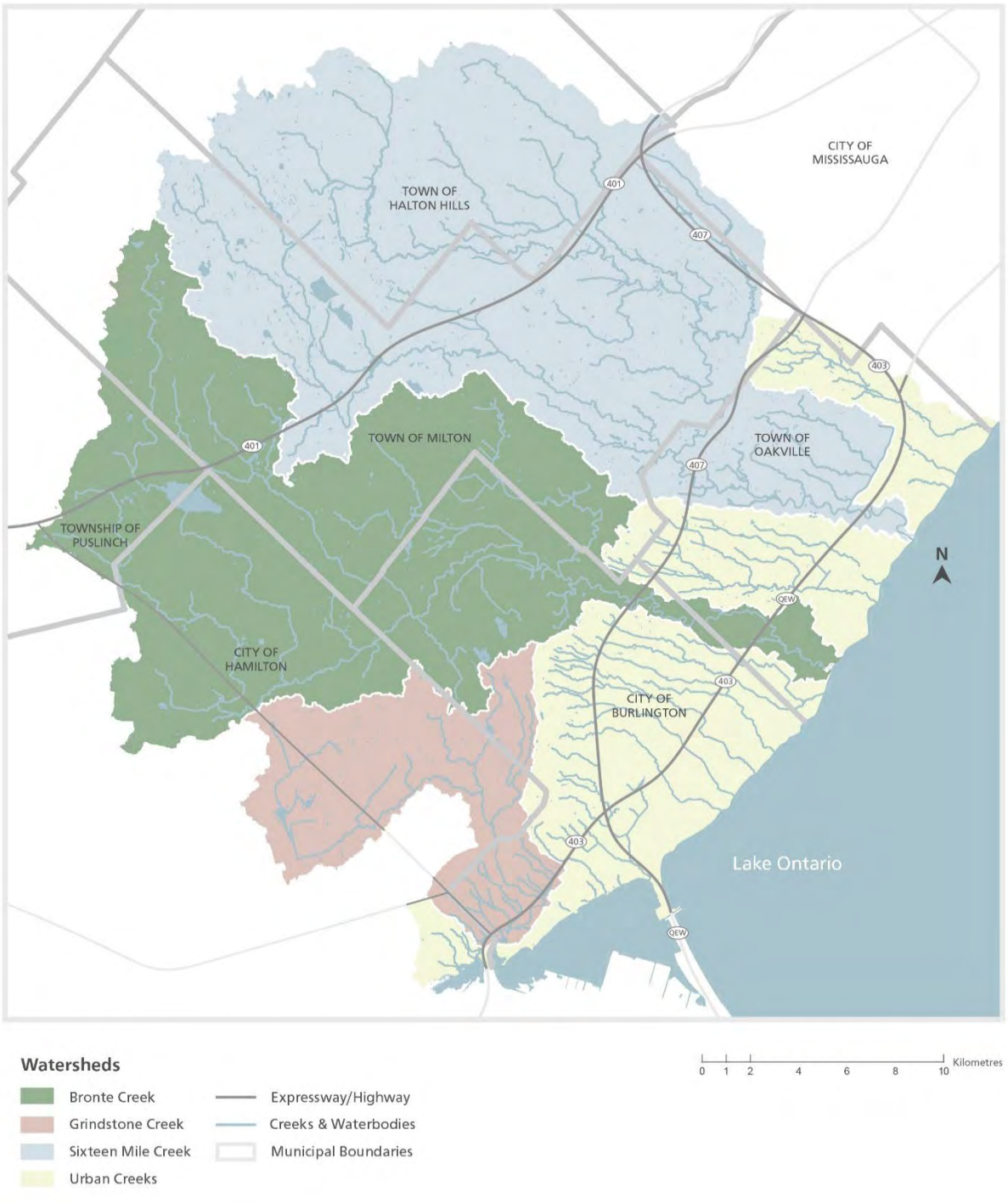
1.2 Conservation Halton's Role in Reviewing Hydrology and Stormwater Management

CH protects, manages, and enhances the area within its jurisdiction (see Figure 1-1) through a wide variety of mandatory programs and services. Under Ontario Regulation 686/21, CH must provide programs and services related to understanding and managing risks related to natural hazards, including preventing or mitigating those risks. Changes in stormwater runoff may impact natural hazards by changing when and how much stormwater reaches watercourses, valleys, shorelines, wetlands, or karst. For example, increases in runoff due to changes in land cover that are not mitigated through proper stormwater management can increase flood depths, velocities and limits within the receiving creek system, potentially increasing risks associated with natural hazards.

CH also administers Ontario Regulation 162/06 (O. Reg. 162/06), under which CH regulates:

- All development in or adjacent to river or stream valleys, wetlands and surrounding lands where development could interfere with the hydrologic function of the wetland, Lake Ontario shorelines, or hazardous lands such as karst and any associated allowances;
- Alterations to a river, creek, stream, or watercourse; and
- Interference with wetlands.

FIGURE 1-1: CONSERVATION HALTON WATERSHED



Source: Conservation Halton.

Permission is required from CH for undertaking any development within regulated areas. "Development" means,

- the construction, reconstruction, erection or placing of a building or structure of any kind,
- any change to a building or structure that would have the effect of altering the use or potential use of the building or structure, increasing the size of the building or structure or increasing the number of dwelling units in the building or structure,
- site grading, or
- the temporary or permanent placing, dumping or removal of any material, originating on the site or elsewhere.

Permission from CH is required for construction of storm water infrastructure or any associated work within an area regulated under the Regulation. These works may include outlet pipes/swales, emergency spillways, grading, or the entire facility.

CH's Board-approved *Policies and Guidelines for the Administration of Ontario Regulation 162/06 and Land Use Planning Policy Document* (November 26, 2020) outlines the policies and technical requirements which must be met before permission may be granted. As part of a CH permit application, an applicant must demonstrate that CH's Board-approved policies and technical requirements can be met to the satisfaction of CH.

CH also provides technical advice and support to its municipal partners on planning and development applications where it relates to CH's mandatory programs and services, including those related to managing and understanding risks associated with natural hazards.

While CH does not review or provide advice on stormwater quality, it is an essential aspect of stormwater management. The municipality should be consulted for stormwater quality requirements.

CH's review of proposed SWM works provides for a streamlined and integrated assessment of the merits of the proposal that is linked to CH's roles and responsibilities.

1.3 Stormwater Management and Planning Processes

The level of SWM related detail required in each study depends on the scale and scope of the development proposal or stage in the planning process. SWM-related studies should reflect existing and proposed land use(s) and the scale and scope required to support the planning application or planning studies under other legislation (e.g., Environmental Assessment Act). Studies should also be in-keeping with higher-level studies (e.g., Subwatershed Plans, Environmental Implementation Reports/Functional Servicing Studies, Master Environmental Servicing Plans, Environmental Assessments, etc.), where applicable.

The following provides an overview of the SWM-related studies required to support various planning documents and applications under the *Planning Act* or other legislation. As the scale and scope of land development varies widely, pre-consultation with CH and the municipality, as well as relevant Provincial ministries, is strongly recommended.

Watershed Studies (WSs) and Subwatershed Studies (SWSs) are valuable resources and supporting studies for municipalities when developing and updating their Official Plans (OPs) and Secondary Plans. A comprehensive Terms of Reference (TOR) guides the scope and components of these studies. Typically, TOR are developed collaboratively to ensure the technical requirements of both the municipalities and CH are met. Typically, WSs are carried out to gain a broad understanding of the ecosystem's functions and status, including the role and appropriate management of stormwater. SWSs build upon the recommendations made within the higher-level WS following the same ecosystem approach but at a greater level of detail for a smaller area (typically Secondary Plan).

In addition to other matters such as ecology and hydrogeology, a SWS should demonstrate how SWM planning will:

- Ensure systems are optimized, feasible, and financially viable over the long term;
- Minimize, or where possible, prevent increases in contaminant loads in the receiving watercourse or wetland;
- Minimize changes in water balance and erosion;
- Prepare for the impacts of a changing climate;
- Minimize, or where possible prevent, increases in peak surface water flows in the receiving watercourses;
- Mitigate risks to human health and safety, property, and the environment; and,
- Promote SWM best practices, including stormwater attenuation and re-use, water conservation and efficiency, and Low Impact Development (LID) techniques.

When reviewing a SWS, CH will only comment on SWM with respect to impacts on natural hazards or the hydrologic function of wetlands (for works proposed within regulated areas). The SWS should identify management and implementation strategies to meet the above objectives and establish acceptable practices, applications, targets, and SWM facility location(s) at a conceptual level. The SWS should also provide guidance on the requirements of future studies.

An **Environmental Implementation Report (EIR)/Subwatershed Impact Study (SIS)/Municipal Environmental Servicing Plan (MESP)** or similar study typically supports Tertiary or "Block" Plans, Official Plan Amendments (OPA), Zoning By-law Amendments (ZBA), and Draft Plans of Subdivision/Condominium. An EIR/SIS/MESP involves a more detailed assessment of many components, including conceptual SWM designs and grading plans. Typically, an EIR/SIS/MESP is used to demonstrate how a specific development concept will comply with the applicable SWS recommendations while addressing/evaluating all lands within a given subcatchment area. TOR for these studies is key, and preferably determined at the SWS stage. CH should be involved in the development of the TOR, including when work is being scoped.

OPA, ZBA, and Draft Plans of Subdivision/Condominium, are normally also supported by a **Functional Servicing Report (FSR)** as outlined in this document. The FSR may be combined with an EIR or EIS/EIA. Detailed Subdivision/Condominium Designs and Site Plans are normally supported by a **SWM Brief/Design** Report as outlined in this document. The requirements for an FSR and other SWM reports are provided in Section 5.

CH typically defers SWM requirements and reviews for Consents (Severances), Minor Variances, and Single Lot Residential Development (<0.5 ha) to municipal staff; however, CH may recommend technical evaluations and SWM controls depending on the location, size and complexity of the site.

Environmental Assessments, under the *Environmental Assessment Act*, are generally undertaken to support municipal, provincial, and federal infrastructure projects. These documents should identify potential stormwater impacts of the evaluated alternatives as well as mitigation measures. The document should also outline the SWM requirements associated with the preferred alternative.

These guidelines apply to new projects proposed, following CH Board approval of these guidelines. For legacy projects that have remained active, CH encourages incorporation of the new criteria, requirements and recommendations, where appropriate. Otherwise, CH will be consistent with past direction for the duration of the *Planning Act*/Permit application or Environmental Assessment study as well as for subsequent planning and permitting stages for the same project. In cases where legislation or Federal/Provincial direction change; when it is necessary to protect public safety; or when required by updated technical reports and policies (e.g., 5-year Official Plan reviews, SWS updates, new CA regulations and associated policies), different approaches may be required.

Section 2 Stormwater Management Criteria and Objectives

A SWM strategy should assess the impacts of proposed development with respect to flooding and erosion/sediment transport. For development within an area regulated by CH, the SWM strategy should also assess the hydrological impacts to wetlands, where applicable. The recommended strategy should demonstrate how impacts will be mitigated and SWM objectives addressed.

The following is a list of some of the key documents that provide guidance to the proponent for SWM submissions:

- *Stormwater Management Planning and Design Manual*, Ministry of the Environment (March 2003)
- *Low Impact Development Stormwater Management Planning and Design Wiki Guide*, Credit Valley Conservation and Toronto and Region Conservation Authority
- Toronto and Region Conservation Authority, *Erosion and Sediment Control Guide for Urban Construction* (2019)
- *Erosion and Sediment Control Inspection and Monitoring (CAN/CSA-W202-18)*, CSA Group (October 2018)
- *Approaches to Manage Regulatory Event Flow Increases Resulting from Urban Development*, Toronto and Region Conservation Authority (2016)
- *Halton-Hamilton Source Water Protection Plan and Mapping*
- Municipal SWM/Engineering Guidelines/Standards (both local and Regional)
- Hamilton Harbour Remedial Action Plan

2.1 Treatment Train

CH encourages the use of a treatment train approach in addressing SWM volume requirements. The treatment train approach involves providing controls at multiple locations (i.e., treatment at source, along the conveyance system, and at the end-of-pipe outlet). A treatment train may be required to meet the multiple objectives of water quantity, water balance and erosion control as well as municipal requirements for water quality. Multiple methods could be used to achieve this goal.

2.2 Water Quantity

Stormwater quantity control is intended to protect life and property from increased flood risk, which could result from increased peak flows and/or increased runoff volume.

Quantity control requirements are typically established through a SWS, which assesses the effects of cumulative development impacts within the subwatershed. Where a current SWS is unavailable, site-specific stormwater quantity control criteria will be established through consultation with CH and the municipality. The applicant may be required to prepare a scoped SWS (i.e., a limited study) or other study that assesses cumulative impacts. The type of study and its limits would be determined through pre-consultation.

If the scale of development does not warrant a completion of a scoped SWS or SWS update, CH typically recommends that post-development peak flow rates not exceed corresponding pre-development rates for the 1:2-year, 1:5-year, 1:10-year, 1:25-year, 1:50-year and 1:100-year storms. If there is a known deficiency in the downstream conveyance system (e.g., undersized pipes, insufficient overland flow paths), an insufficient downstream outlet, or specific municipal requirements, additional quantity controls (i.e., over-controlling outflows to less than the existing conditions) may be required. This requirement should be identified through pre-consultation with the municipality.

Safe conveyance of the Regulatory flow from a SWM facility to a sufficient receiving system must be provided such that there will be no adverse effects on downstream lands. The Regulatory flow is the greater of the uncontrolled 100-year or Regional (Hurricane Hazel) flows. A sufficient receiver typically consists of a watercourse or lake, though a wetland may also be an acceptable discharge location for clean controlled runoff. A public right-of-way may also be an acceptable receiver, provided the applicant has written permission from the municipality.

2.2.1 Regulatory Storm Control

The need for Regulatory Storm control is typically determined at a watershed or subwatershed-level of study based on a flood risk assessment. Several studies have identified the requirement for quantity control for the Regulatory Storm within CH's jurisdiction. If not stated in a higher-level document, consultation with CH and the municipality is recommended to confirm if Regulatory Storm control is required. CH follows the approaches outlined in the document *Approaches to Manage Regulatory Event Flow Increases Resulting from Urban Development* (Toronto and Region Conservation Authority, 2016) except for flooding of internal roadways within additional storage areas and a minimum freeboard based on fetch length for off-line SWM facilities.

2.3 Stream Erosion Control

Development can alter the rate and quantity (i.e., flow and volume) of water that enters a receiving watercourse, as well as the amount of sediment transported in the system. The objective of stream erosion control is to prevent excess erosion or sedimentation (i.e., changes to the rate of natural or existing erosion) and associated risks to property/infrastructure.

An erosion threshold assessment will typically be required at the watershed, subwatershed, or EIR/FSS/SIS/MESP study level. The erosion assessment should be completed by a qualified professional using scientifically defensible models, and current industry standards. A field assessment of channel features, forms, and sensitivity should be done by walking the watercourse throughout the subject site and downstream to the extent reasonably anticipated to be impacted by proposed development (as feasible, recognizing site access constraints). Erosion assessments are typically terminated at the first major confluence or the point where the site represents approximately 10% of the contributing area of the system. Multiple methodologies should be used to establish thresholds and targets and should include the total work performed on the channel and not simply review/match duration of exceedance. More detailed information on CH submission requirements for erosion threshold assessments will be provided in future fluvial geomorphology guidelines.

In the absence of higher-level studies establishing erosion control requirements, a site-specific erosion study may be required. CH and the municipality should be consulted about the need and scope for an erosion study. The following are typical scenarios where an erosion study would likely be required to support large-scale new development:

- If development is proposed upstream of a known erosion area,
- If development is proposed to discharge to small watercourses, or
- If flow diversions are proposed.

Where higher-level studies have not specified requirements and a site-specific erosion study is not warranted, CH typically recommends that the runoff from a 25 mm design storm be retained or detained and released over a period of at least 24 hours for sites, even those sites that outlet directly to a storm sewer. For smaller sites, it is sufficient for submissions to demonstrate that the use of parking lot/pipe storage, infiltration, evapotranspiration, and on-site re-use of runoff has been applied to the extent feasible to reduce erosion potential.

2.4 Wetland Water Balance

Water balance requirements are to be considered when development within a CH regulated area has the potential to impact a wetland. the objective of a water balance is:

- To replicate as closely as possible existing hydrologic conditions by maintaining a balance between infiltration, runoff and evapotranspiration;
- To maintain as closely as possible groundwater and base flow regimes; and
- To ensure long-term sustainability of hydrological form and function of the wetland.

Increased impervious areas can result in increased runoff volumes and/or decreased groundwater flows directed to natural features such as wetlands. Grading and servicing can change drainage patterns. For example, the use of end-of-pipe SWM facilities transfer runoff to a single discharge point which may direct flows away from wetlands. These changes in runoff can impact the function of the wetland.

Wetland water balances establish a wetland's hydrological function(s) and demonstrate how these functions will be maintained during and post-development. Typically, the SWM strategy should maintain the existing quantity, timing, duration and frequency of surface water and groundwater contributions on a monthly, seasonal, and annual basis to maintain pre-development hydrologic functions of the wetland. CH is in the process of creating guidelines with respect to wetland water balance assessments. CH staff should be consulted prior to design.

2.5 Diversions

CH requires maintenance of existing watershed boundaries and drainage patterns unless there are extenuating circumstances or where a higher-level study supports a diversion (i.e., re-direction of flows from one drainage basin to another).

Should the applicant put forward a drainage diversion or modification of drainage basin boundaries, the impact of the proposed changes must be assessed holistically, considering both the 'losing' and 'gaining' systems. The impacts of water takings and land use changes must be evaluated relative to risk to flooding and erosion, including maintenance of geomorphic functions. The analysis should consider the anticipated changes in flow frequency, timing, duration, peak, and volume and should be supported through supporting analysis. Opportunities must be investigated to mitigate a diversion from one subwatershed to another through an equal offsetting diversion.

Given the inherent complexities, consultation with CH and the municipality is required to establish site specific requirements related to any proposed diversions.

2.6 Climate Change

Climate change is the long-term modification of weather conditions (e.g., temperature, precipitation, wind, etc.). It can involve changes in average conditions and changes in weather predictability. As a result of climate change, Ontario is experiencing more frequent variation in temperature, wind patterns, and precipitation events.

In recent years, southern Ontario has experienced intense storms that have caused flooding and resulted in large economic and physical damage to infrastructure. The frequency and severity of storm and flood events is anticipated to escalate in the coming years. Thus, stormwater infrastructure should be designed with due consideration of possible changes.

Anticipated impacts that will affect SWM strategies include:

- Shift in seasonal flows (e.g., reduced spring freshet, longer periods of low flow in summer, increased precipitation and flows in fall/winter);
- Reduced level of service provided by existing infrastructure due to more intense rainfall or blockage because of more frequent freeze/thaw cycles;
- Increased urban flooding (surcharging sewers, basements, roadways, and an inability to achieve design control levels within centralized facilities);
- Increased thermal impacts of stormwater on the receiving water body;
- Increased occurrence of algae blooms; and
- More sediment transport due to intense rainfall.

Provincial and municipal policies encourage consideration of climate change in stormwater management, including infrastructure design. Watershed studies, subwatershed studies and Master Plans, are important vehicles for considering the implications of climate change on SWM. These studies should assess the implications of climate change and include recommendations for climate resiliency for future developments and retrofits of existing SWM assets. The assessment/recommendations should demonstrate that the design performance of the SWM infrastructure is maintained over the lifespan of the asset. Due to the uncertainty of climate change on SWM, adaptive management is strongly encouraged.

Proponents are directed to consult with the municipality for direction on how to address climate change resiliency and adaptive management in their SWM design.

2.7 Summary – Criteria & Objectives

Table 2.1 provides a summary of CH's SWM criteria and objectives for water quantity, stream erosion and feature-based water balance. The proponent should follow the requirements of current higher-level studies (e.g., SWS) and in instances where a higher-level study is not available, consult with the municipality and CH.

TABLE 2-1: SUMMARY – SWM CRITERIA AND OBJECTIVES

Criteria / Objective	Key Information
Treatment Train	• Use of a treatment train approach is encouraged, and may be required, to meet multiple SWM objectives.
Water Quantity	• Use the targets and sizing criteria established in higher-level studies. • Confirm the need for Regulatory controls through higher-level studies or through consultation with CH/municipality. • In the absence of current higher-level studies, control post-development flows to pre-development levels for 1:2-year through 1:100-year storm events. Overcontrol may be required where downstream capacity constraints exist. • Provide safe conveyance of Regulatory Storm from a SWM facility.
Stream Erosion Control	• Use the erosion control criteria established in current higher-level studies. • Consult with CH and municipality to determine the need for site specific erosion study, where there are no higher-level studies. • Use 24-hour detention of the 25 mm storm, where an erosion study is not required.
Wetland Water Balance	• Consult with CH regarding wetland water balance requirements.
Diversions	• Maintain existing watershed boundaries and drainage patterns unless there are extenuating circumstances and supporting analysis is provided or where diversion is supported by a higher-level study. • Consult with CH to establish site specific SWM requirements for any proposed diversions.
Climate Change	• Watershed studies, subwatershed studies and Master Plans, should consider climate change and plan/design development for climate resilience. Consult with the municipality for direction on how to address climate change in SWM design.

Section 3 Stormwater Management Practices

This section summarizes CH's expectations related to infrastructure elements typically included as part of a stormwater management strategy. These expectations should also complement the requirements in the following documents:

- The guidelines and criteria set out in the Ministry of the Environment *Stormwater Management Planning and Design Manual* (March 2003), as well as any supporting documents such as the forthcoming Low Impact Development guidelines;
- Requirements/recommendations of relevant watershed/subwatershed studies; and
- Municipal guidelines and standards (both local and Regional).

This section does not provide a comprehensive list of SWM practices. CH will consider alternative methods/approaches through consultation, subject to approval by the municipality.

CH recommends SWM strategies for nearby projects be coordinated.

CH requires that SWM infrastructure be in accordance with CH's *Policies and Guidelines for the Administration of Ontario Regulation 162/06 and Land Use Planning Policy Document* (November 26, 2020). These policies require that most SWM infrastructure, excluding outfalls/spillways, be located outside of areas regulated by CH.

Where the placement of SWM infrastructure within CH's regulated area is necessary, permission is required from CH. The applicant must consult with CH to determine the feasibility/acceptability of the proposed location, as well as site-specific design requirements prior to applying for a permit under O. Reg. 162/06.

3.1 Low Impact Development Techniques

CH encourages the use of LID techniques in SWM strategies, where appropriate. Studies have shown that appropriately operated and maintained LID techniques have multiple positive impacts which are noted in the table below (not all benefits are experienced depending on the LID technique used or how it is considered in the SWM strategy).

TABLE 3-1: LID TECHNIQUE BENEFITS

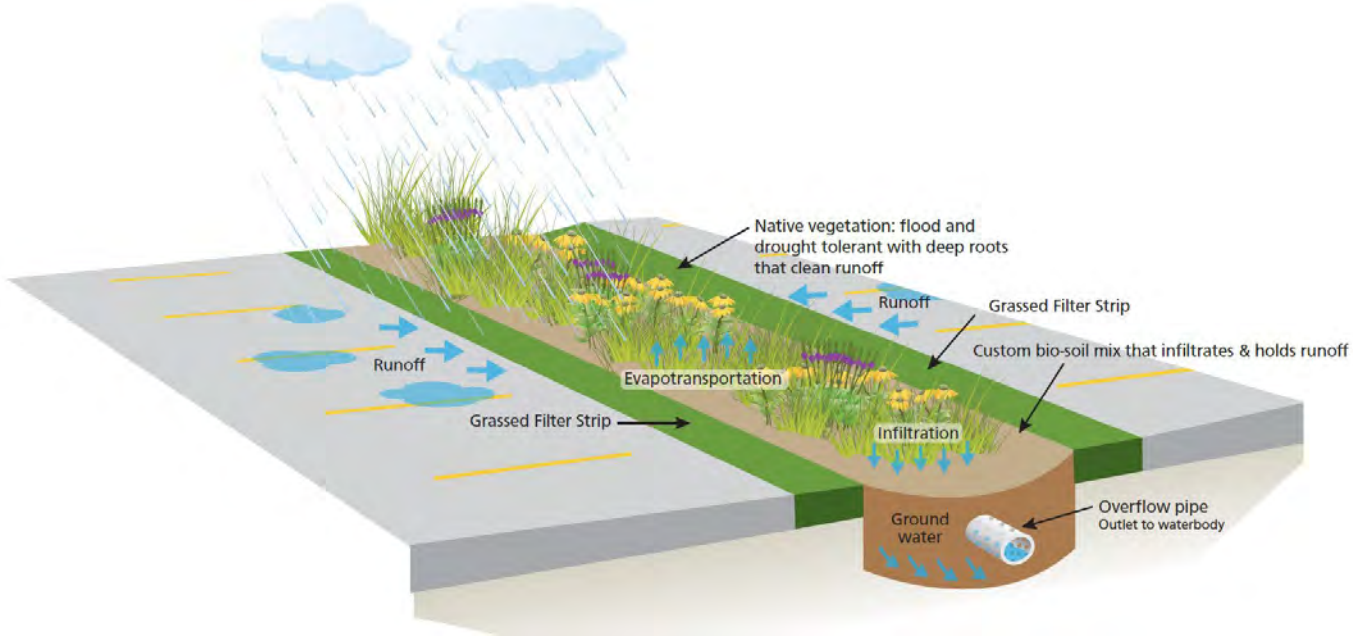
Category	Potential Benefit(s)
Infrastructure	• LID techniques reduce drawdown times in downstream end-of-pipe SWM facilities. • Retrofit areas lacking formal SWM controls. • Provides resiliency to adapt to the negative impacts of climate change. • Reduces volume of runoff and thermal loading of SWM facilities. • Reduces nuisance flooding related to poorly graded sites or lack of storm outlet.
Environmental	• Helps manage increased runoff volumes to wetlands. • Maintains hydrologic functions of streams and wetlands. • Protects downstream resources. • Mitigates increased runoff volumes resulting from proposed diversions. • Recharges groundwater. • Improves water quality. • Helps reduce potential erosion.

Category	Potential Benefit(s)
	• Reduces impacts to and promotes sustainability of ecological habitat. • Improves air quality. • Mitigates the heat island effect through increased vegetation which provides shading of impervious surfaces, deflects radiation from the sun, and releases moisture into the atmosphere.
Social	• Improves human well-being through increased green space, reduced noise levels, and enhanced aesthetics. • Increases road safety through traffic calming and aligns with objectives of creating 'Complete Streets' in urban areas https://www.completestreetsforcanada.ca/ • Boosts property values.

Source: Sustainable Technologies Evaluation Program; USEPA.

Of value are LIDs techniques that provide lot level controls as they retain rainfall where it falls (e.g., rain gardens/bioretention cells, green roofs, and water reuse; see Figure 3-1). Nevertheless, it is recognized that the use of infiltration techniques may not be suitable in certain instances, due to land use (e.g., gas stations), soil conditions (e.g., high water table) or area sensitivity (e.g., Vulnerable Areas as defined under the Clean Water Act, 2006 – municipal wellhead protection areas and water quality issue contributing area).

FIGURE 3-1: EXAMPLE OF LOT LEVEL CONTROL (BIOSWALE)



Source: Conservation Halton.

It is strongly recommended that the applicant consult with CH and the municipality to assess where and what LID techniques will be supported by all parties and if/how they may be credited in any SWM analysis.

There are many manuals available which can assist in informing the location and design of LID techniques. CH currently uses the Toronto and Region Conservation Authority (TRCA) and Credit Valley Conservation

(CVC) *Low Impact Development Stormwater Planning and Design Wiki Guide* (https://wiki.sustainabletechnologies.ca/wiki/Main_Page) to guide LID techniques technique.

Information to be provided within the SWM report includes a description of the design objectives (i.e., water quality, erosion and/or quantity control) and confirmation of site appropriateness such as land use and existing site conditions. Of note, the applicant should ensure that the LID technique design is supported by geotechnical and hydrogeological investigations following the TRCA/CVC guide. Calculations supporting the LID technique designs must also be provided by a qualified engineer.

3.2 Rooftop Storage

Flat building roofs, such as on commercial or industrial buildings, can be designed to store runoff and dampen/reduce the structure's peak flow rate. Where rooftop storage is proposed and permitted by the municipality, controls should be integrated with the building's design to prevent/discourage removal.

The type of control to be installed should be specified in the SWM report/brief with supporting manufacturer's design information provided in the appendix. Sizing calculations should be provided outlining the number and placement of the controls, release rate, ponding volume, and drawdown time. These must be for individual structures as well as for the entire roof. Clogging of the control structures (typically 50% blockage) should be considered in the design.

3.3 Parking Lot and Underground Storage

Sites can use aboveground/parking lot ponding or underground storage for the purpose of quantity control. Underground storage can consist of oversized pipes (super pipes), precast or cast-in-place concrete tanks, or individual pre-manufactured units.

The system should be designed to minimize the opportunities for controls to be removed and, where possible and allowed, the controls providing quantity control (i.e., orifice tube, maintenance hole, etc.) should be located such that it is partly on public lands.

Sizing calculations for any orifice/pipe restrictions should be provided. A stage-storage-discharge chart indicating all storm events is recommended and should contain elevations, equations used, coefficients of discharge, orifice and weir details, tailwater, surface area and resulting volume, and drawdown times.

If underground storage is proposed to provide Regulatory Storm control, it must be supported by the municipality and CH and must meet the requirements of Section 3.7.5. Sizing for the facility must take into consideration the potential for tailwater effects and storm stacking, as outlined in Sections 3.5.1 and 3.5.2.

The design drawings should provide details of these restrictions and their outlet. The maximum ponding extent, elevation, and storage volume should be provided at each ponding location and shown on a drawing.

3.4 Consideration of New Technologies

To foster innovation in stormwater management, new products and emerging technologies are encouraged. New technologies should be supported through background documentation, pilot studies, monitoring and adaptive management. Consult with municipalities and CH early in the design process to establish requirements for approval.

3.5 Stormwater Management Ponds

Stormwater management ponds (SWMPs) may be designed to provide water quantity, water quality, and erosion control. Depending on the requirements of the study area and the specific systems, as well as municipal design standards, SWMPs can be configured as a dry pond, wet pond, wetland, or hybrid wet pond/wetland. The majority of SWMPs are in municipal ownership.

Table 3-2 provides a summary of common SWMP design elements and areas of municipal and CH interest.

TABLE 3-2: SWMP DESIGN ELEMENTS and REVIEW INTERESTS

Design Element	CH [1]	Municipality
Stage-Storage-Discharge Curve & Supporting Calculations	✓	✓
Pond Grading	✓ (2)	✓
Outlet Control Structure	✓	✓
Outfall / Erosion Protection	✓ (2)	✓
Emergency Spillway	✓	✓
Freeboard	✓	✓
Geotechnical Considerations	✓	✓
Thermal Mitigation		✓
Landscaping	✓ (2)	✓

(1) CH reviews design elements and supporting calculations for water quantity and erosion controls only.
(2) CH reviews grading, landscaping and outfall details within regulated areas only. CH may review grading plans for pond berms outside of our regulated area if the facility provides Regulatory storm controls.

In general, all SWMPs must be supported by a design report and detailed drawings. Calculations supporting the stage-storage-discharge curve (i.e., elevations, equations used, coefficients of discharge, orifice and weir details, tailwater, surface area and resulting volume, storm events, drawdown times, etc.) should be provided. The figures/drawings must show the emergency spillway, erosion protection, pond outlet control structure details, the outfall and at least one cross-section through the facility. The amount of detail required for a SWMP design directly corresponds to the scope of work for the project/study.

3.5.1 Outlet Control Structure

The details of the outlet control structure should be provided within the SWM report as well as on an appropriate engineering drawing. The outlet control components should be designed in such a way that they cannot be readily removed or altered (see Figure 3-2).

FIGURE 3-2: EXAMPLE OF DESIRED OUTLET CONTROL COMPONENTS

Source: Conservation Halton.

The pond design should consider potential blockage of all low flow and grated outlet structures (typically 50%); however, if there is a potential for larger debris being transferred through the system, additional blockage considerations may need to be analyzed.

Analysis must be provided that demonstrates the facility is able to meet the required level of quantity control under both free-flowing conditions and under submerged outlet conditions (i.e., tailwater conditions) resulting from flooding within the receiving watercourse system. It should further be demonstrated that the facility operation provides sufficient capacity under both conditions (i.e., the emergency spillway at the facility outlet would not convey flows under either condition). Tailwater effects can be analyzed assuming Regulatory Storm flood elevations within the channel for the full range of storm events controlled within the SWMP. The analysis may alternatively assume a static tailwater condition at the outlet whereby the water surface elevation within the receiving watercourse corresponds to the return period of the design storm being assessed. Other analytical methods can be considered.

3.5.2 Emergency Spillway and Freeboard

The emergency overflow spillway for a SWMP should be designed to safely convey the greater of the uncontrolled 100-year peak or Regional Storm flow to the receiving system. If the required spillway size is considered infeasible due to local constraints, additional discussions with the municipality and CH will be required to determine the acceptable conveyance capacity of the emergency spillway, and any additional flood protection which may be required for properties adjacent to the facility during an overflow condition. A piped system may be considered/required for valleys with high and/or unstable slopes.

The proposed design should be supported with calculations demonstrating the full length of the flow path has been designed with adequate capacity including freeboard and erosion resistance along the entire flow path. Drawings must include details for the proposed spillway through plan, profile, and cross-sectional views.

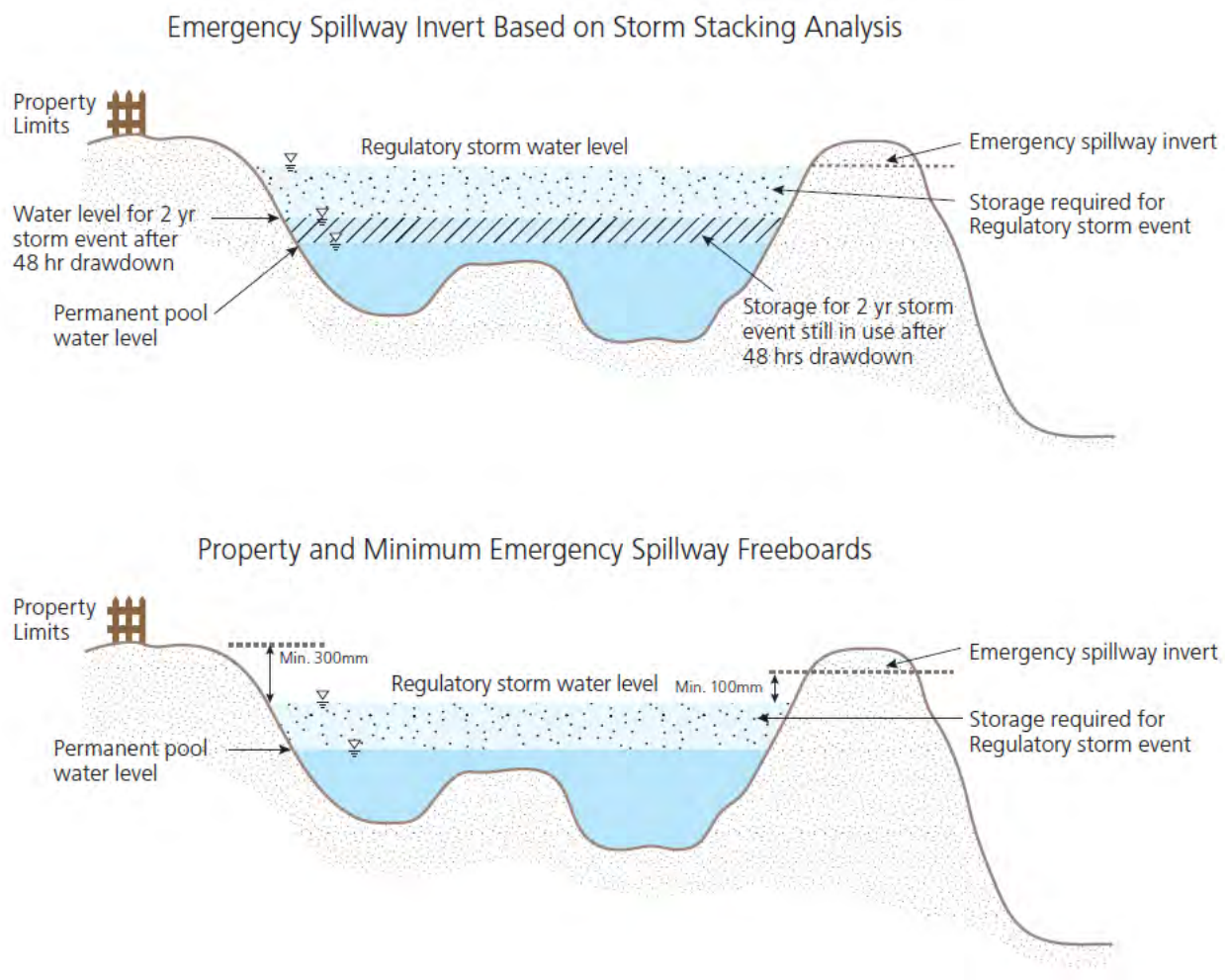
A minimum of 0.3 m of freeboard should be provided above the greater of the Regional Storm or 100-year designed operating water surface elevation in the pond to the edge/limit of the pond block. This requirement applies to all SWMP, including those not designed specifically for Regulatory Storm quantity control.

Where higher-level studies, such as the North Oakville Creeks Subwatershed Study or the Sixteen Mile Creek Areas 2 and 7 Subwatershed Update Study, credit Regulatory Storm Control facilities in land use planning and regulatory flood hazard mapping:

- Storage calculations for the Regulatory Storm should presume a 2-year design storm occurred 48 hours prior to the Regulatory Storm, with the emergency overflow invert elevation set above the resulting Regulatory Storm maximum water surface elevation; and,
- The emergency overflow invert elevation must also be a minimum of 100 mm above the normal Regulatory Storm water surface elevation (i.e., the water surface elevation calculated based on an assumption that all flood storage above the permanent pool was available prior to the Regulatory Storm occurring). CH recommends that this criterion apply to all SWM ponds.

Figure 3-3 provides a visual representation of the above.

FIGURE 3-3: FREEBOARD and EMERGENCY SPILLWAY PLACEMENT FOR REGULATORY STORM CONTROL PONDS



Source: Conservation Halton.

3.5.3 Geotechnical Considerations

A geotechnical report is required to support the SWMP design at the detailed design stage. For Regulatory Storm control facilities with berm heights more than 0.5 m (either on pond or valley sides) and/or berm top widths less than 7.5 m, the supporting geotechnical (i.e., slope stability) analysis should verify that the structure has been designed to withstand all static and dynamic forces and conditions (including groundwater) anticipated for all foreseeable conditions (e.g., during construction (undrained); permanent pool (drained); steady state full pond (undrained); and rapid drawdown (undrained)). This analysis should be based on a geotechnical site investigation considering an adequate number of representative boreholes and standpipe piezometers/monitoring wells. The need for seismic analysis is to be determined by the qualified professional based on standard industry practices and an understanding of the project's risks.

Construction notes for the SWMP berms, slopes and liners must be included on the engineering drawings (e.g., material composition, compaction percentage, moisture, lift thickness, etc.).

It is recommended that the excavated pond subgrade be inspected by qualified professionals to confirm geotechnical design recommendations and/or provide design refinements prior to pond completion.

3.5.4 Ownership of Regulatory Storm Control Ponds

For Regulatory Storm control ponds (and tanks) that have been identified by municipalities and CH in higher-level studies for downstream flow reductions in land use planning and regulatory flood hazard mapping, CH requires either public ownership of the facility or demonstration by the municipality that sufficient mechanisms are in place to ensure the proper operation and maintenance of a privately-owned facility.

3.6 Outfalls

Outfalls provide the discharge point for SWM facilities, typically to a receiving watercourse or drainage feature (e.g., storm sewer, ditch, etc.). All outfalls proposed within regulated areas will require a permit from CH under O. Reg. 162/06. Figure 3-4 provides examples of outfalls within regulated areas. An outfall permit checklist should be obtained through permit pre-consultation with CH staff.

CH discourages the construction of new outfalls within regulated areas unless required to support the flow regime of the natural heritage system and justified to CH's satisfaction in accordance with O. Reg. 162/06. However, greenfield development will typically require a new outfall to the natural system. Where permitted, storm outfalls should be sited and designed to minimize impacts to the regulated features, address valley slope stability, protect watercourse embankments and ensure no wetland interference as per CH Board-approved policies.

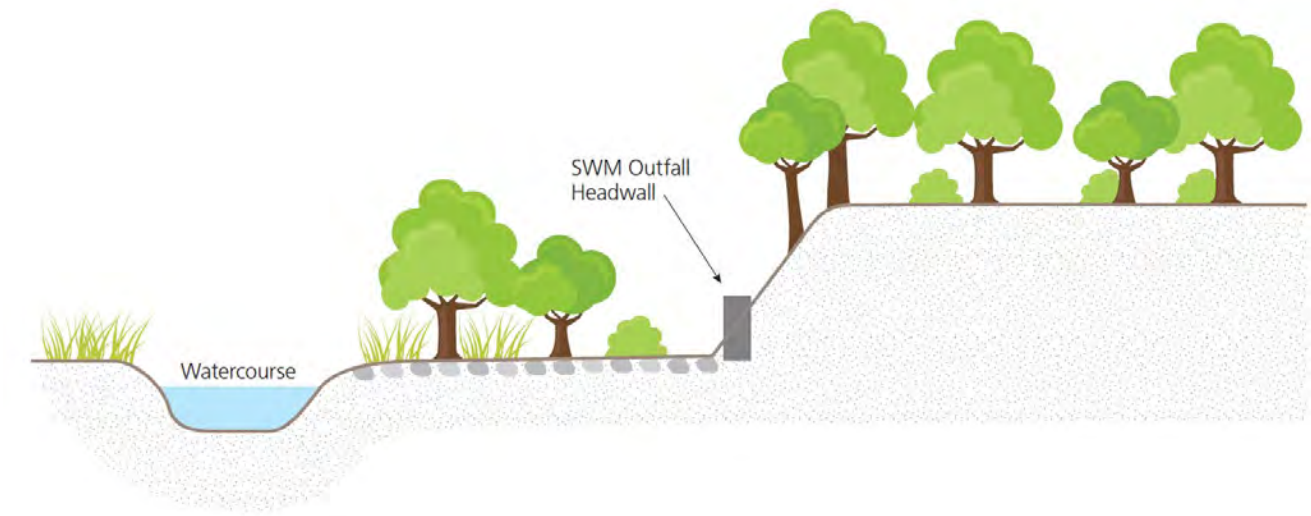
Where feasible, outfall entry points into a valley should generally be placed co-incident with the valley toe, minimally above the bankfull channel (i.e., above the 2-year flood elevation) and outside of the 100-year erosion limit (see Figure 3-5). The outfall (and where required any constructed conveyance channel) should be positioned such that flows are directed down current with the receiving watercourse. A site visit with CH staff and the designer is recommended to confirm any new outfall locations.

New storm sewer outfalls proposed within valley systems with slopes greater than 6 metres in height should be designed to protect the natural integrity of the valley slope (i.e., slope stability). This normally includes the use of a drop shaft and tunneling but other methods will be considered depending on site circumstances. The outfall may also be designed to accommodate emergency flows. Where the outfall construction impacts a valley slope (even when installed utilizing trenchless technologies), the outfall permit application must be supported with a geotechnical analysis demonstrating the outfall will not negatively impact stability of the existing slope. Refer to CH's *Slope Stability Assessment Submission Guidelines* for additional information in this regard.

FIGURE 3-4: EXAMPLES OF OUTLETS WITHIN CH REGULATED AREAS

Source: Conservation Halton.

FIGURE 3-5: DESIRED OUTFALL LOCATION



Source: Conservation Halton.

The outfall design must include calculations demonstrating adequate erosion protection under maximum discharge velocity conditions. All analysis supporting the design must be included within the submission.

Restoration plans should be included for any areas disturbed by the installation of the outfall or conveyance channel.

3.7 Landscaping

CH has specific requirements for planting within area regulated by CH which can be found in the *Guidelines for Landscaping and Rehabilitation Plans* (February 2024). CH has endorsed alternate landscaping criteria that should be used instead of CH's guidelines in select areas within the watershed. CH staff should be consulted in this regard.

3.8 Monitoring

Monitoring of the SWM practices implemented is key in ensuring that the desired criteria (e.g., quantity control, etc.) have been met by the SWM strategy and to provide insight for future designs. Monitoring protocols are set by each municipality, generally through higher-level studies, in consultation with CH as well as part of the MECP Environmental Certificate of Approval. Until the end of the monitoring period, CH requires monitoring reports to be provided within 3 months of the end of the reporting period (e.g., annual monitoring reports within 3 months of year-end). Additional monitoring of SWM works within a regulated area may be established through the permit approval process.

3.9 Summary – Stormwater Management Practices

Table 3.3 provides a summary of CH's recommendations related to SWM practices/infrastructure elements typically included in a SWM strategy for quantity and erosion controls. Additional practices for water quality controls, such as oil/grit separators and filtration units, may be required by the municipality.

TABLE 3-3: SUMMARY – SWM PRACTICES

SWM Practice	Key Information
Low Impact Development Techniques	• Use LID techniques where appropriate and feasible to do so. • Refer to the TRCA / CVC LID Stormwater Planning and Design wiki guide. • Consult with CH and municipality. • Describe design objectives, confirm site appropriateness, and provide design calculations.
Rooftop Storage	• Integrate controls with the building's design to prevent/discourage alteration or removal, where allowed by the municipality. • Include sizing calculations outlining number and placement of the controls, release rate, ponding volume, and drawdown time. • Include the type of control proposed and supporting manufacturer's design information.
Parking Lot and Underground Storage	• Design system to minimize opportunities to remove controls. • Include sizing calculations for all orifice/pipe restrictions (stage-storage-discharge chart). Design drawings showing locations of restrictions, outlets and maximum ponding elevations are needed.

SWM Practice	Key Information
Consideration of New Technologies	• CH is supportive of pilot projects and experimental approaches provided there is monitoring and adaptive management. • Final acceptance of these technologies will require consultation and approval of the municipality as well as CH.
SWM Ponds	• Include calculations supporting the design and detailed drawings (e.g., calculations supporting the stage-storage-discharge curve). • Show the emergency spillway, erosion protection, pond outlet control structure details, the outfall and at least one cross-section through the facility in figures/drawings. • Provide the level of detail for a SWM plan that directly corresponds to the scope of work for the project/study. • Include the specific requirements for control structure, emergency spillway, and geotechnical evaluation.
Outfalls	• Site and design outfalls to address valley slope stability, protect watercourse embankments and ensure no wetland interference. • Position, where feasible, the outfall such that it is co-incident with the valley toe, outside the 100-year erosion limit, and above the bankfull channel with flows directed downstream along the receiving watercourse. • Provide calculations demonstrating adequacy of erosion protection measures under maximum discharge velocity.
Landscaping	• For CH regulated areas, follow CH's *Guidelines for Landscaping and Rehabilitation Plans* (February 2024) and municipal guidelines.
Monitoring	• Follow the protocols outlined by a higher-level study, the municipality, and MECP or as established through the permit approval process. Submit monitoring reports within 3 months of the end of the monitoring period (including annual reports within 3 months of the year end).

Section 4 Hydrologic Modelling Requirements

This section discusses hydrologic modelling and associated hydraulic calculations. This section should be read in conjunction with the most up-to-date municipal requirements.

Hydrologic modelling is used to approximate the runoff response of a watershed to various climatic conditions under varying land use scenarios (e.g., pre-development, post-development, etc.). The results from hydrologic analyses are used to demonstrate the adequacy of a SWM strategy for erosion and quantity controls.

This section provides limited direction with respect to hydrologic analysis in support of regulatory flood hazard mapping. While it is encouraged that the same parameters be used to support both SWM and floodplain mapping assessments within the same study, different parameters may be required to meet the needs/circumstances of both assessments. Further information will be provided in CH's Guidelines for Floodplain Alterations and Mapping Submissions.

This section presents procedures, computational methods, and parameters that are commonly accepted industry standards supported by CH; however, it is the consulting engineer's responsibility to select an appropriate method and/or justify the parameters used. If the consulting engineer selects an alternative computational method or parameter, an explanation for its use should be provided. In these situations, consultation should be undertaken with CH and municipal staff.

4.1 Software and Documentation

Commonly available hydrologic modelling software should preferably be used. The use of open source (Public Domain) software is recommended. Use of specific software (or model) may be required by a higher-level study. Where appropriate, different models may be considered to achieve different objectives (e.g., subwatershed model, SWM pond design). Modelling should be completed using the most current version of the software unless otherwise requested or agreed upon. For sites less than 5 hectares in total area, a manual calculation method, such as the Rational Method, may be used.

All input parameters should be tabulated within the design report with their sources cited. All model input and output files shall be submitted to CH in digital format (pdf and executable). A model schematic should be provided to facilitate interpretation of the model input and output files. Documentation within the model is recommended. At a minimum, the model should provide the name of the modeller, company, date of the model, purpose of model run (e.g., existing, proposed uncontrolled, proposed controlled, etc.), and the source of topographic data. If there are many digital files, a README file or equivalent is required.

The technical submission should contain enough information such that a qualified professional can replicate the results of the submission. Submitted modelling, calculations, drawings, and reports should be stand-alone documents and contain all key information including documentation obtained from other approved reports that is necessary to support the analysis.

For large or complex areas, applicants should obtain municipal and CH's support of the existing/pre-development conditions models before advancing to post-development analyses.

4.2 Hydrologic Analysis Components

There are several key components that a hydrologic analysis should include as a minimum.

4.2.1 Catchment Delineation

Catchments should be delineated under both pre- and post-development surface drainage conditions. Key features such as ponds, railways, roads, culverts, undrained depressions, wetlands, etc., must be included. The discretization process should be based on field reconnaissance, topographic mapping, aerial photography, and site survey. The best level of topographic data available should be used. LIDAR/DTM data is recommended for watershed/subwatershed studies while total station site survey or equivalent is recommended for subdivision or site plan level modelling. There may be additional information available within approved reports such as watershed/subwatershed studies, EIR/SIS/MESPs, and Area Specific Plans.

Sources must be documented for all topographic and survey data used in the analysis. Reference information should include map title, author, publisher, scale, datum, publishing date and date flown or surveyor name and survey date.

Separate pre- and post-development (interim and ultimate conditions) catchment plans should be submitted in support of the modelling. Catchment plans should be consistent with the modelling completed. Catchment areas should be plotted over pre- or post-development contours and be labelled with catchment ID (consistent with modelling), catchment area, and % impervious/runoff coefficient. Flow direction arrows and the location(s) of outlets should also be shown. Post-development catchment area plans should include proposed land use conditions. A detailed digital (pdf) copy of the labelled catchment drainage area plan(s) should be included as part of the digital submission. A copy of the drainage area plan(s) suitable for insertion into CH's Geographic Information System should be submitted.

4.2.2 Rainfall Input

When assessing hydrology as part of a SWS or other higher-level study, a variety of rainfall distributions for Design Storms should be modelled, and justification provided for the temporal rainfall distribution(s) recommended for use in the study. For continuous modelling, actual historical rainfall records at the nearest available station should be used. A minimum record of 20 years is required.

The rainfall simulation (i.e., single event modelling with Design Storms or continuous modelling with flood frequency analysis) used in the higher-level planning studies should generally be used in subsequent studies (e.g., SWM report for a subdivision). Should an alternate rainfall method be selected, the rationale for the selection must be validated and justified. It is recommended a rainfall sensitivity analysis be undertaken to support this justification. For the sizing of SWMPs, the 24-hour Chicago design storm distribution should be considered with a suite of storm lengths and distributions in accordance with municipal guidelines to demonstrate peak flow control and calculate required storage volumes.

Rainfall amounts should be based on the Intensity-Duration-Frequency (IDF) curves for the precipitation station identified within the municipality's requirements. IDF information is provided in Appendix A1 through A6. Municipalities should be contacted to confirm the most current IDF data to use and determine if the modeler will need to consider specific historical storm events.

The Regional Storm (Hurricane Hazel) must also be modelled. CH preference is to model the last 12 hours of the Hurricane Hazel storm event assuming pre-saturated soils. However, the full 48-hour storm event could be used if the results are properly assessed (e.g., rainfall distribution and reasonable runoff volume). Depending on the size of the catchment area, areal reduction factors may be applicable. The Hurricane Hazel distribution and areal reduction factors are provided within Appendix A7.

The rainfall time step should be no larger than 1/5 (20%) of the smallest basin's approximate time to peak.

4.2.3 Hydrologic Parameters

Sources and rationale for the selection of all hydrologic parameter values should be provided, especially those factors affecting runoff generation (i.e., percentage impervious coverage, soil infiltration method and related parameters, etc.), and factors affecting hydrograph shape (i.e., flow length, Manning's Roughness Coefficients, etc.). All hydrologic parameters should be compared to the applicable higher-level planning study(s) or confirmed through consultation.

Values/approaches typically acceptable to CH are found in Appendix B1 through B12; however, while approaches and values are given, it is recognized that the values are not uniformly applicable. Typical values may need to be refined for several reasons (e.g., to represent watershed topography, software model, routing approach, event return period, model purpose, etc.). Model calibration and validation using local data, completed during the higher-level study to improve accuracy of the model results, may have adjusted parameters. References and justification should be provided for values selected.

Imperviousness

An accurate estimate of the percentage of imperviousness within catchments is very important as hydrologic models are generally sensitive to this parameter. This parameter will impact the proposed stormwater runoff volumes and consequently the land requirements and volume of the SWM facilities.

Impervious areas should be determined by sampling a representative area in each catchment for higher-level studies. For detailed level studies, they should be calculated by using the draft plan to calculate an overall imperviousness based on estimated maximum development envelopes and road configuration. Conservative assumptions for future amenity areas should be applied. Typical values for imperviousness are found in Appendix B1.

Rainfall Abstractions

Initial Abstraction (Ia) should be set for both the impervious and pervious areas within modelled catchments.

Three methods for determining infiltration have commonly been applied within CH's jurisdiction: 1) the Horton method, 2) the Soil Conservation Service (SCS) curve number method, and 3) the Green-Ampt method. To allow for a direct comparison of impacts between existing and future conditions, consistent infiltration approaches should be applied during both pre-development and post-development model scenarios. Typical values for rainfall abstractions are found in Appendix B2 through B6. Modelling for the 1:2 through 1:100-year storm events should consider average soil moisture; however, saturated conditions must be considered when modelling the Regional Storm event. For example, using the SCS method, AMC II should be used for 1:2 through 1:100 year and AMC III should be used for 12-hr Hurricane Hazel.

A thorough understanding of these methodologies is required to ensure their proper application within hydrologic modelling. This is especially important where the hydrologic modelling has not been validated against suitable monitoring data.

Time of Concentration

Hydrograph time of concentration values can be determined based on the Airport Method (for catchments with a runoff coefficient less than 0.40) or the Bransby-Williams Equation (for catchments with a runoff coefficient greater than or equal to 0.40). The equations and design charts for these methods are provided within Appendix B7 and B8. Other technically sound and well documented methods, such as the Uplands Method, are also acceptable as the standardized equations may not accurately represent site conditions or be consistent with municipal criteria.

The time to peak should be calculated as two-thirds of the time of concentration (or $t_p = 0.67\ t_c$).

The hydrograph computation time step (DT) should be no greater than 1/5 of the catchment time to peak (i.e., DT = $0.2\ t_p$) but not less than the rainfall time step.

Overland Flow Length & Catchment Widths

Various hydrologic software requires that overland flow length and/or catchment widths be provided as an input parameter for each subcatchment. Overland flow length for pervious areas in an un-calibrated watershed can generally be estimated using the equation available in Appendix B9. Other approaches can be used where justified to CH staff satisfaction.

4.2.4 Channel Routing

Channel routing elements should be considered in the hydrologic model as determined by site conditions. Channel routing is most applicable to large-scale watershed and subwatershed hydrologic modelling. Rating curves and travel times used in the routing should be determined by hydraulic calculations of the backwater profile or by procedures available in the approved model software (e.g., Modified Pulse, Muskingum method, etc.). Alternatively, a stage-storage relationship can be generated using HEC-RAS. The routing methodology applied and technical justification for the associated routing parameters should be included in the report text of the submission.

Cross-section information used to define channel routing elements should be obtained from sufficiently detailed DTM data or field surveys. Cross-sections should be extended such that flows do not exceed the rating curve; however, cross-sections should not be substantially larger than the wetted width associated with the largest modelled storm.

The routing time step must be determined relative to the smallest channel section and be equal to the hydrograph time step at a maximum. Selected Manning's Roughness Coefficients for overland flow should be in accordance with the values in Appendix B10 and supported in the submission documentation.

4.2.5 Reservoir Routing

Many hydrologic modelling packages include several reservoir/storage routing tools, including modelling for natural storage areas and SWMP. When modelling natural features such as wetlands, reservoir routing commands are typically applied over the full range of storms, up to the Regional Storm. Routing/storage elements associated with SWMPs are generally applied only when modelling the 1:2 year through 1:100-year events. These however may be applied when modelling the Regional Storm, if the pond has been designed specifically to provide Regional Storm controls and meets all CH, municipal and provincial criteria for such a pond (see Section 3.6).

Where routing has been used, documentation should be provided discussing the routing used, the source data for the routing element, and any assumptions made when determining the routing of flows, especially for natural storage areas.

Outlet orifice and emergency spillway details should be provided along with a stage-storage-discharge table. The table should include the following for each storm event: maximum water surface elevation; maximum storage volume used; peak discharge rates; and approximate drawdown time.

Discharge equations should be used for free-flowing hydraulic structures such as orifices, weirs and spillways and are provided in Appendix B11. When calculating orifice discharge in an outlet structure, the orifice equation should only be applied for water levels above the centroid of the orifice. Flow rates for water levels below the orifice centroid should be calculated using the weir equation. Typical discharge coefficients are provided in Appendix B11.

4.3 Rational Method

The Rational Method can be used for developments which are less than 5 hectares in total area and consideration for the effects of detention/SWM are not required (the methodology is limited in this regard). The rainfall intensity should be based on the IDF curves and time of concentration identified within the municipality's SWM standards/guidelines. The municipality should be contacted to confirm the most current IDF data to use. The Rational Method equation and runoff coefficients are provided in Appendix B12.

4.4 Summary – Hydrologic Modelling Requirements

Table 4.1 provides a summary of the requirements for hydrologic modelling undertaken to support the SWM strategy proposed.

TABLE 4-1: SUMMARY – HYDROLOGIC MODELLING REQUIREMENTS

Modelling Component	Key Information
Software & Documentation	• Use software (or model) required by a higher-level study or use a commonly available modelling software in the absence of higher-level study requirements. • Tabulate all input parameters within the design report with their sources cited. • Submit all model input and output files in both digital and hard copy formats. • Include summary tables demonstrating that targets will be met. • Provide a model schematic to facilitate interpretation of the model input and output files. • Obtain municipal and CH approval of pre-development condition models before submitting post-development analyses for large or complex areas.
Hydrologic Analysis Components	• Delineate catchments under both pre- and post- development conditions. • Include base topographic mapping, flow direction arrows, the location(s) of outlets and key features in the catchment depictions. • Use the rainfall distribution included in higher-level planning studies. • Base rainfall amounts on municipal IDF curves. • Model the Regional Storm. • Provide sources and rationale for the selection of all hydrologic parameter values and compare them to the applicable higher-level planning studies or confirm them through pre-consultation with the municipality and CH. • Include channel routing in the hydrologic model as determined by site conditions and include the routing methodology applied and technical justification for the associated routing parameters. • Provide documentation where routing has been used, including the assumptions, especially for natural storage areas.
Rational Method	• The Rational Method may be acceptable for developments less than 5 hectares in area. • Base the rainfall intensity on the IDF curves and time of concentration identified within the municipality's SWM standards/guidelines.

Section 5 Submission Document Requirements

This section outlines the information needed to satisfy CH with respect to SWM for specific *Planning Act* applications. The items listed below do not replace municipal or provincial requirements. While the following components and format are suggested for inclusion, the report may follow a different format, or a component may be presented in a separate report and referenced in the subject report. Additional details are provided within Sections 2.0 to 4.0 of this document.

CH Permit Application Checklists should be used for submission requirements for infrastructure and grading works proposed within an area regulated under O. Reg. 162/06.

5.1 Functional Servicing Report (OPAs, ZBAs, Draft Plan of Subdivision/Condominium)

A Functional Servicing Report (FSR) will be required to support the issuance of conditions for Subdivision Draft Plan Approval as well as to support approval of Official Plan and Zoning By-law Amendments. The FSR may be combined with an EIR. The purposes of these reports are to show, at a conceptual level, the following:

- Location/design criteria for SWM infrastructure and LID techniques;
- SWM blocks are sufficiently sized to address the required level of control;
- SWM facilities drain to appropriate outlets; and
- Development lots/blocks do not encroach into natural hazards and regulated areas in accordance with CH policies.

While other information such as water and sanitary servicing are contained within an FSR, the components listed in Table 5.1 are related to CH's review for SWM. Additional components such as storm water quality controls and site water balances may also be required by the municipality.

TABLE 5-1: FUNCTIONAL SERVICING REPORT (OPAS, ZBAS, DRAFT PLAN OF SUBDIVISION/CONDOMINIUM)

Item Number	Components
1	**Project Description** This section of the FSR should include a description of the development that is proposed for the site.
2	**Referenced Drainage Studies/Background Reports** This section of the FSR should outline all background reports relevant to the development, including but not limited to: • Approved Watershed, Subwatershed Studies • Approved Subwatershed Impact Study/Environmental Implementation Report/Master Environmental Servicing Plan • Approved SWM reports for same site and nearby developments (for peak flow analysis)
3	**List of Design Criteria (refer to Section 2.0 for details)** This section of the FSR should list the design criteria for the development, including but not limited to: • Erosion control • Water quantity control • Wetland water balance * • Other municipal criteria
4	**Site Conditions** This section should provide a description of existing and proposed site conditions, including but not limited to: • Identified limits of development • Hazard & Wetlands constraints mapping o Topographic details o Meander belt allowance for unconfined[1] systems – fluvial geomorphic study o Slope stability allowance for confined[1] systems – geotechnical engineering study or conservative stable slope assessment based on acceptable principles o Floodplain delineation/refinement o Areas of unstable bedrock or soils o Wetlands o Adjacent regulated allowances • Preliminary grading plans

Item Number	Components
5	**Site Hydrology and Hydraulics (Pre- and Post-Development) (refer to Section 4.0 for details)** This section should characterize site hydrology and hydraulics under both pre- and post-development conditions and should include the following: • Topographic maps showing the following for pre-development and post-development (interim and ultimate) conditions: o Sub-basin boundaries o External contributing drainage areas o Development drainage area o Preliminary major and minor drainage patterns o Land use o Watercourses and drainage features o Points of discharge from the site o Existing on and off-site drainage facilities, including overland swales • Input parameters (hydrologic analysis) in tabular format • Output summary (hydrologic analysis) in tabular format • Hydrologic calculations (Appendix) • Detailed hardcopy of any modelling as well as digital copy (Appendix)
6	**Stormwater Management Strategy (refer to Section 3.0 for details)** The section of the FSR should outline the functional stormwater management strategy for the site, including but not limited to: • Proposed technologies • Justification for choice of proposed technologies • Summary table(s) demonstrating that erosion and quantity design criteria will be met • Preliminary calculations (Appendix) • Preliminary design plans in accordance with municipal requirements
7	**Hydrogeology (For development in CH regulated area that may impact the hydrologic function of wetlands)** This section should characterize the site's hydrogeologic conditions within the regulated area and identify any requirements and constraints. • Refer to CH's Guidelines for Wetland Water Balance Assessments (forthcoming) • Detailed water balance including identification of any mitigation measures and locations • Confirmation that preliminary LID technique & SWMP designs are appropriate for existing groundwater, soil and bedrock conditions (e.g., depth to seasonally high-water table; depth to bedrock; disruption of shallow groundwater flow to areas of groundwater discharge, etc.) and the requirement for any specific mitigation measures

Item Number	Components
8	**Wetland Water Balance *** This section of the FSR should provide water balance requirements and the proposed strategy for specified wetlands. • Preliminary water balance to specific wetlands (evaluating impacts of changes to hydrologic functions including flow rate, volume, timing, duration, etc.) • Identification of mitigation measures and potential locations
9	**Baseline Monitoring Program (if applicable)** This section should outline the final detailed baseline monitoring program, including but not limited to: • Reference applicable higher-level planning studies • Outline detailed baseline monitoring required prior to any Site Alteration, if applicable • Identify monitoring plan components to be finalized during detail design
10	**Future Study Requirements** This section of the FSR should outline any commitments for detailed design.
11	**Summary and Conclusions**

Notes:

- All reports and engineering plans must be signed, stamped and dated by a Professional Engineer, except for any fluvial geomorphological reports which should be signed, stamped and dated by a Professional Geoscientist.

- Contact CH for current digital drawing submission requirements.

* Pre-consultation with CH before design is strongly recommended

[1] Confined systems mean those systems where the watercourse is contained within valleys greater than or equal to 2 metres in height. Unconfined systems mean those systems where the watercourse is contained within valleys less than 2 metres in height.

5.2 SWM Design Report (Subdivision Detailed Design)

The purpose of this report is to provide detailed calculations, methodology, background criteria, and engineering drawings to support the detailed subdivision design. Typically, the report is an expansion of the earlier FSR. This is required to obtain clearance of draft plan conditions to support Registration of a Plan of Subdivision. This information is also required for permit issuance, where applicable. The same report and relevant drawings should be provided through both approval processes. Additional components such as water quality controls and site water balances may be required by the municipality.

TABLE 5-2: SWM DESIGN REPORT (SUBDIVISION DETAILED DESIGN)

Item Number	Components
1	**Project Description** This section of the SWM Design Report should include a description of the development that is proposed for the site.
2	**Referenced Drainage Studies/Background Reports** This section of the SWM Design Report should outline all background reports relevant to the development, including but not limited to: • Approved Watershed, Subwatershed Studies • Approved Subwatershed Impact Study/Environmental Implementation Report/Master Environmental Servicing Plan • Functional Servicing Report. • Approved SWM reports for same site and near by developments (for peak flow analysis)
3	**List of Design Criteria (refer to Section 2.0 for details)** This section of the SWM Design Report should list the design criteria for the development, including but not limited to: • Erosion control • Water quantity control • Wetland Water balance * • Other municipal criteria

Item Number	Components
4	**Site Conditions** This section should provide a description of existing and proposed site conditions, including but not limited to: • Identified limits of development • Hazard constraints mapping o Topographic details o Meander belt allowance for unconfined systems[1] – fluvial geomorphic study o Slope stability allowance for confined systems[1] – geotechnical engineering study or conservative stable slope assessment based on acceptable principles o Floodplain delineation/refinement o Adjacent regulated allowances • Detailed grading plans
5	**Site Hydrology and Hydraulics (Pre- and Post-Development) (refer to Section 4.0 for details)** This section should characterize site hydrology and hydraulics under both pre- and post-development conditions and should include the following: • Topographic map showing the following for pre-development and post-development (interim and ultimate) conditions: o Sub-basin boundaries o External contributing drainage areas o Development drainage area o Major and minor drainage patterns o Land use o Watercourses and drainage features o Points of discharge from the site o Existing on and off-site drainage facilities, including overland swales • Input parameters (hydrologic analysis) in tabular format • Output summary (hydrologic analysis) in tabular format • Detailed hydrologic calculations (Appendix) • Detailed hardcopy of any modelling as well as digital copy (Appendix)
6	**Stormwater Management Strategy (refer to Section 3.0 for details)** The section of the SWM Design Report should outline the detailed stormwater management strategy for the site, including but not limited to: • Proposed technologies • Justification of proposed technologies • Summary table(s) demonstrating that erosion and quantity design criteria will be met • Detailed calculations (Appendix) • Detailed design plans in accordance with municipal requirements sufficient for construction

Item Number	Components
7	**Hydrogeology (for development in CH regulated areas that may impact the hydrologic function of wetlands)** This section should characterize the site's hydrogeologic conditions within the regulated area and identify any requirements and constraints. • Refer to CH's Guidelines for Wetland Water Balance Assessments (forthcoming) • Detailed design of any infiltration facilities required to maintain pre-development water balance • Confirmation that SWM and infiltration facilities are designed appropriately for hydrogeological conditions (e.g., soil types and depth to seasonally high-water table)
8	**Wetland Water Balance *** This section of the SWM Design Report should provide water balance requirements and the proposed strategy for specified wetlands. • Detailed water balance to specific wetland (evaluating impacts of changes to flow rate, volume, timing, duration, etc.) • Identification of mitigation measures and locations
9	**Erosion and Sediment Control Plans** The proposed erosion and sediment control measures to be used on-site should be outlined in this section and supported with drawings. • *Erosion and Sediment Control Guide for Urban Construction (TRCA 2019)* • *Erosion and Sediment Control Inspection Guide (TRCA, 2008)*
10	**Revegetation/Landscape Plans** While not a section of the report, landscape drawings will need to be provided with the document. • Refer to Conservation Halton's *Guidelines for Landscaping and Rehabilitation Plans (July 2021).* • Refer to any specific municipal restoration guidelines.
11	**Monitoring Plan** This section should outline the proposed monitoring program, if required, including but not limited to: • Provide detailed information on items to be monitored and the process to be followed or reference relevant documents • Location plans for all monitoring sites

Item Number	Components
12	**Summary and Conclusions**

Notes:

- All reports and engineering plans must be signed, stamped and dated by a Professional Engineer, except for any fluvial geomorphological reports which should be signed, stamped and dated by a Professional Geoscientist.

- Contact CH for current digital drawing submission requirements.

* Pre-consultation with CH before design is strongly recommended

[1] Confined systems mean those systems where the watercourse is contained within valleys greater than or equal to 2 metres in height. Unconfined systems mean those systems where the watercourse is contained within valleys less than 2 metres in height.

5.3 SWM Brief (Site Plan)

The purpose of this submission is to obtain approval for individual site plans. The type of report(s) and level of detail will be dependent on the complexity of the project. This information is also required for permit issuance, where applicable. The same report and relevant drawings should be provided through both approval processes. Additional components such as water quality controls and site water balances may be required by the municipality.

TABLE 5-3: SWM BRIEF (SITE PLAN)

Item Number	Components
1	**Project Description** This section of the SWM Brief should include a description of the development that is proposed for the site.
2	**Referenced Drainage Studies/Background Reports** This section of the SWM Brief should outline all background reports relevant to the development, including but not limited to: • Approved Watershed, Subwatershed Studies • Approved Subwatershed Impact Study/Environmental Implementation Report/Master Environmental Servicing Plan • Approved SWM reports for same site and nearby developments (for peak flow analysis)

Item Number	Components
3	**List of Design Criteria (refer to Section 2.0 for details)** This section of the SWM Brief should list the design criteria for the development, including but not limited to: • Erosion control • Water quantity control • Wetland Water balance * • Other municipal criteria
4	**Site Conditions** This section should provide a description of existing and proposed site conditions, including but not limited to: • Identified limits of development • Hazard constraints mapping o Topographic details o Meander belt allowance for unconfined systems[1] – fluvial geomorphic study o Slope stability allowance for confined systems[1] – geotechnical engineering study o Floodplain delineation/refinement o Adjacent regulated allowances • Detailed grading plans
5	**Site Hydrology and Hydraulics (Pre- and Post-Development) (refer to Section 4.0 for details)** This section should characterize site hydrology and hydraulics under both pre- and post-development conditions and should include the following: • Topographic map showing the following for pre-development and post-development (interim and ultimate) conditions: o Sub-basin boundaries o External contributing drainage areas o Development drainage area o Major and minor drainage patterns o Land use o Watercourses and drainage features o Points of discharge from the site o Existing on and off-site drainage facilities, including overland swales • Input parameters (hydrologic analysis) in tabular format • Output summary (hydrologic analysis) in tabular format • Detailed hydrologic calculations including Rational method modelling (Appendix)

Item Number	Components
6	**Stormwater Management Strategy (refer to Section 3.0 for details)** The section of the /SWM Brief should outline the stormwater management strategy for the site, including but not limited to: • Proposed technologies • Justification for choice of proposed methods • Summary table(s) demonstrating that erosion and quantity design criteria will be met • Detailed calculations (Appendix) • Detailed design plans in accordance with municipal requirements sufficient for construction
7	**Hydrogeology (for development in CH regulated areas that may impact the hydrologic function of wetlands)** This section should characterize the site's hydrogeologic conditions within the regulated area and identify any requirements and constraints. • Refer to CH's Guidelines for Wetland Water Balance Assessments (forthcoming) • Detailed design of any infiltration facilities required to maintain pre-development water balance • Confirmation that SWM and infiltration facilities are designed appropriately for hydrogeological conditions (e.g., soil types and depth to water table)
8	**Wetland Water Balance *** This section of the SWM Design Report should provide water balance requirements and the proposed strategy for specified wetlands. • Detailed water balance to specific wetland (evaluating impacts of changes to flow rate, volume, timing, duration, etc.) • Identification of mitigation measures and locations
9	**Erosion and Sediment Control Plans** The proposed erosion and sediment control measures to be used onsite should be outlined in this section and supported with drawings. • *Erosion and Sediment Control Guide for Urban Construction (TRCA 2019)* • *Erosion and Sediment Control Inspection Guide (TRCA, 2008)*
10	**Revegetation/Landscape Plans** While not a section of the report, landscape drawings will need to be provided with the document. • Refer to Conservation Halton's *Guidelines for Landscaping and Rehabilitation Plans (July 2021).* • Refer to any specific municipal guidelines.

Item Number	Components
11	**Monitoring Plan** This section, if required, should outline the proposed monitoring program, including but not limited to: • Provide detailed information on items to be monitored and the process to be followed or reference relevant documents
12	**Summary and Conclusions**

Notes:

- All reports and engineering plans must be signed, stamped and dated by a Professional Engineer, except for any fluvial geomorphological reports which should be signed, stamped and dated by a Professional Geoscientist.

- Contact CH for current digital drawing submission requirements.

* Pre-consultation with CH before design is strongly recommended

[1] Confined systems mean those systems where the watercourse is contained within valleys greater than or equal to 2 metres in height. Unconfined systems mean those systems where the watercourse is contained within valleys less than 2 metres in height.

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Appendix A Rainfall Data

Provided below are available rainfall data for municipalities within Conservation Halton's watershed taken from their municipal engineering standards; however, **consult with the municipality to confirm the current information.**

A1 City of Burlington

Source: *City of Burlington Stormwater Management Design Guidelines*, City of Burlington, 2020).

IDF curves derived from 54 years of historical rainfall data from the RBG meteorological station with a +15% climate change adjustment.

TABLE A-1: CITY OF BURLINGTON, 2100 PROJECTED RAINFALL INTENSITIES

5-year Event	Existing	Historic*	RCP 2.6	RCP 4.5	RCP 8.5
	88.09	88.2	95.01	97.20	102.37
% Increase compared to Existing	N/A	0.12	7.85	10.34	16.21
	141.89	141.11	151.92	153.82	163.11
% Increase compared to Existing	N/A	-0.88	10.56	8.4	14.85

FIGURE A-1: CITY OF BURLINGTON, INTENSITY-DURATION-FREQUENCY CURVES

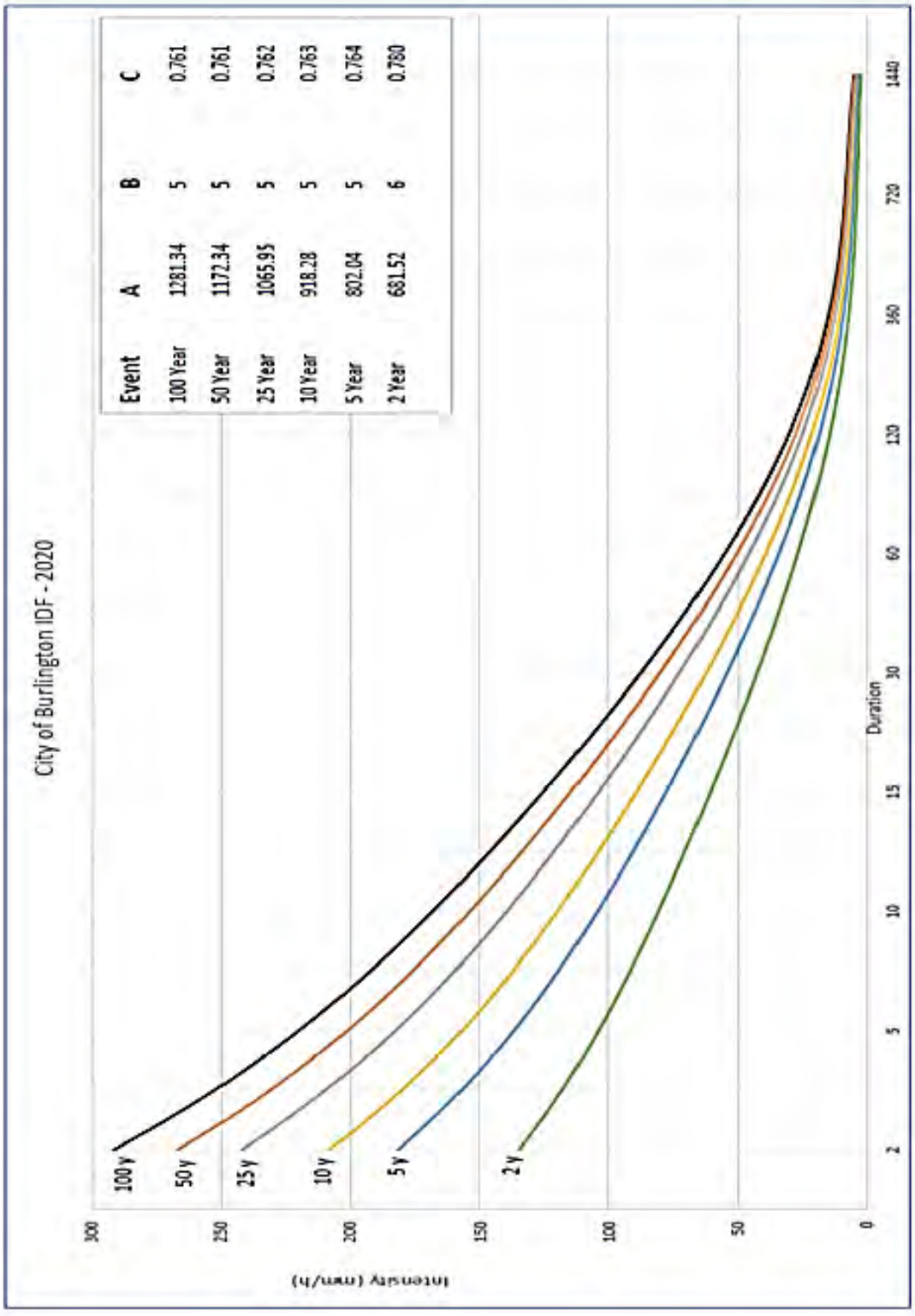


TABLE A-2: CITY OF BURLINGTON, RAINFALL INTENSITY EQUATION COEFFICIENTS

	A	b	c
2	681.52	6.0	0.780
5	802.04	5.0	0.764
10	918.28	5.0	0.763
25	1065.95	5.0	0.762
50	1172.34	5.0	0.761
100	1281.34	5.0	0.761

$$i = \frac{A}{(t_d + b)^c}$$

Where: i = Rainfall intensity (mm/hr)
t_d = Duration (hr)
A, b and c = constants

A2 Town of Halton Hills

Source: Town of Halton Hills, *Town of Halton Hills Subdivision Manual,* 1999.

TABLE A-3: TOWN OF HALTON HILLS, INTENSITY-DURATION-FREQUENCY VALUES

Compilation of AES Hydrometeorological Division data for Toronto International Airport, Fergus Shand Dam and Heart Lake (weighted by total years of record)

Duration min	2 Year mm/hr (mm)*	5 Year mm/hr (mm)*	10 Year mm/hr (mm)*	25 Year mm/hr (mm)*	50 Year mm/hr (mm)*	100 Year mm/hr (mm)*
5	104.64 (8.72)	135.36 (11.28)	155.64 (12.97)	181.44 (15.12)	200.40 (16.70)	219.36 (18.28)
10	73.08 (12.18)	94.68 (15.78)	109.02 (18.17)	127.08 (21.18)	140.46 (23.41)	153.78 (25.63)
15	61.60 (15.40)	82.88 (20.72)	97.04 (24.26)	114.84 (28.71)	128.08 (32.02)	141.24 (35.31)
30	41.22 (20.61)	56.96 (28.48)	67.40 (33.70)	80.58 (40.29)	90.32 (45.16)	100.06 (50.03)
60	24.23 (24.23)	35.32 (35.32)	42.68 (42.68)	51.97 (51.97)	58.85 (58.85)	65.69 (65.69)
120	14.73 (29.45)	21.23 (42.45)	25.54 (51.07)	30.98 (61.97)	35.01 (70.01)	39.02 (78.03)
360	6.51 (39.05)	9.11 (54.63)	10.83 (64.96)	13.00 (78.00)	14.61 (87.67)	16.22 (97.29)
720	3.76 (45.16)	5.21 (62.49)	6.17 (73.98)	7.37 (88.49)	8.27 (99.25)	9.16 (109.95)
1440	2.44 (58.49)	3.01 (72.21)	3.56 (85.50)	4.26 (102.26)	4.78 (114.69)	5.29 (127.05)

* The bracketed value is the total precipitation over the time interval

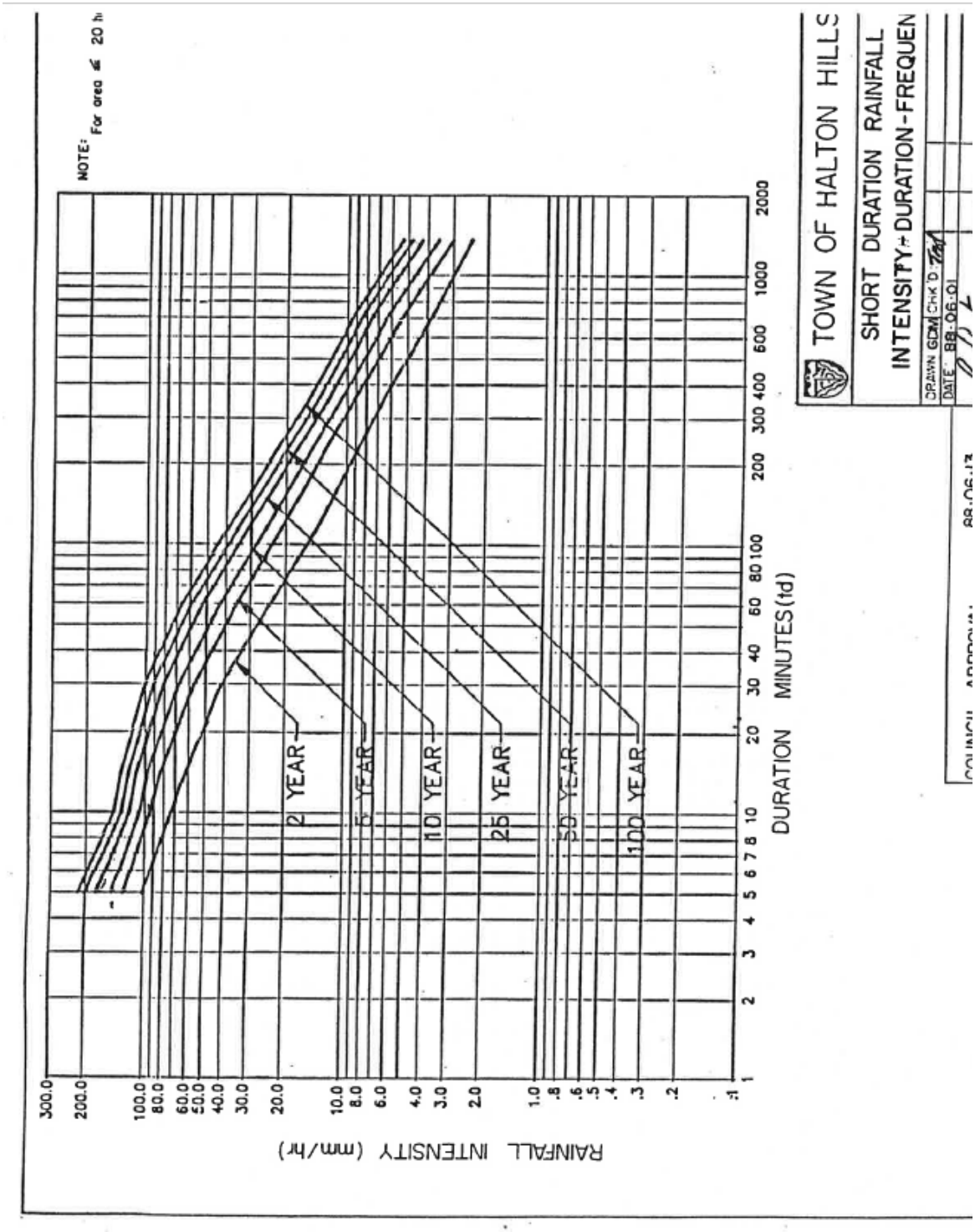
TABLE A-4: TOWN OF HALTON HILLS, RAINFALL INTENSITY EQUATION COEFFICIENTS

	A	b	c
2	586.10	6.0	0.760
5	946.46	7.0	0.788
10	1173.48	8.0	0.794
25	1363.91	8.0	0.789
50	1622.45	9.0	0.797
100	1777.20	9.0	0.795

$$i = \frac{A}{(t_d + b)^c}$$

Where: i = Rainfall intensity (mm/hr)
t_d = Duration (hr)
A, b and c = constants

FIGURE A-2: TOWN OF HALTON HILLS, SHORT DURATION INTENSITY-DURATION-FREQUENCY CURVES



A3 City of Hamilton

Source: City of Hamilton, *Comprehensive Guidelines and Financial Policies Manual,* 2018.

TABLE A-5: CITY OF HAMILTON, INTENSITY-DURATION-FREQUENCY VALUES, MOUNT HOPE

Duration min	2 Year mm/hr	5 Year mm/hr	10 Year mm/hr	25 Year mm/hr	50 Year mm/hr	100 Year mm/hr
5	102.7	140.1	165.0	196.3	219.6	242.4
10	72.1	100.4	119.1	142.8	160.4	177.8
15	58.4	81.2	96.3	115.4	129.5	143.6
30	39.5	55.2	65.6	78.6	88.3	97.9
60	24.7	36.2	43.8	53.4	60.6	67.7
120	15.0	22.2	26.9	33.0	37.4	41.9
360	6.6	9.4	11.3	13.6	15.3	17.0
720	3.7	5.2	6.2	7.5	8.4	9.3
1440	2.2	3.0	3.5	4.2	4.6	5.1

TABLE A-6: CITY OF HAMILTON, RAINFALL INTENSITY EQUATION COEFFICIENTS, MOUNT HOPE

	A	b	c
2	646.0	6.0	0.781
5	1049.5	8.0	0.803
10	1343.7	9.0	0.814
25	1719.5	10.0	0.823
50	1954.8	10.0	0.826
100	2317.4	11.0	0.836

$$i = \frac{A}{(t_d + b)^c}$$

Where: i = Rainfall intensity (mm/hr)
t_d = Duration (hr)
A, b and c = constants

TABLE A-7: CITY OF HAMILTON, INTENSITY-DURATION-FREQUENCY VALUES, ROYAL BOTANICAL GARDENS

Duration min	2 Year mm/hr	5 Year mm/hr	10 Year mm/hr	25 Year mm/hr	50 Year mm/hr	100 Year mm/hr
5	94.6	122.2	140.6	163.7	180.9	198.0
10	68.3	89.2	100.2	120.8	133.8	146.7
15	55.7	74.3	86.7	102.2	113.8	125.2
30	36.2	47.2	54.5	63.7	70.5	77.3
60	22.1	27.6	31.2	35.7	39.1	42.5
120	14.3	18.6	21.4	25.0	27.7	30.4
360	6.0	8.5	10.2	12.3	13.9	15.4
720	3.5	4.9	5.8	7.0	7.8	8.6
1440	2.1	2.8	3.3	3.8	4.3	4.7

TABLE A-8: CITY OF HAMILTON, RAINFALL INTENSITY EQUATION COEFFICIENTS, ROYAL BOTANICAL GARDENS

	A	b	c
2	595.5	6.0	0.778
5	688.2	5.0	0.753
10	748.0	4.5	0.740
25	867.0	4.5	0.737
50	947.3	4.5	0.733
100	1036.1	4.5	0.733

* Please note the following: The City of Hamilton has adopted the Mount Hope IDF relationship. The Royal Botanical Gardens IDF relationship has been provided in addition to the Mount Hope IDF relationship for the purpose of Watershed and Subwatershed Studies and Master Drainage Plans.

TABLE A-9: CITY OF HAMILTON, 3-HOUR CHICAGO DISTRIBUTION DESIGN STORM HYETOGRAPHS, MOUNT HOPE

Time Step min	Rainfall Intensity mm/hr					
	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
10	2.85	3.90	4.57	5.46	6.03	6.61
20	3.20	4.41	5.20	6.23	6.89	7.57
30	3.67	5.10	6.04	7.76	8.04	8.89
40	4.32	6.07	7.23	8.74	9.69	10.77
50	5.29	7.55	9.06	11.02	12.24	13.70
60	6.93	10.08	12.20	14.96	16.65	18.78
70	10.32	15.37	18.80	23.26	25.95	29.53
80	21.58	32.79	40.38	50.04	56.09	63.97
90	73.99	103.04	122.29	146.10	164.61	181.81
100	22.24	33.80	41.62	51.58	57.82	65.94
110	10.92	16.31	19.98	24.74	27.61	31.44
120	7.38	10.77	13.06	16.04	17.86	20.17
130	5.64	8.09	9.72	11.85	13.16	14.76
140	4.60	6.51	7.76	9.41	10.44	11.62
150	3.91	5.47	6.48	7.82	8.66	9.59
160	3.42	4.73	5.58	6.70	7.42	8.17
170	3.04	4.18	4.91	5.87	6.49	7.13
180	2.75	3.75	4.39	5.24	5.79	6.33

TABLE A-10: CITY OF HAMILTON, 6-HOUR CHICAGO DISTRIBUTION DESIGN STORM HYETOGRAPHS, MOUNT HOPE

Time Step (min)	Rainfall Intensity (mm/hr)					
	2	5	10	25	50	100
10	1.59	2.10	2.41	2.83	3.12	3.35
20	1.68	2.22	2.56	3.01	3.31	3.56
30	1.77	2.36	2.72	3.20	3.53	3.81
40	1.89	2.52	2.91	3.43	3.78	4.09
50	2.02	2.70	3.13	3.70	4.08	4.42
60	2.17	2.92	3.39	4.02	4.43	4.81
70	2.35	3.18	3.71	4.40	4.86	5.28
80	2.58	3.50	4.09	4.87	5.38	5.87
90	2.85	3.90	4.57	5.46	6.03	6.61
100	3.20	4.41	5.20	6.23	6.89	7.57
110	3.67	5.10	6.04	7.26	8.04	8.89
120	4.32	6.07	7.23	8.74	9.69	10.77
130	5.29	7.55	9.06	11.02	12.24	13.70
140	6.93	10.08	12.20	14.96	16.65	18.78
150	10.32	15.37	18.80	23.26	25.95	29.53
160	21.58	32.79	40.38	50.04	56.09	63.97
170	73.99	103.04	122.29	146.10	164.51	181.81
180	22.24	33.80	41.62	51.58	57.82	65.94
190	10.92	16.31	19.98	24.74	27.61	31.44
200	7.38	10.77	13.06	16.04	17.86	20.17
210	5.64	8.09	9.72	11.85	13.16	14.76

TABLE A-10: CITY OF HAMILTON, 6-HOUR CHICAGO DISTRIBUTION DESIGN STORM HYETOGRAPHS, MOUNT HOPE

Time Step (min)	Rainfall Intensity (mm/hr)					
	2	5	10	25	50	100
220	4.60	6.51	7.76	9.41	10.44	11.62
230	3.91	5.47	6.48	7.82	8.66	9.59
240	3.42	4.73	5.58	6.70	7.42	8.17
250	3.04	4.18	4.91	5.87	6.69	7.13
260	2.75	3.75	4.39	5.24	5.79	6.33
270	2.51	3.41	3.98	4.73	5.22	5.70
280	2.32	3.13	3.64	4.32	4.77	5.18
290	2.15	2.89	3.36	3.98	4.39	4.76
300	2.01	2.69	3.12	3.69	4.07	4.40
310	1.89	2.52	2.92	3.44	3.79	4.10
320	1.79	2.37	2.74	3.23	3.56	3.84
330	1.69	2.24	2.59	3.04	3.35	3.61
340	1.61	2.13	2.45	2.88	3.17	3.41
350	1.54	2.03	2.33	2.73	3.01	3.23
360	1.47	1.93	2.22	2.60	2.86	3.07

TABLE A-11: CITY OF HAMILTON, 3-HOUR CHICAGO DISTRIBUTION DESIGN STORM HYETOGRAPHS, ROYAL BOTANICAL GARDENS

Time Step min	Rainfall Intensity mm/hr					
	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
10	2.70	3.85	4.66	5.55	6.27	6.86
20	3.04	4.30	5.19	6.17	6.97	7.52
30	3.47	4.88	5.87	6.97	7.87	8.61
40	4.09	5.69	6.81	8.08	9.12	9.97
50	5.00	6.88	8.19	9.71	10.94	11.96
60	6.54	8.86	10.46	12.38	13.92	15.23
70	9.71	12.84	14.97	17.69	19.84	21.70
80	20.22	25.81	29.53	34.75	38.75	42.38
90	68.88	89.56	103.39	120.81	133.42	145.92
100	20.84	26.57	30.38	35.74	39.84	43.58
110	10.28	13.54	15.76	18.62	20.87	22.82
120	6.96	9.39	11.06	13.09	14.71	16.09
130	5.33	7.31	8.68	10.29	11.58	12.67
140	4.36	6.04	7.22	8.57	9.66	10.56
150	3.70	5.19	6.23	7.40	8.35	9.13
160	3.24	4.57	5.50	6.54	7.39	8.08
170	2.88	4.10	4.95	5.88	6.65	7.27
180	2.61	3.72	4.51	5.37	6.07	6.64

TABLE A-12: CITY OF HAMILTON, 6-HOUR CHICAGO DISTRIBUTION DESIGN STORM HYETOGRAPHS, MOUNT HOPE

Time Step min	Rainfall Intensity mm/hr					
	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
10	1.51	2.22	2.72	3.24	3.68	4.02
20	1.59	2.33	2.86	3.41	3.86	4.23
30	1.69	2.46	3.01	3.59	4.07	4.45
40	1.79	2.61	3.19	3.80	4.31	4.71
50	1.92	2.78	3.39	4.04	4.58	5.01
60	2.06	2.98	3.63	4.33	4.90	5.36
70	2.24	3.22	3.91	4.66	5.27	5.77
80	2.44	3.50	4.25	5.06	5.72	6.26
90	2.70	3.85	4.66	5.55	6.27	6.86
100	3.04	4.30	5.19	6.17	6.97	7.62
110	3.47	4.88	5.87	6.97	7.87	8.61
120	4.09	5.69	6.81	8.08	9.12	9.97
130	5.00	6.88	8.19	9.71	10.94	11.96
140	6.54	8.86	10.46	12.38	13.92	15.23
150	9.71	12.84	14.97	17.69	19.84	21.70
160	20.22	25.81	29.53	34.75	38.75	42.38
170	68.88	89.56	103.39	120.81	133.42	145.92
180	20.84	26.57	30.38	35.74	39.84	43.58
190	10.28	13.54	15.76	18.62	20.87	22.82
200	6.96	9.39	11.06	13.09	14.71	16.09

TABLE A-12: CITY OF HAMILTON, 6-HOUR CHICAGO DISTRIBUTION DESIGN STORM HYETOGRAPHS, MOUNT HOPE

Time Step min	Rainfall Intensity mm/hr					
	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
210	5.33	7.31	8.68	10.29	11.58	12.67
220	4.36	6.04	7.22	8.57	9.66	10.56
230	3.70	5.19	6.23	7.40	8.35	9.13
240	3.24	4.57	5.50	6.54	7.39	8.08
250	2.88	4.10	4.95	5.88	6.65	7.27
260	2.61	3.72	4.51	5.37	6.07	6.64
270	2.38	3.42	4.15	4.94	5.59	6.12
280	2.20	3.17	3.85	4.59	5.19	5.68
290	2.04	2.96	3.60	4.29	4.86	5.31
300	1.91	2.77	3.39	4.03	4.57	5.00
310	1.80	2.62	3.20	3.81	4.32	4.72
320	1.70	2.48	3.03	3.61	4.10	4.48
330	1.61	2.36	2.89	3.44	3.90	4.27
340	1.53	2.25	2.75	3.28	3.73	4.07
350	1.46	2.15	2.64	3.14	3.57	3.90
360	1.40	2.06	2.53	3.02	3.42	3.75

A4 Town of Milton

Source: Town of Milton, *Engineering and Parks Standards,* 2019.

TABLE A-13: TOWN OF MILTON, INTENSITY-DURATION-FREQUENCY VALUES

AES Toronto Pearson International Airport, 39 years of Record, 1950 – 1990

Duration min	2 Year mm/hr	5 Year mm/hr	10 Year mm/hr	25 Year mm/hr	50 Year mm/hr	100 Year mm/hr
5	107.4	141.5	164.2	192.7	213.9	235.0
10	79.0	103.5	119.8	140.3	155.5	170.6
15	65.3	86.5	100.7	118.5	131.7	144.8
30	43.0	57.0	66.3	78.0	86.7	95.4
60	24.3	32.2	37.5	44.1	49.0	53.9
120	14.2	19.2	22.5	26.7	29.8	32.8
360	6.2	8.5	10.1	12.1	13.5	15.0
720	3.5	4.9	5.9	7.1	7.9	8.8
1440	2.0	2.8	3.3	4.0	4.6	5.1

TABLE A-14: TOWN OF MILTON, RAINFALL INTENSITY EQUATION COEFFICIENTS

	A	b	c	Correlation Coefficient
2	779	6	0.8206	0.99985036
5	959	5.7	0.8024	0.99982256
10	1089	5.7	0.7955	0.99978510
25	1234	5.5	0.7863	0.99976364
50	1323	5.3	0.7786	0.99976825
100	1435	5.2	0.7751	0.99974784

$$i = \frac{A}{(t_d + b)^c}$$

Where: i = Rainfall intensity (mm/hr)
t_d = Duration (hr)
A, b and c = constants

A5 City of Mississauga

Source: City of Mississauga Transportation and Works Department, *Development Requirements Manual*, 2020.

TABLE A-15: CITY OF MISSISSAUGA, RAINFALL INTENSITY EQUATION COEFFICIENTS

	A	b	c
2	610	4.6	0.78
5	820	4.6	0.78
10	1010	4.6	0.78
25	1160	4.6	0.78
50	1300	4.7	0.78
100	1450	4.9	0.78

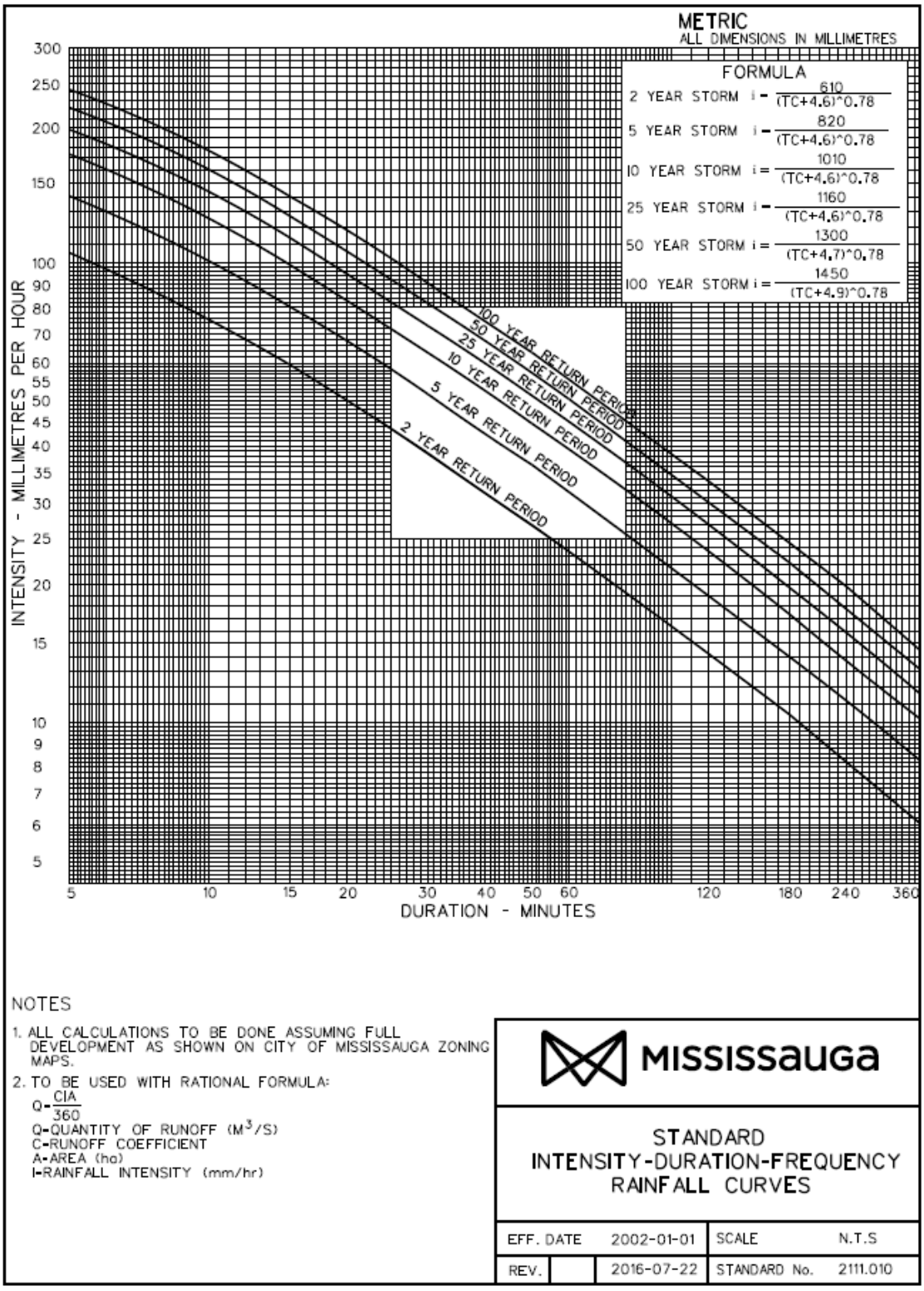
$$i = \frac{A}{(t_d + b)^c}$$

Where: i = Rainfall intensity (mm/hr)
t_d = Duration (hr)
A, b and c = constants

TABLE A-16: CITY OF MISSISSAUGA, INTENSITY-DURATION-FREQUENCY VALUES

Duration min	2 Year mm/hr	5 Year mm/hr	10 Year mm/hr	25 Year mm/hr	50 Year mm/hr	100 Year mm/hr
5	104.51	140.49	173.04	198.74	220.93	242.53
10	75.36	101.30	124.77	143.31	159.75	176.31
15	58.89	80.51	99.17	113.89	127.13	140.69
30	38.45	51.68	63.66	73.11	81.75	90.77
60	23.62	31.76	39.11	44.92	50.28	55.95

FIGURE A-3: CITY OF MISSISSAUGA, STANDARD INTENSITY-DURATION-FREQUENCY RAINFALL CURVES



A6 Town of Oakville

Source: Town of Oakville Development Engineering Department, *Development Engineering Procedures and Guidelines.*

TABLE A-17: TOWN OF OAKVILLE, INTENSITY DURATION FREQUENCY VALUES

AES Toronto Pearson International Airport, 39 years of Record, 1950 - 1990

Duration min	2 Year mm/hr	5 Year mm/hr	10 Year mm/hr	25 Year mm/hr	50 Year mm/hr	100 Year mm/hr
5	117.0	164.0	194.0	233.0	262.0	291.0
10	80.0	108.0	126.0	149.0	166.0	183.0
15	65.0	90.0	107.0	129.0	145.0	160.0
30	41.0	58.0	69.0	83.0	93.0	103.0
60	25.0	35.0	41.0	48.0	54.0	60.0
120	15.0	20.0	23.0	27.0	30.0	33.0
360	6.1	8.1	9.4	11.0	12.0	13.0
720	3.6	4.6	5.3	6.2	6.8	7.5
1440	2.0	2.5	2.9	3.4	3.7	4.1

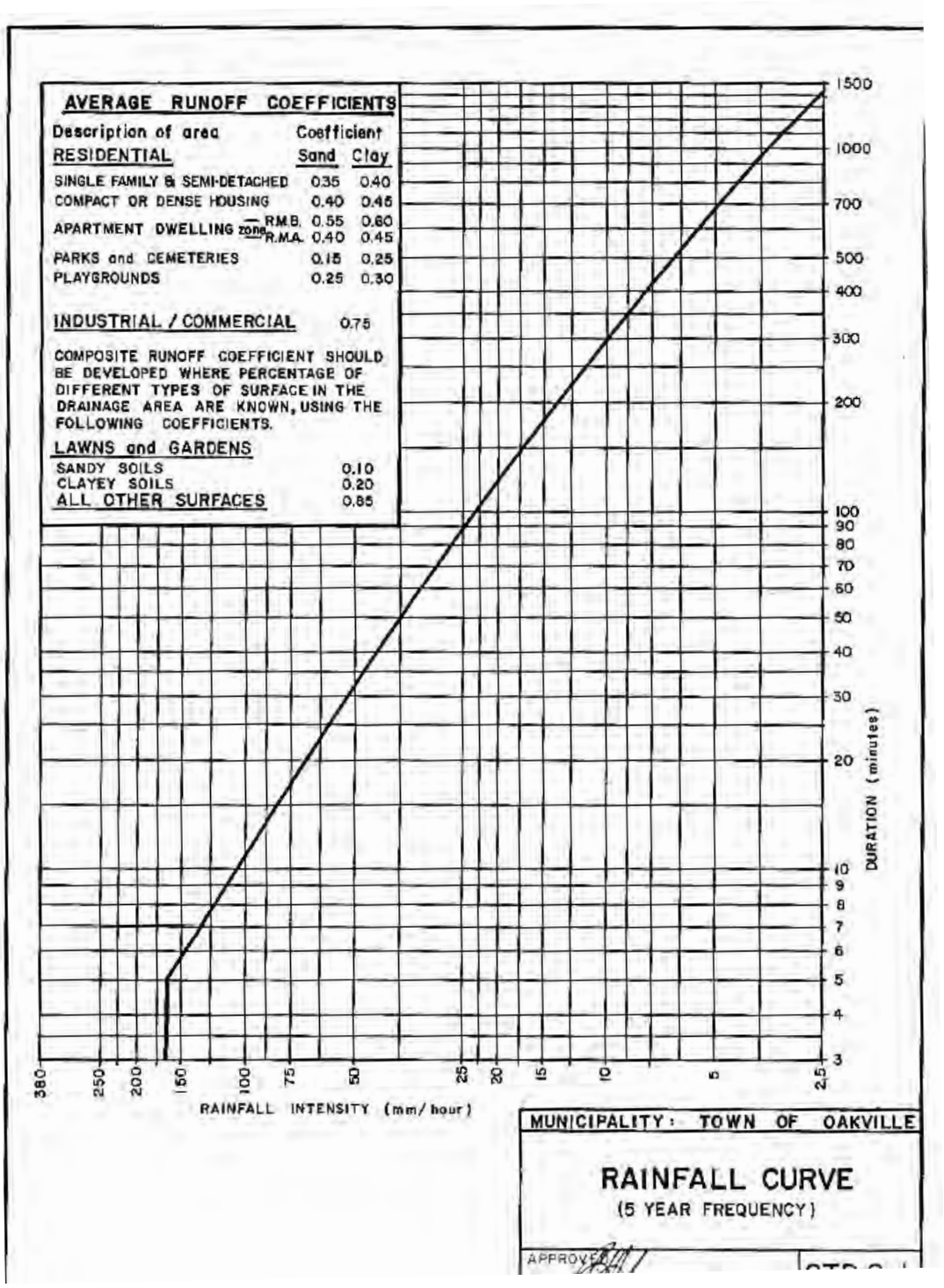
TABLE A-18: TOWN OF OAKVILLE, RAINFALL INTENSITY EQUATION COEFFICIENTS

	A	b	c
2	725	4.8	0.808
5	1170	5.8	0.843
10	1400	5.8	0.848
25	1680	5.6	0.851
50	1960	5.8	0.861
100	2150	5.7	0.861

$$i = \frac{A}{(t_d + b)^c}$$

Where: i = Rainfall intensity (mm/hr)
t_d = Duration (hr)
A, b and c = constants

FIGURE A-4: TOWN OF OAKVILLE, RAINFALL CURVE (5-YEAR FREQUENCY)



A7 Hurricane Hazel Distribution and Areal Reduction

Source: O. Reg. 162/06

TABLE A-19: HURRICANE HAZEL DISTRIBUTION

	Depth mm	Percent of 12 hour
First 36 hours	73	
37th hour	6	3
38th hour	4	2
39th hour	6	3
40th hour	13	6
41st hour	17	8
42nd hour	13	6
43rd hour	23	11
44th hour	13	6
45th hour	13	6
46th hour	53	25
47th hour	38	18
48th hour	13	6
Total	285	100

TABLE A-20: AREAL REDUCTION

Drainage Area km^2	Percentage	Drainage Area km^2	Percentage
0 to 25	100.00	2501 to 2700	69.0
26 to 45	99.2	2701 to 4500	64.4
46 to 65	98.2	4501 to 6000	61.4
66 to 90	97.1	6001 to 7000	58.9
91 to 115	96.3	7001 to 8000	57.4
116 to 140	95.4		
141 to 165	94.8		
166 to 195	94.2		
196 to 220	93.5		
221 to 245	92.7		
246 to 270	92.0		
271 to 450	89.4		
451 to 575	86.7		
576 to 700	84.0		
701 to 850	82.4		
851 to 1000	80.8		
1001 to 1200	79.3		
1201 to 1500	76.6		
1501 to 1700	74.4		
1701 to 2000	73.3		
2001 to 2200	71.7		
2201 to 2500	70.2		

Appendix B Typical Hydrologic/Hydraulic Parameters and Equations

B1 Total Impervious Area and Directly Connected Impervious Area

Total Impervious Area (TIMP) – The percentage of the total impervious area. Directly Connected Impervious Area (XIMP) – The percentage of the directly connected impervious area.

TABLE B-1: TIMP & XIMP VALUES

Land Use	XIMP	TIMP
Parks		
Village Square/Parkette	28	35
Neighbourhood Park	16	20
Open Space		
NHS	0	5
Utility Corridor	0	2
SWM Ponds[1]	50	50
Institutional		
School	60[2] / 30[3]	75
Church	60[2] / 30[3]	75
Employment / Commercial	85	85
Industrial	90	90
Mixed Use	80	80
Impervious Surfaces (i.e., roads, parking)	99	99
Residential[4]		
Rural Estate (> 0.3 ha lot)	16	20
Detached	50	70
Townhouses / Medium	55	75
Condominiums / High	65	85

* Public roads are included as part of other land uses within development blocks.

1 While the permanent pools of SWM ponds are impervious, this value includes the entire pond block. However, if impermeable liners are included that extend beyond the permanent pool, this number may need revision.

2 Roof leaders connected to impervious areas (e.g., driveway) and to storm sewer for XIMP calculations.

3 Roof leaders are connected to pervious area (e.g., lawn) for XIMP calculations.

4 Numbers within older developments may need refinement.

Source: Developed in house

B2 Initial Abstraction Values

TABLE B-2: INITIAL ABSTRACTION VALUES

Land Use	Ia (mm)
Impervious	2
Open Space / Green Space / Lawns	5
Crop / Cultivated	7
Pasture / Meadow	8
Woods/Woodlot/Forest	10
Wetlands	15

* Please note that if grade lot control is implemented, initial abstractions can be adjusted accordingly
Source: Technical Guidelines for Flood Hazard Mapping, (EWRG for CA Steering Committee, 2017)

B3 Horton's Infiltration Equation Parameters

TABLE B-3: HORTON'S PARAMETERS

Soil Group	f_o (mm/hr)	f_c (mm/hr)	K (1/hr)
A	250	25	2
B	200	13	2
C	125	5	2
D	75	3	2

Source: SWMHYMO User's Manual (J.F. Sabourin and Associates Inc., December 1998) – Note these parameters may not be appropriate for use in floodplain mapping studies. Further direction will be provided in CH's Guidelines for Floodplain Alterations and Mapping Submissions.

B4 Soil/Land Use Curve Numbers

TABLE B-4: SCS CURVE NUMBERS

Land Use	Soil Group			
	A	B	C	D
Agriculture / Nursery[1]	67	78	85	89
Buildings[2]	98			
Bedrock[3]	98			
Cemetery / Golf Course	49	69	79	84
Commercial & Business District (85% imp.)[4]	89	92	94	95
Dirt Areas (e.g., Confinement Yard)	72	82	87	89
Extraction	98			
Field / Meadow / Pasture	49	69	79	84
Forest / Plantation[1]	36	60	73	79
Grass / Highway Median	49	69	79	84

TABLE B-4: SCS CURVE NUMBERS

Land Use	Soil Group			
	A	B	C	D
Hedge Row / Orchard	45	66	77	83
Industrial (72% imp.)[4]	81	88	91	93
Institutional (50% imp.)[4]	71	80	88	90
Open Water	98			
Residential[4]				
High Density	89	92	94	95
Medium / Low Density[5] (65% imp.)	77	85	90	92
Trailer Park	71	80	88	90
Rural	51	69	79	84
SWM Pond	50			
Transportation (Roads, Railway, Parking)	98			
Wetland / Marsh	50			

1 Values should be refined further based on hydrologic condition as per the MTO Design Chart, if warranted by the nature of the study/available information.
2 Building footprints
3 100% bedrock
4 Represents a composite value. For solely pervious areas, use “Grass” values.
5 Values can be refined for older neighbourhoods.

Source: Developed in house

B5 SCS Curve Number Relationships for Different Antecedent Moisture Conditions

AMC I – A condition of soils where the soils are dry but not to the wilting point. This is the lowest runoff potential.

AMC II – The average case.

AMC III – Heavy or light rainfall and low temperatures having occurred during the previous five days. This is the highest runoff potential.

TABLE B-5: SCS CURVE NUMBER RELATIONSHIPS

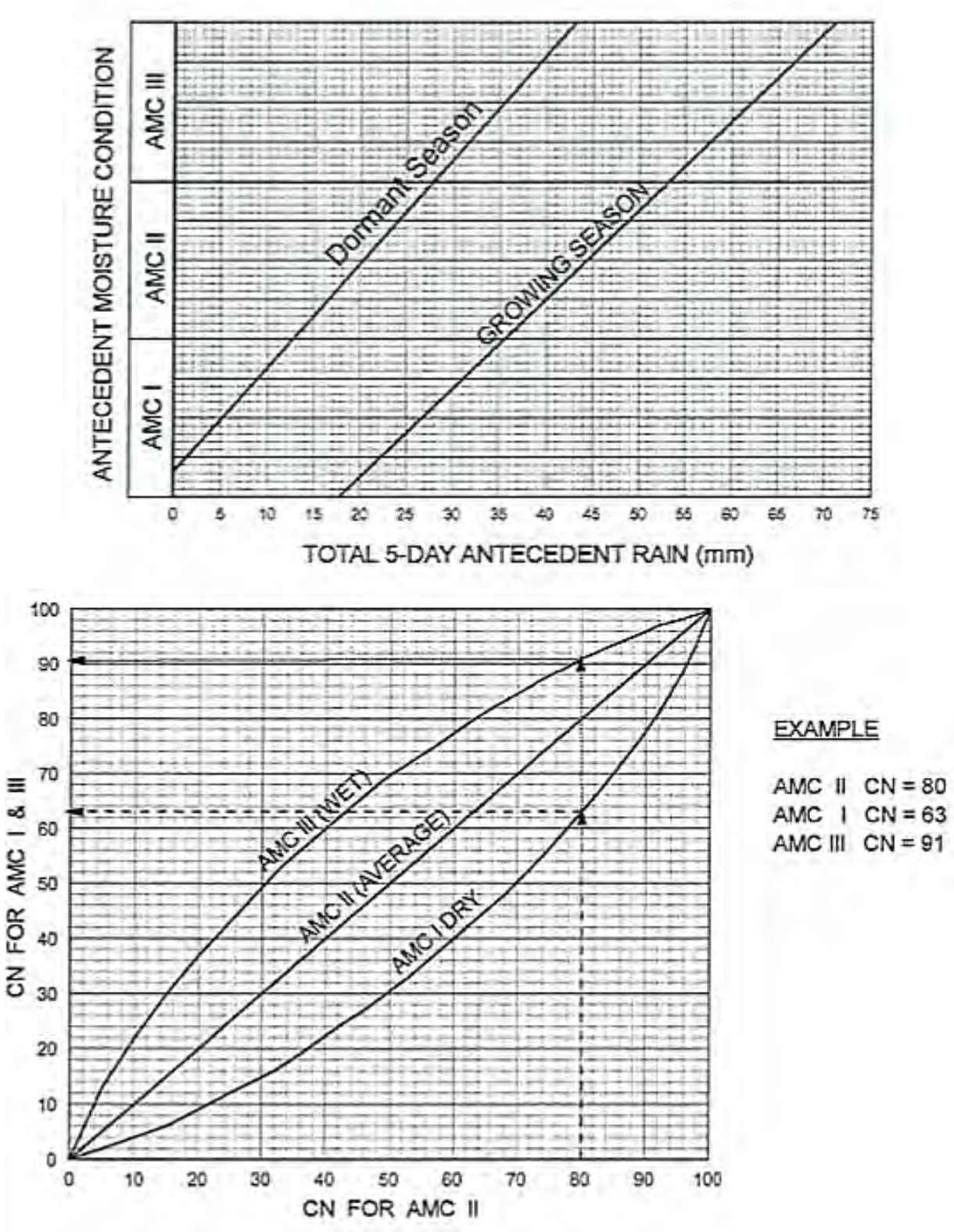
CN @ AMC II	AMC I	AMC III	CN @ AMC II	AMC I	AMC III
100	100	100	60	40	78
99	97	100	59	39	77
98	94	99	58	38	76
97	91	99	57	37	75
96	89	99	56	36	75
95	87	98	55	35	74
94	85	98	54	34	73
93	83	98	53	33	72
92	81	97	52	32	71
91	80	97	51	31	70
90	78	96	50	31	70
89	76	96	49	30	69
88	75	95	48	29	68
87	73	95	47	28	67
86	72	94	46	27	66
85	70	94	45	26	65
84	68	93	44	25	64
83	67	93	43	25	63
82	66	92	42	24	62
81	64	92	41	23	61

TABLE B-5: SCS CURVE NUMBER RELATIONSHIPS

CN @ AMC II	AMC I	AMC III	CN @ AMC II	AMC I	AMC III
80	63	91	40	22	60
79	62	91	39	21	59
78	60	90	38	21	58
77	59	89	37	20	57
76	58	89	36	19	56
75	57	88	35	18	55
74	55	88	34	18	54
73	54	87	33	17	53
72	53	86	32	16	52
71	52	86	31	16	51
70	51	85	30	15	50
69	50	84	25	12	43
68	48	84	20	9	37
67	47	83	15	6	30
66	46	92	10	4	22
65	45	82	5	2	13
64	44	81	0	0	0
63	43	80			
62	42	79			
61	41	78			

Source: Modern Sewer Design, Corrugated Steel Pipe Institute (1996)

FIGURE B-1: ANTECEDENT MOISTURE CONDITIONS



Source: Drainage Design Standards (MTO, 1995-1997)

B6 Green-Ampt Method Parameters

TABLE B-6: GREEN-AMPT PARAMETERS

Soil Group	IMD (mm/mm)	S_u (mm)	K_s (mm/hr)
A	0.34	100	25
B	0.32	300	13
C	0.26	250	5
D	0.21	180	3

Source: Drainage Design Standards (MTO, 1995-1997)

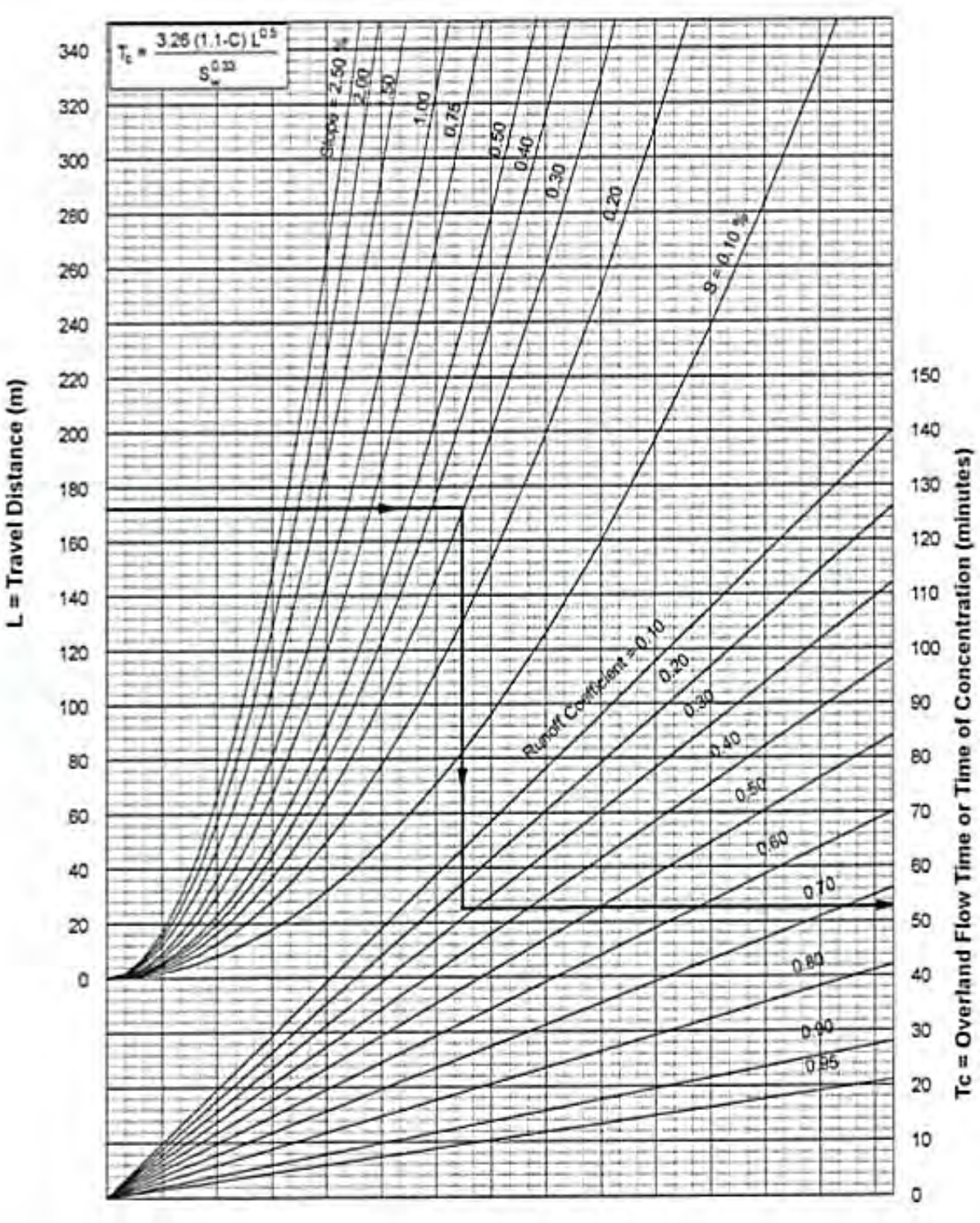
B7 Airport Equation

Generally applicable for subcatchments with runoff coefficients less than 0.4

$$Tc = 3.26(1.1 - C)L^{0.5}Sw^{-0.33}$$

Where:
Tc = Time of Concentration (min)
C = Runoff Coefficient
L = Catchment Length (m)
Sw = Catchment Slope (%)

FIGURE B-2: TIME OF CONCENTRATION – AIRPORT METHOD



Source: Drainage Design Standards (MTO, 1995-1997)

B8 Bransby-Williams Equation

Generally applicable for subcatchments with runoff coefficients greater than 0.4.

$$Tc = 0.057LSw^{-0.2}A^{-0.1}$$

Where: Tc = Time of Concentration (min)
L = Catchment Length (m)
Sw = Catchment Slope (%)
A = Catchment Area (ha)

Source: Drainage Design Standards (MTO, 1995-1997)

B9 Overland Flow Length & Catchment Widths

$$\mathrm{LGI} = \sqrt{(\mathrm{A} / 1.5)}$$

Where: LGI = overland flow length (m)
A = catchment area (m^2)

$$\mathrm{SW} = (2 - \mathrm{Sk})\mathrm{L}$$

Where: SW = catchment width (m)
Sk = skew factor = (A2 – A1) / At
A2 = largest area to one side of channel (ha)
A1 = area to the other side of the channel (ha)
At = total catchment area (ha)
L = length of main drainage channel (m)

Example – For a perfectly symmetrical watershed, Sk = 0 as A2 = A1

Source: Visual OTTHYMO v.2.4 Reference Manual (December 2011).

B10 Manning's Roughness – Overland Flow (i.e., non-channelized flow)

TABLE B-7: MANNING'S ROUGHNESS

Land Use	n
Impervious areas	0.013
Crop / Cultivated	0.300
Meadow	0.350
Woodlot	0.600
Lawns	0.250

Source: Technical Guidelines for Flood Hazard Mapping (EWRG for CA Steering Committee, 2017)

B11 Weir and Orifice Equations and Coefficients

Orifice

$$Q = CA\sqrt{2g\Delta h}$$

Where:
- Q = discharge / flow rate (m^3/s)
- C = discharge coefficient
- A = orifice area (m^2)
- g = acceleration due to gravity (9.81 m/s^2)
- Δh = differential head measured from the centroid of the orifice (m)

Sharp Crested Weir with End Contractions (used for example on DICB inlets operating under weir flow)

$$Q = C(L - 0.2\Delta h)\Delta h^{1.5}$$

Where:
- Q = discharge / flow rate (m^3/s)
- C = discharge coefficient
- L = crest length of the weir (m)
- Δh = differential head measured from the centroid of the weir crest (m)

Rectangular Broad Crested Weir and Sharp Crested Weir without End Contractions

$$Q = CL\Delta h^{1.5}$$

Where:
- Q = discharge / flow rate (m^3/s)
- C = discharge coefficient
- L = weir length (m)
- Δh = differential head measured from the centroid of the weir (m)

Trapezoidal Broad Crested Weir (Emergency Spillways)

$$Q = C(L - 0.1n\Delta h)\Delta h^{1.5}$$

Where: Q = discharge / flow rate (m^3/s)
C = discharge coefficient
L = length of weir (bottom length + side slope * Δh)
n = number of side contractions
Δh = differential head measured from the centroid of the weir (m)

Partial Pipe Flow

To sufficiently model the hydraulics of a SWM pond outlet control structure, partial pipe flow should be considered. Partial pipe flow below the orifice centroid should be included in the calculations.

TABLE B-8: HYDRAULIC EQUATION COEFFICIENTS (METRIC UNITS)

Application	Coefficient
Orifice	0.63
Orifice Tube	0.80
Sharp Crested Weir	1.7
Rectangular Broad Crested Weir (SWMP and Dam Spillway)	1.5 (or using equation)
Rectangular Broad Crested Weir (Road Crossing)	1.5

Source: CH standard values

Rectangular Broad Crested Weir Coefficient Equation (applicable until H/L = 0.6)

$$C = \frac{(-1.04E^{04} + 3.42E^{06}x)}{(1 + 2.13E^{06}x - 2.35E^{05}x^{2)}}$$

Where: C = Discharge Coefficient
X = Head Divided by the Downstream Length of the Weir (H/L)

Triangular Broad Crested Weir Coefficient (applicable until H/L = 0.6)

$$C = \frac{(-1.01E^{-05} + 1.44E^{02}x)}{(1 + 1.15E^{02} - 4.77x^{2})}$$

Where: C = Discharge Coefficient
X = Head Divided by the Downstream Length of the Weir (H/L)

B12 Rational Method

$$Q = \frac{CiA}{360}$$

Where: Q = discharge / flow rate (m^3/s)
C = runoff coefficient
i = rainfall intensity (mm/hr)
A = contributing drainage area (ha)

TABLE B-9: RUNOFF COEFFICIENTS

Land Use		RC (Urban)	Soil Group, where applicable (Rural)		
			A-AB	B-BC	C-CD-D
Agriculture / Nursery[1]	Rolling (5-10%)		0.30	0.45	0.60
	Flat (0-5%)		0.22	0.35	0.55
Buildings[2]		0.95			
Bedrock[3]		0.95			
Cemetery / Golf Course			0.10	0.15	0.20
Commercial & Business District (85% imp.)		0.90			
Dirt Areas (e.g., Confinement Yard)		0.50			
Extraction		0.95			
Field / Meadow / Pasture	Rolling (5-10%)		0.15	0.35	0.45
	Flat (0-5%)		0.10	0.28	0.40
Forest / Plantation	Rolling (5-10%)		0.12	0.30	0.42
	Flat (0-5%)		0.08	0.25	0.35
Grass / Highway Median			0.10	0.15	0.20
Hedge Row / Orchard	Rolling (5-10%)		0.12	0.30	0.42
	Flat (0-5%)		0.08	0.25	0.35

TABLE B-9: RUNOFF COEFFICIENTS

Land Use		RC (Urban)	Soil Group, where applicable (Rural)		
			A-AB	B-BC	C-CD-D
Industrial		0.90			
Institutional		0.90			
Low Impact Development	Refer to manufacturer specifications and consultation with Conservation Halton and municipal staff				
Residential					
High Density		0.80			
Medium / Low Density[4]		0.70			
Estate		0.40			
Trailer Park		0.55			
Rural Residential		0.40			
Transportation (Roads, Railway, Parking)		0.95			
SWM Pond		0.05			
Open Water		0.05			
Wetland / Marsh		0.05			

1 Corn system
2 Building footprints
3 100% bedrock
4 Conservation Halton would consider alternate values, particularly in older residential neighbourhoods

Source: Developed in house

To account for a decrease in available perviousness during major storms, the recommended factors as identified within the Ministry of Transportation Drainage Design Standards (1995-1997) shall be used. For storms having a return period of more than 10 years, runoff coefficients shall be increased as follows. Note that RC cannot exceed 1.0.

- 25-year event – add 10%
- 50-year event – add 20%
- 100-year event – add 25%

Conversion Equation (Runoff Coefficient to Percent Impervious)

$$i = \frac{(C - 0.2)}{0.7} \; X \; 100$$

Where: i = Percent Impervious
C = Runoff Coefficient

Conservation Halton Guidelines for Slope Stability Assessments for Valleys

February 2024

Version 2.0

Conservation Halton

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CONSERVATION HALTON GUIDELINES

Conservation Halton (CH) protects, manages, and enhances the area within its jurisdiction through the delivery of a range of programs and services, including mandatory programs and services related to managing the risks associated with natural hazards. In the planning and development process, CH exercises its roles and responsibilities in accordance with Section 21.1 of the *Conservation Authorities Act* and Ontario Regulation 686/21, including as:

- A regulatory agency under Section 28 of the *Conservation Authorities Act*;
- A body with delegated responsibility to represent the Provincial interest and ensure that development applications are consistent with the natural hazards policies of the Provincial Policy Statement (PPS), but not including those policies related to hazardous forest types for wildland fire;
- A public commenting body under the *Planning Act, Clean Water Act* and other Acts and Provincial Plans;
- A resource management agency operating on a local watershed basis; and
- A landowner in the watershed.

CH's Planning and Regulations staff (i.e., environmental planners, regulations officers, planning ecologists, water resource engineers, technologists, and hydrogeologists) work together on interdisciplinary teams to deliver timely and comprehensive reviews and advice to provincial agencies, municipalities and landowners across CH's jurisdiction.

Section 28 (1) of the *Conservation Authorities Act* allows conservation authorities to make regulations to protect life and property from natural hazards. CH's regulation is Ontario Regulation 162/06. Under Ontario Regulation 162/06, CH regulates:

- All development in or adjacent to river or stream valleys, wetlands and surrounding lands where development could interfere with the hydrologic function of the wetland, Lake Ontario shorelines, and hazardous lands such as karst and any prescribed allowances;
- Alterations to a river, creek, stream or watercourse; and
- Interference with wetlands.

Permission is required from CH for undertaking the above noted works within regulated areas. CH's Board-approved Policies and Guidelines for the Administration of Ontario Regulation 162/06 and Land Use Planning Policy Document outlines the policies and technical requirements which must be met before permission may be granted. As part of a CH permit application, an applicant must demonstrate that CH's Board-approved policies and technical standards can be met.

CH also provides technical advice and support to its municipal partners on planning and development applications where it relates to CH's mandatory programs and services, as well as a public commenting body and a resources management agency.

These Guidelines provide clear expectations regarding the criteria and approaches that are acceptable to CH and are used by staff to assess the technical merits of slope stability assessments. Applicants proposing development within, or near, *confined* or *semi-confined valleys*, must follow these Guidelines. By doing so, more efficient and consistent reviews, fewer resubmissions, and faster approvals are anticipated.

These Guidelines are specific to CH and do not replace or supersede any other federal, provincial, or municipal requirement.

OBJECTIVE	The purpose of the **Guidelines for Slope Stability Assessments for Valleys** is to: • **Identify CH's** requirements for a Slope Stability Assessment submission; and • **Outline CH's** key expectations for Slope Stability Assessments.
APPLICATION & USE	Applies to all slope stability engineering submissions associated with *Planning Act* and *Ontario Regulation 162/06* permit applications. These Guidelines have been developed for: • **Qualified professionals** such as geotechnical engineers and other qualified persons tasked to guide the preparation of slope stability assessments • **CH staff** to facilitate quicker and more consistent reviews and assess the technical merits of slope stability assessments • **Landowners** when considering new or altered development
ADDITIONAL REFERENCE MATERIALS (to be read in conjunction with this document)	• Ontario Regulation 686/21: Mandatory Programs and Services, 2021 • Ontario Regulation 162/06 Halton Region Conservation Authority: Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses, 2006 • Policies and Guidelines for the Administration of Ontario Regulation 162/06 and Land Use Planning Policy Document (November 26, 2020). • Provincial Policy Statement, Section 3.1 (2020) • Technical Guide - River and Stream Systems: Erosion Hazard Limit, Ministry of Natural Resources, 2002 • Geotechnical Principles for Stable Slopes, Terraprobe Limited and Aqua Solutions, June 1998
VERSION	**Version 2.0** This version of the Guidelines for Slope Stability Assessments for Valleys was presented and endorsed by the Board of Directors on XXXX, 2024. The Guidelines may be updated from time to time. For more information, visit https://www.conservationhalton.ca/policies-and-guidelines.

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Abbreviations

The following table lists the various abbreviations used within this document:

TABLE 0-1: LIST OF ABBREVIATIONS

CH	Conservation Halton
FOS	Factor of Safety
OLS	Ontario Land Surveyor
O. Reg 162/06	Ontario Regulation 162/06
O.Reg 686/21	Ontario Regulation 686/21
STOB	Stable Top of Bank
TOB	Top of Bank

Section 1 Introduction

Streams and valleys are dynamic systems that are subject to erosive forces, including *instream erosion* and *surface erosion*, as well as *unstable slopes*. These areas are regulated under Ontario Regulation 162/06 (O.Reg 162/06). When development is proposed within or near a *confined* or *semi-confined valley system* an assessment of *erosion hazards* may be required. The assessment is used to ensure that new development is located away from areas susceptible to *erosion hazards* where there is an unacceptable risk to public heath or safety or property damage or to ensure that development associated with existing uses does not create new or aggravate existing hazards.

The purpose of this guideline is to:

- Identify Conservation Halton's (CH) requirements for Slope Stability Assessments; and
- Outline CH's key expectations for Slope Stability Assessments.

This document focuses primarily on CH's expectations related to slope stability assessments. Other disciplines may also be relevant such as water resource engineering, fluvial geomorphology, hydrogeology and ecological restoration. Consultation with Conservation Halton is advised to ensure the appropriate guidelines are used.

1.1 Document Outline

This document is divided into three sections.

- **Section 1 – Introduction** – Provides an overview of Conservation Halton's role in the review of slope stability assessments and general requirements for assessments.

- **Section 2 – Stable Top of Bank Assessments** – Outlines requirements for establishing the location of the *stable top of bank*.

- **Section 3 – Existing Development on the Valley Slope** – Outlines requirements for assessing potential slope stability impacts resulting from alterations to existing development within valleys.

These guidelines are not intended to be a comprehensive document on slope stability assessments but rather to act as a complement to provincial documents, *accepted geotechnical principles*, and technical literature.

These Guidelines are specific to CH and do not replace or supersede any other federal, provincial or municipal requirement. Pre-consultation with CH and municipal agency staff is encouraged in conjunction with the use of this document.

1.2 Conservation Halton's Role in Reviewing Slope Stability Assessments

CH protects, manages, and enhances the area within its jurisdiction (see Figure 1-1) through a wide variety of programs and services, including the administration of regulations and the provision of planning services.

Section 28 (1) of the Conservation Authorities Act allows conservation authorities to make regulations to protect life and property from natural hazards. CH's regulation is Ontario Regulation 162/06. Under Ontario Regulation 162/06 (O. Reg. 162/06), CH regulates:

- All development in or adjacent to river or stream valleys, wetlands and surrounding lands where development could interfere with the hydrologic function of the wetland, Lake Ontario shorelines, or hazardous lands such as karst and any associated allowances;
- Alterations to a river, creek, stream or watercourse; and
- Interference with wetlands.

Permission is required from CH for undertaking any development within regulated areas. "Development" means,

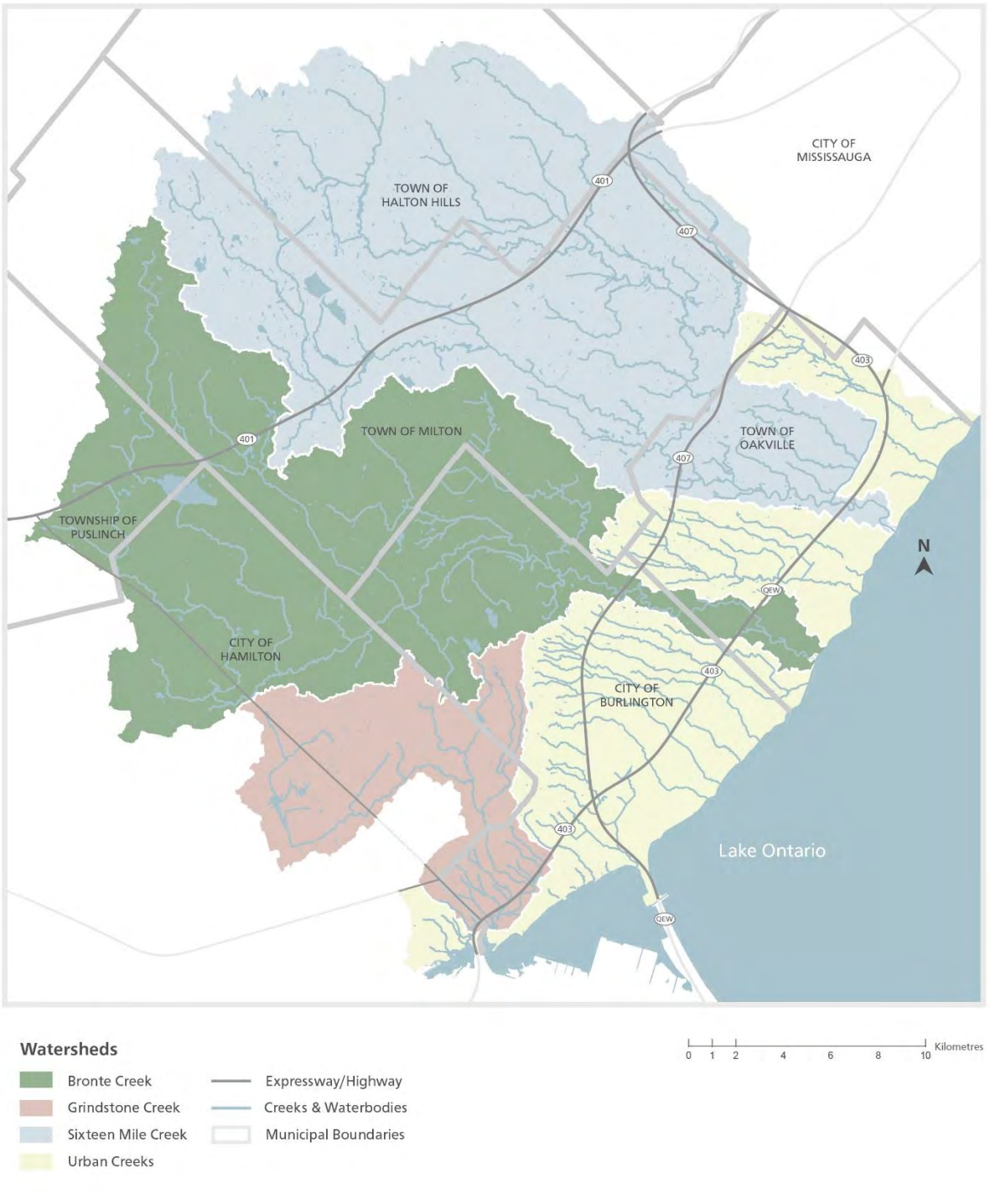
a) the construction, reconstruction, erection or placing of a building or structure of any kind,
b) any change to a building or structure that would have the effect of altering the use or potential use of the building or structure, increasing the size of the building or structure or increasing the number of dwelling units in the building or structure,
c) site grading, or
d) the temporary or permanent placing, dumping or removal of any material, originating on the site or elsewhere.

Grindstone Creek

CH's Board-approved *Policies and Guidelines for the Administration of Ontario Regulation 162/06 and Land Use Planning Policy Document* (2020) outlines the policies and technical requirements which must be met before permission may be granted. As part of a CH permit application, an applicant must demonstrate that CH's Board-approved policies and technical standards can be met to the satisfaction of CH.

CH also provides technical advice and support to its municipal partners on planning and development applications where it relates to CH's mandatory programs and services, including those related to managing and understanding risks associated with natural hazards. O.Reg. 686/21 sets out that CAs are to act on behalf of the Province to ensure that decisions under the *Planning Act* are consistent with the natural hazard policies of the PPS (except hazardous forest types for wildfires). CAs are to review applications or other matters under the *Planning Act* and provide comments, technical support, or information to the responsible planning authority. CH's review of slope stability assessments provides for a streamlined and integrated assessment of the merits of the proposal that is linked to all of CH roles and responsibilities.

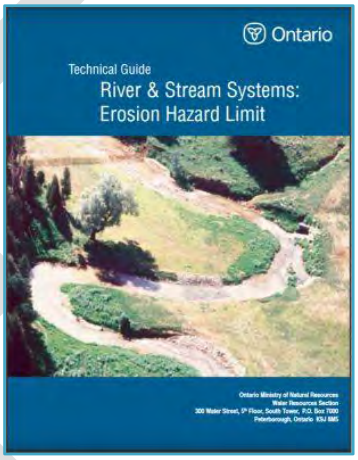
FIGURE 1-1 CONSERVATION HALTON WATERSHEDS



1.3 Qualified Professional(s) and Standard Industry Practices

As outlined in Section 2.1, CH staff will determine through a site visit or based on previous knowledge / information for a site if a slope stability assessment is required. The slope stability assessment must be completed by a qualified geotechnical engineer (P.Eng.) and may require input from a hydrogeologist, fluvial geomorphologist (P. Geo.), Ontario Land Surveyor (OLS), water resources engineer (P.Eng.), structural engineer (P.Eng), arborist, and/or ecologist. The final report must be signed, dated and sealed by a Professional Engineer.

The qualified professionals working on a slope stability assessment for submission to CH must be familiar with standard industry practices, including the following documents:



- ***Technical Guide - River and Stream Systems: Erosion Hazard Limit*** (Ministry of Natural Resources, 2002) (hereafter referred to as MNR Technical Guide); and,

- ***Geotechnical Principles for Stable Slopes*** (Terraprobe Limited and Aqua Solutions, June 1998) (hereafter referred to as Principles Document).

1.4 Validity of the Report

A Slope Stability Assessment is typically considered valid for a period of up to 10 years provided the following criteria can be met:

- No disturbance (natural or human-caused) on or in the immediate vicinity of the slope;
- No changes in the level of imperviousness of the lands draining to the slope;
- No changes to stormwater outlet locations and/or local drainage conditions; and
- No changes in toe erosion potential.

CH staff must be consulted prior to relying on a slope stability assessment report that was previously prepared for a prior project on the site to verify if the assumptions and findings are still valid.

Information from an existing report may be re-used within an updated or scoped new report, subject to validation by the qualified professional. The updated report must clearly state the source and date of any information used from a previous assessment.

Section 2 Stable Top of Bank Assessments

This section outlines CH's expectations related to studies establishing the location of the *stable top of bank*.

2.1 Components of the Stable Top of Bank and Regulated Area

As part of the *stable top of bank* (*STOB*) analysis, the consultant is required to assess the following:

- The physical *top of bank*;
- *Toe erosion allowance*; and
- *Stable slope allowance*.

The physical *top of bank* is typically identified and staked by CH staff in the field. If a physical *top of bank* (*TOB*) staking is conducted, it will be done in coordination with a qualified Ontario Land Surveyor (OLS). Staff will determine at that time whether additional study by the applicant is required to determine if the physical *TOB* is stable and confirm the location of the *STOB*. Please refer to *Conservation Halton Physical Top of Bank Staking Protocol* (2022) for more guidance on how to stake the TOB.

Toe erosion allowances provide setbacks from watercourses sufficient to account for lateral stream migration and are required where a watercourse is within 15 metres of the *toe of slope*, (Figure 2). The width of the allowance is determined by examining the abutting watercourse feature. The composition of its bed and bank materials and whether the watercourse is actively eroding is used to select the appropriate allowance and establish the location of the stable *toe of slope*. Additional discussion on this procedure is included in Sections 2.2 through 2.5 below.

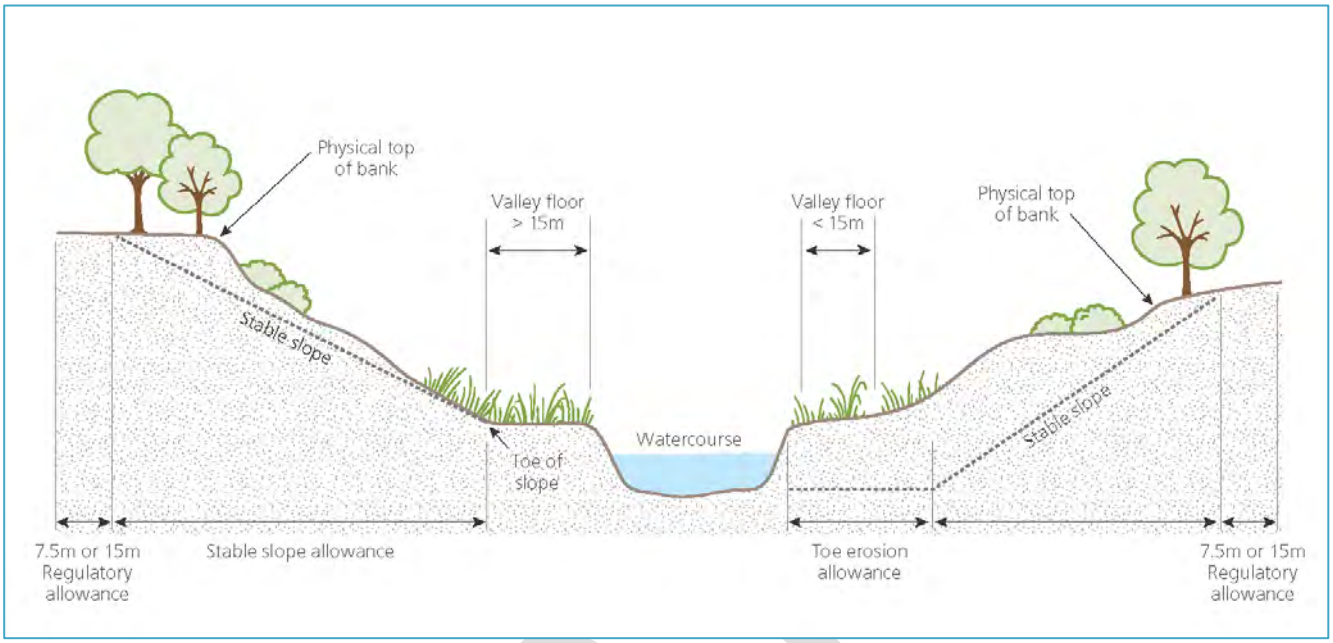
Measured from the stable *toe of slope*, the *stable slope allowance* accommodates stable slope inclinations, which are based on soil, rock, groundwater and other site conditions. Additional discussion is included in Sections 2.1 - 2.4 and Section 2.6.

As per *O.Reg. 162/06*, a regulatory allowance of 7.5 m (24.6 ft.) for *minor valley systems* and 15 m (49.2 ft.) for *major valley systems* (i.e., Grindstone, Bronte, and Sixteen Mile Creeks and their tributaries) is applied from the *STOB* to establish the limits of CH's regulated area associated with a *confined valley system*. CH staff must be consulted to confirm the appropriate allowance. A 6 m (19.7 ft.) erosion access allowance which provides for emergency and maintenance access to the valley lands and as further described within the MNR Technical Guide, is incorporated within CH's regulatory allowance.

CH's regulation limit extends from the greater of the physical *top of bank* as staked in the field or the *stable top of bank* as determined by a geotechnical slope stability assessment.

Figure 2-1 illustrates the components of a *confined valley system*.

FIGURE 2-1 CONFINED VALLEY SYSTEM



2.2 Field Evaluation & Sample Analysis

The level of investigation undertaken is dependant on several factors and must be justified by the qualified professional with the assistance of a completed Slope Stability Rating Chart (Appendix B) from the MNR Technical Guide. While the Slope Stability Rating Chart is used as a guide in selecting a reasonable level of investigation, staff may request a more robust/additional analysis where deemed appropriate or concerns identified (i.e., inconsistencies in topography, high-risk areas, documented slope failures, etc.).

Field inspections conducted by the qualified professional must evaluate the following components:

- evidence of slope instability,
- location of watercourse feature(s) relative to *toe of slope*,
- evidence of seepage on the slope,
- evidence of concentrated flow on the slope,
- vegetation condition on the slope,
- evidence of erosion at the slope toe, face or crest, and
- boreholes to determine soil subsurface conditions, if necessary.

Laboratory analysis of soil samples collected from boreholes must be undertaken to establish the properties of the soils, such as grain size distribution, unit weights, etc. Conservative values based on standard industry practices must be assumed within the assessment if laboratory analysis is not completed.

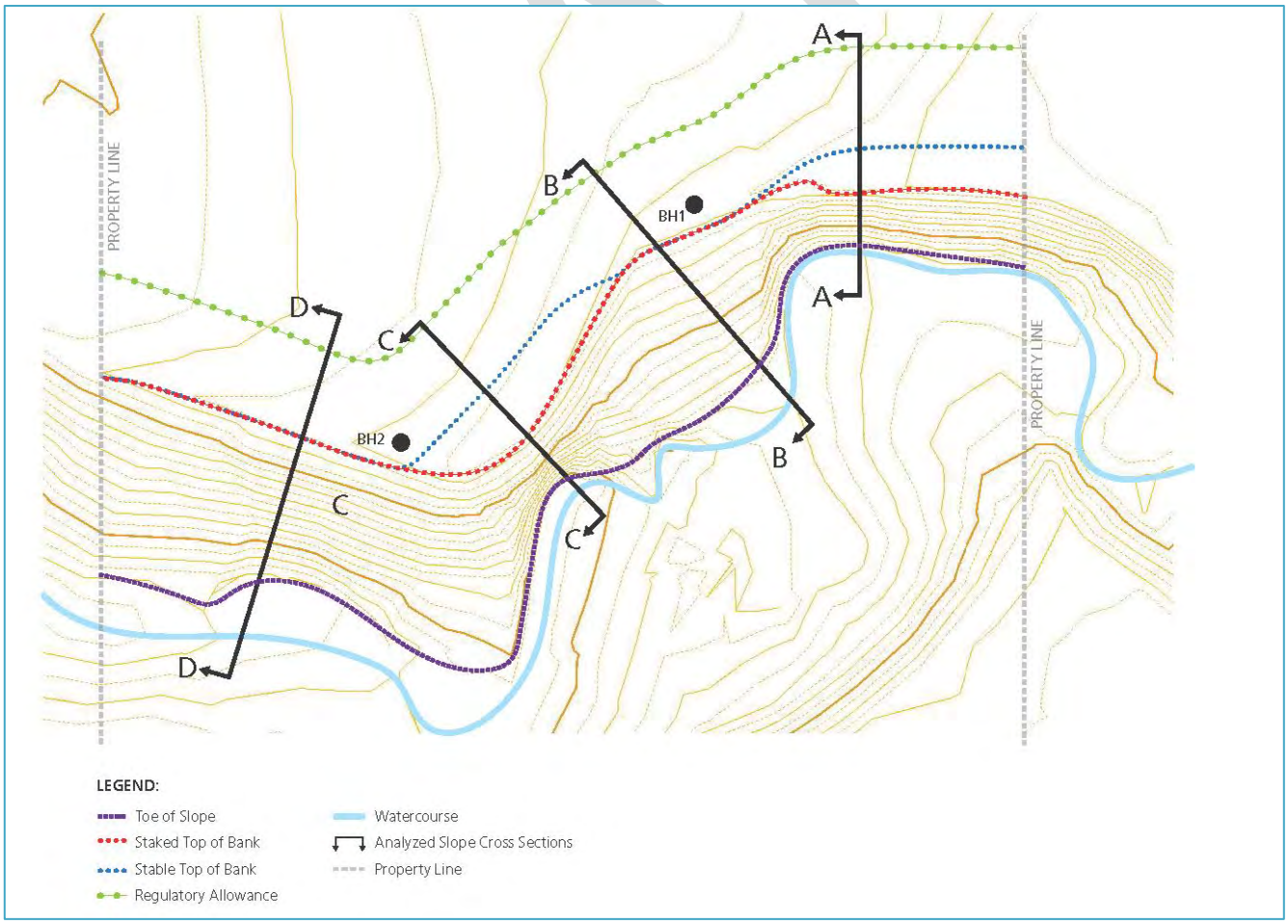
Rock coring and analysis will be required if a stable inclination steeper than 1.4:1 is proposed for shale bedrock.

2.3 Topographic Information

A topographical survey must be completed by an Ontario Land Surveyor (OLS) or qualified engineer (P.Eng.). Additional field measurements by the qualified professional may be used to augment and confirm available survey information.

The topographical data must be used to generate the analysed slope cross-sections. It will also typically be used to illustrate in plan view the findings of the analysis and other relevant aspects of the site assessment (Figure 2-2).

FIGURE 2-2 TYPICAL PLAN VIEW



2.4 Slope Cross-sections

The number of sections analyzed must be based on sound engineering judgment with the justification documented in the report. Cross-sections must represent both typical conditions and the most critical area(s) of the slope. Examples of the critical areas are:

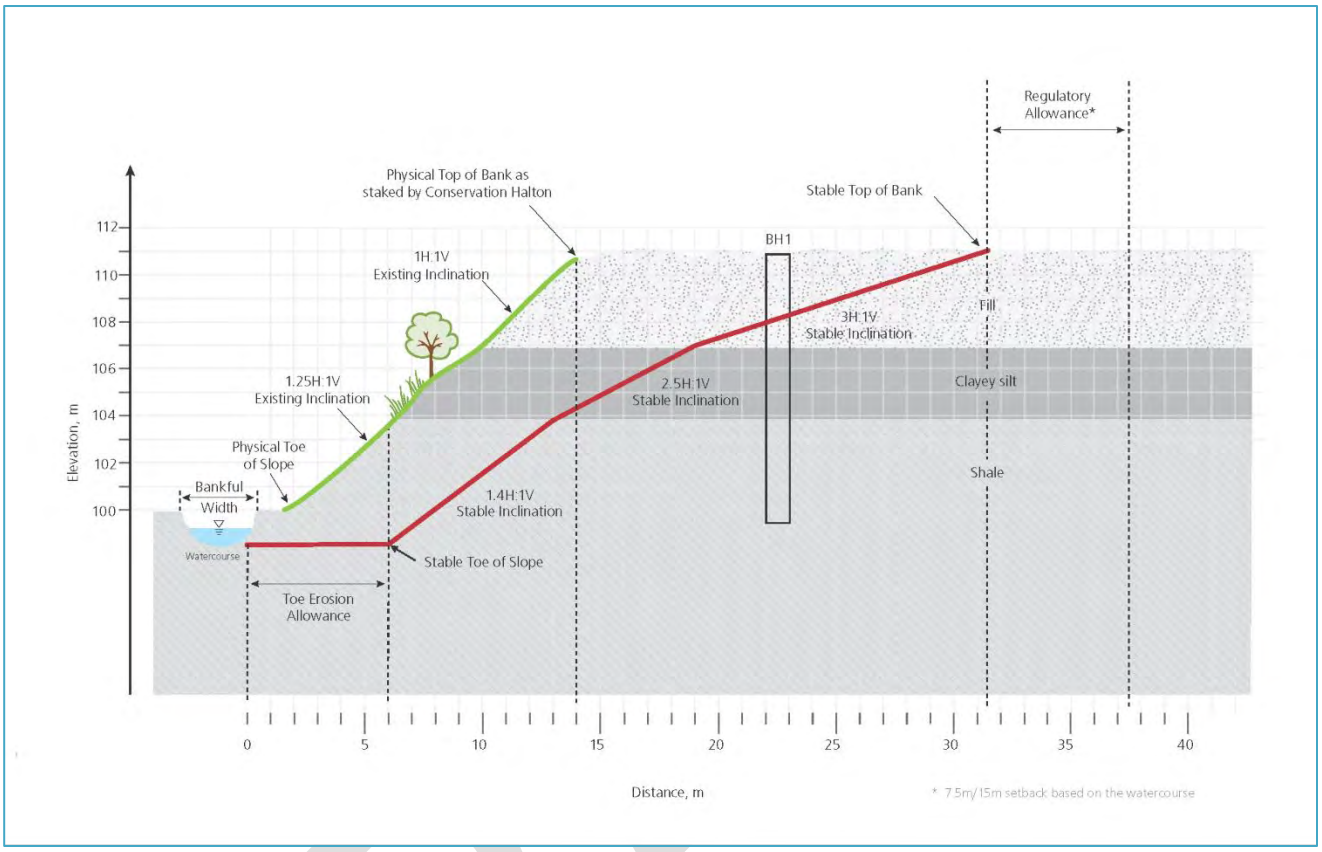
- steep portions of the slope,
- seepage locations,
- greatest toe erosion potential,
- existing drainage feature,
- *slope surface erosion*,
- existing structure including foundation details,
- excavation and restoration areas,
- overland flow route locations, and/or
- fill slopes.

Each section must be drawn to scale and at a size that is easy to read/understand. Each cross-section must illustrate:

- existing topography,
- soil/bedrock stratigraphy,
- borehole location, if applicable,
- watercourse,
- *toe erosion allowance*,
- stable slope inclinations,
- *stable top of bank*,
- points surveyed,
- regulatory allowance (as provided by CH),
- development setbacks (as provided by CH), if applicable, and
- existing and proposed development, if applicable.

Figure 2-3 illustrates a typical cross-section.

FIGURE 2-3 TYPICAL CROSS-SECTION



Note: Cross-section details may be provided on Factor of Safety Analysis figures as per Section 2.6.

2.5 Toe Erosion Allowance

A *toe erosion allowance* provides a setback from the watercourse bank sufficient to account for the lateral migration of the stream over a 100 year period. Where the toe of the slope is within 15 m (49.2 ft.) of the watercourse bank, a *toe erosion allowance* assessment in accordance with the MNR Technical Guide must be provided.

The most common method of establishing the *toe erosion allowance* is based on soil types and hydraulic processes as described in the MNR Technical Guide and shown in Table 2-1; however, a qualified professional must confirm the appropriateness of using this table. Alternative methods of establishing the *toe erosion allowance* as outlined in the MNR Technical Guide will also be considered if appropriately applied. The assessment must clearly outline how the recommended *toe erosion allowance* was determined throughout the study area.

TABLE 2-1 REFERENCE VALUES FOR TOE EROSION PARAMETERS

MINIMUM TOE EROSION ALLOWANCE - River Within 15 m of Slope Toe*

Type of Material Native Soil Structure	Evidence of Active Erosion** OR Bankfull Flow Velocity >Competent Flow Velocity*** Range Of Suggested Toe Erosion Allowances	No evidence of Active Erosion** OR Bankfull Flow Velocity <Competent Flow Velocity*** Bankfull Width		
		< 5m	5-30m	> 30m
Hard Rock (granite) *	0 - 2 m	0 m	0 m	1 m
Soft Rock (shale, limestone) Cobbles, Boulders *	2 - 5 m	1 m	1 m	2 m
Stiff/Hard Cohesive Soil (clays, clay silt), Coarse Granular (gravels) Tills *	5 - 8 m	1 m	2 m	4 m
Soft/Firm Cohesive Soil, loose granular, (sand, silt) Fill *	8 - 15 m	1-2 m	5 m	7 m

*Where a combination of different native soil structures occurs, the greater or largest range of applicable toe erosion allowances for the materials found at the site should be applied

**Active Erosion is defined as: bank material is exposed directly to stream flow under normal or flood flow conditions where undercutting, oversteepening, slumping of a bank or down stream sediment loading is occurring. An area may have erosion but there may not be evidence of 'active erosion' either as a result of well rooted vegetation or as a result of a condition of net sediment deposition. The area may still suffer erosion at some point in the future as a result of shifting of the channel. The toe erosion allowances presented in the right half of Table 3 are suggested for sites with this condition. See Step 3.

***Competent Flow Velocity is the flow velocity that the bed material in the stream can support without resulting in erosion or scour.

Ref: Technical Guide - River and Stream Systems: Erosion Hazard Limit 2002 - Ontario Ministry of Natural Resources

In most situations, CH provides no credit for toe erosion protection. Toe erosion protection measures may fail over time and, therefore, the assessment should consider the long-term erosion based on no protection. The analysis should be based on assumed natural conditions at the watercourse and *toe of slope* and the applicable *toe erosion allowance* determined accordingly. CH may credit toe erosion protection in select circumstances such as robust measures built and maintained by a public agency.

In the absence of a full geotechnical / fluvial geomorphological investigation, a standard *toe erosion allowance* of 15 m (49.2 ft.) must be provided for systems situated in non-cohesive soils and 8 m (26.2 ft.)

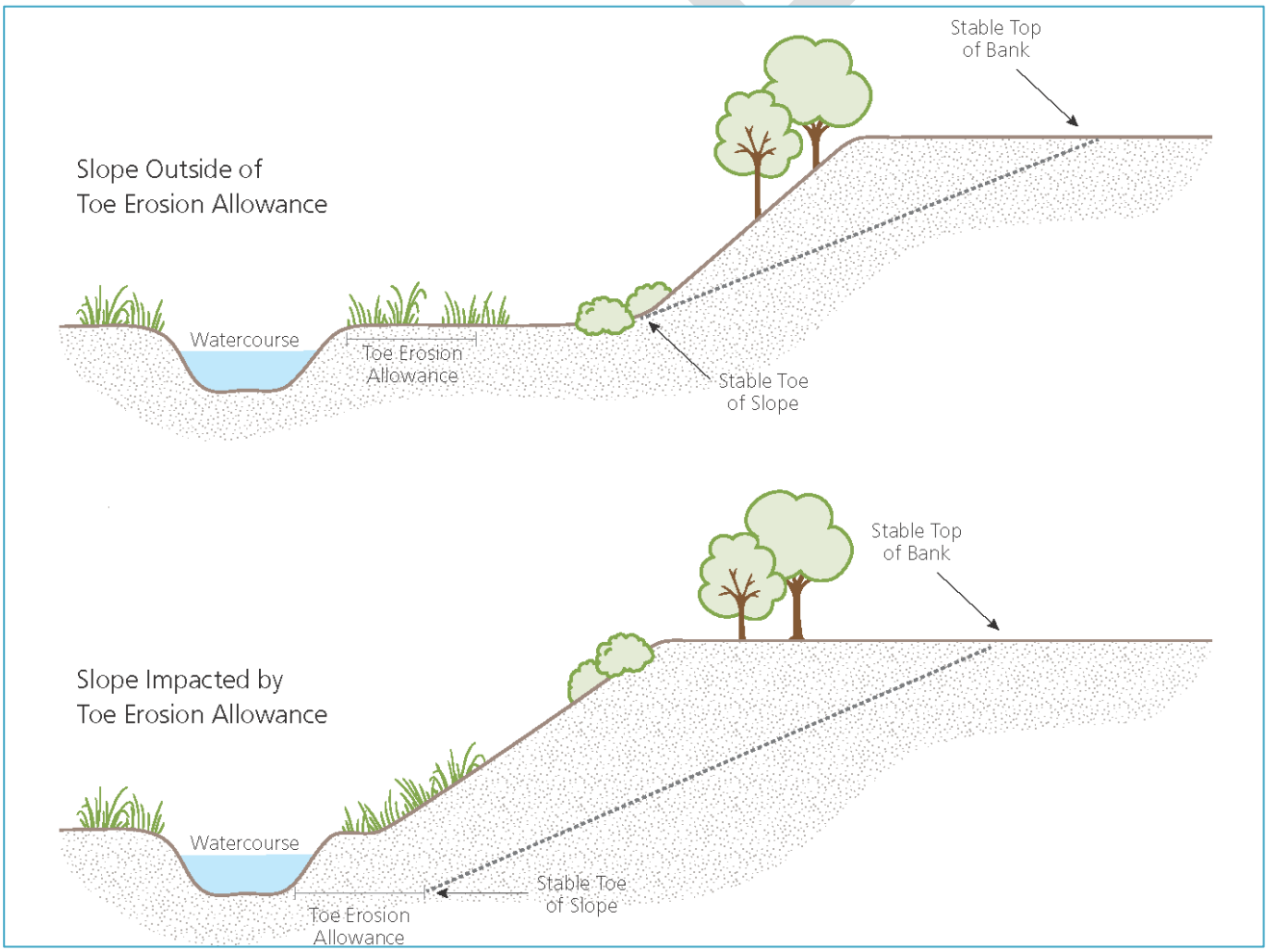
for systems situated in cohesive soils. Where a combination of cohesive and non-cohesive soils is present, the more conservative *toe erosion allowance* should be applied unless adequate justification for a lower value is given.

2.6 Stable Slope Allowance

The *stable slope allowance* is a setback that accounts for the stable inclinations of a slope, which are determined by the local rock/soil stratigraphy, groundwater conditions, and other applicable aspects. The *stable slope allowance* is calculated from either the toe of the valley slope, where the *toe erosion allowance* is less than the distance from the edge of the watercourse to the valley slope, or the **calculated** toe of the valley slope where the *toe erosion allowance* is greater than the distance from the edge of watercourse to the valley slope (Section 2.5).

From the stable *toe of slope*, a gradient line is drawn at the appropriate stable slope inclination(s) to intersect with the tableland. Figure 2-4 illustrates these scenarios.

FIGURE 2-4 STABLE SLOPE ALLOWANCE APPLICATIONS



Future conditions must be assessed and discussed if changes are anticipated that may affect slope stability (e.g., vegetation removal, altered drainage patterns, grading, or additional loads) or potential risk (such as future land use).

Within CH's jurisdiction, the relative strength of the shale bedrock is variable. The material's strength ranges from very competent to weak, depending upon its weathering, cracks, fissures, etc. CH will support a stable slope inclination of 1.4H: 1V for shale. A steeper inclination must be justified by a cored rock analysis. A cored rock analysis would need to determine the material's condition, durability and relative strength, etc. via in-situ sampling and subsequent laboratory analysis.

For the overburden, CH will accept a 3:1 (horizontal to vertical) stable slope inclination without further analysis, except in instances of unconsolidated fill. For slopes steeper than 3:1, a Factor of Safety (FOS) analysis of the slope is required, which typically includes software analysis. Multiple methods of analysis (e.g., Bishop, Spencer, Janbu, Morgenstern/Price, Ordinary, etc.) should be used as part of the assessment. The final recommendations may be based on the most applicable methodology considering site conditions.

FOS analysis must be performed for shallow-seated, deep-seated, and toe failures. Conservative soil parameters should be used in the analysis, unless laboratory testing of soils has been completed. Testing results, if applicable, must be included in the report. It is the qualified engineer's responsibility to select appropriate values and justify the values used.

Surface loads, such as existing buildings located on or near the slope. should be accounted for within the analysis. Retaining structures, other than loading, are typically disregarded in the *stable slope allowance* analysis. The need for seismic analysis is to be determined by the qualified professional based on standard industry practices and an understanding of the project's risks.

An appropriate FOS must be incorporated into the analysis. The minimum FOS supported by CH, for active use, are outlined in Table 2-2.

TABLE 2-2 MINIMUM ACCEPTABLE FACTOR OF SAFETY VALUES

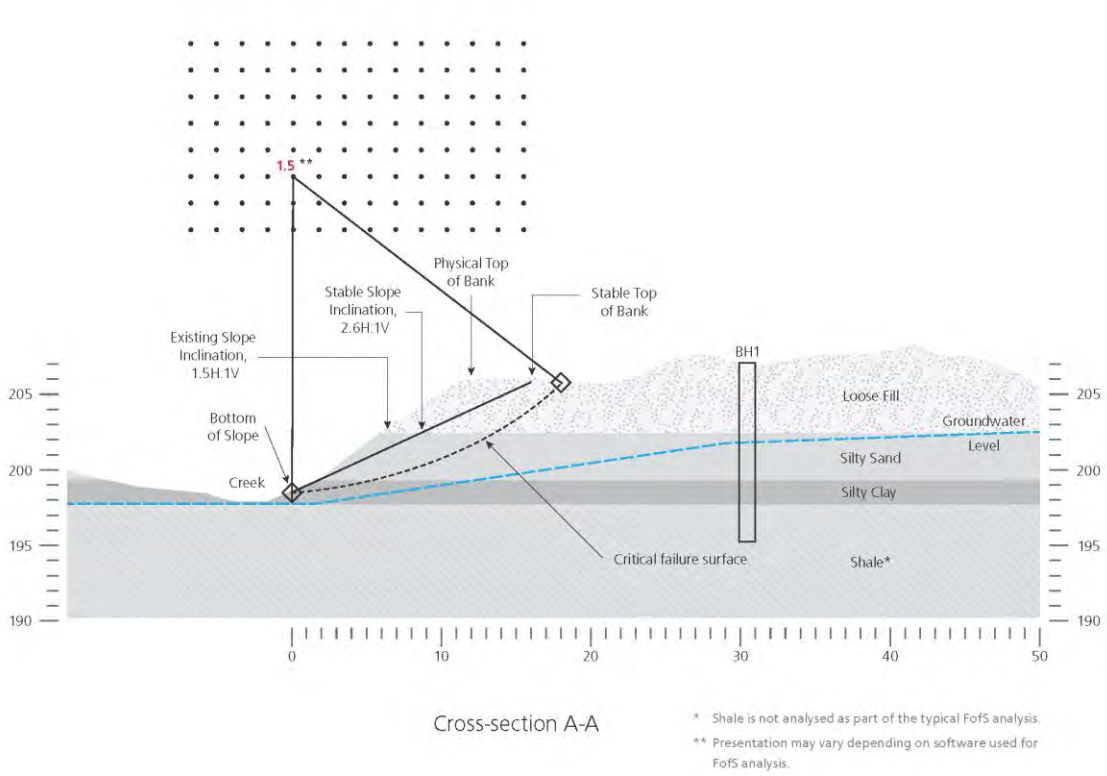
	Minimum FOS
Normal groundwater conditions	**1.5**
Elevated Groundwater conditions*	**1.3**

* Temporary or seasonal conditions after heavy rainfall event; soil drainage conditions should be considered before applying undrained conditions

Higher factors of safety must be used, where warranted, due to the consequences/risks associated with a slope failure (i.e. extreme high risk land-use) or due to soil variability, reliability of data, or other unknowns associated with the analysis.

Results of the software analysis must be presented in the slope stability assessment report. The analysis must demonstrate the inclination of the slope where the minimum required FOS is achieved under both normal and elevated groundwater conditions. The acceptable FOS must not be located on the outer edge of the grid/matrix. FOS contours must be included on the grid. A typical Factor of Safety Analysis is shown in Figure 2-5.

FIGURE 2-5 TYPICAL/MINIMUM FACTOR OF SAFETY ANALYSIS



2.7 Submission Requirements

The level of detail required will depend on the complexity of the project; however, the slope stability assessment report should follow the MNR Technical Guide and the Principles Document and include the components specified in Table 2-3.

TABLE 2-3 SUBMISSION REQUIREMENTS (CHECKLIST)

Item Provided	Components
☐	Project description
☐	Site Location (address and key plan)
☐	A topographical survey plan of the subject site
☐	Description of site conditions based on a recent site visit. Photographs must be included. The description of the site must include the following factors: • Date and time of inspection, including weather conditions, visibility and accessibility • Site topography and slope characteristics including slope height and inclination • Extent of areas draining to the top of slope • Existing and proposed land use • Surface cover (vegetation) • Soil and bedrock stratigraphy or layering • Soil type (composition) • Measured soil density and strength • Groundwater pressure or evidence of groundwater • Nearby watercourse features • Evidence of stream or slope erosion
☐	Discussion of the site's soil/bedrock conditions based on a literature review or knowledge of other investigations in the general area of the subject site
☐	Justification for the level of investigation undertaken, including a completed Slope Stability Rating Chart (Appendix B)
☐	Engineering evaluation of soil/rock – grain size analysis, strength parameters, etc.
☐	*Toe erosion allowance* analysis, including supporting calculations
☐	*Stable slope allowance* analysis, including slope failure/slip analysis
☐	Slope cross-sections
☐	Plan view of the site clearly showing: • cross section locations • watercourse • physical *toe of slope* • staked physical *top of bank* • *stable top of bank* • existing development and proposed development (if applicable) • CH regulatory allowance • Any other development setbacks (if applicable)
☐	Borehole logs and laboratory test results if applicable
Please be advised that based on the results of the Slope Stability Assessment, additional further analysis and/or recommendations for measures that could be implemented to mitigate or address the hazard and risk may be necessary	

Section 3 Existing Valley Development

This section outlines CH's requirements for studies associated with additions/alterations to existing development located in or adjacent to a valley.

3.1 General Submission Requirements

In some cases, protection measures may be needed to improve slope stability to protect existing development or natural areas from the risk of *erosion hazards*. CH has regulatory policies that allow for alterations to the valley slope or additions/modifications to existing valley development that are minor in nature. **Pre-consultation with CH staff is recommended to determine if the proposed development can be permitted by policy and, if so, what analysis will be required to support the permit application.**

Where there is a proposal to modify existing valley development which is permitted by policy, the need for a geotechnical assessment will be determined during pre-consultation and/or a site visit. Assessments are required to confirm:

- the stability of the existing slope,
- existing and future slope stability is not impacted,
- risk of creating new or aggravating existing *erosion hazards* is avoided, and
- the potential for increased loading forces on the slope is addressed through appropriate structural design.

The assessment must evaluate both temporary construction impacts and permanent impacts to slope stability, including future access for maintenance.

It is the qualified professional(s) responsibility to ensure that a submission supporting development in or within proximity to a *confined* or *semi-confined valley* meets all applicable standards, guidelines, regulations, etc.

3.2 Retaining Walls

CH does not generally support the construction of retaining structures for the purpose of expanding or creating new developable areas. Geotechnical input from a qualified professional is required for the replacement of a retaining wall or new wall required for the protection of existing development. In conjunction with the above requirements, the geotechnical analysis must verify the resulting FOS for global stability and review the bearing capacity calculated by the structural engineer. Bearing capacity, overturning, and sliding calculations must be provided by the structural engineer. Structural details, including foundation, depth of embedment, buttressing, tie-backs, drainage etc. must be discussed by the qualified professional and accompanied by cross-sectional and profile drawings. The submission must also address the potential for surficial erosion through inclusion of a drainage plan, erosion and sediment control plan and a site stabilization/restoration plan, where applicable.

APPENDICES

Appendix A – Definitions

Note: Definitions are from the CH *Policies and Guidelines for the Administration of Ontario Regulation 162/06 and Land Use Planning Policy Document* (2020) unless noted by a *.

Accepted Geotechnical Principles:

Those principles, methods and procedures involving slope stability analysis which are used and applied in current geotechnical practice and have been reviewed and approved by CH.

Confined Valley System:

Where the watercourse is located within a valley corridor, either with or without a flood plain, and is confined by valley walls. The watercourse may be located at the toe of the valley slope, in close proximity to the *toe of the valley slope* (less than 15 metres) or removed from the *toe of the valley slope* (more than 15 metres). The watercourse can contain perennial, intermittent or ephemeral flows and may range in channel configuration, from seepage and natural springs to detectable channels (Understanding Natural Hazards, MNR, 2001). Within CH's watershed, all valleys greater than or equal to 2 metres in height are considered confined systems.

Erosion Hazard:

The loss of land, due to human or natural processes, that poses a threat to life and property. The erosion hazard limit is determined using considerations that include the 100-year erosion rate (the average annual rate of recession extended over a one hundred year time span), an allowance for slope stability, and an erosion/erosion access allowance.

Instream Erosion:

The process by which the materials of a stream are worn away by the constant force of flow of water on the channel bottom and banks. This is a natural process which affects the channel plan and profile. Erosive processes, over time, can deepen and widen the channel form. As the channel meanders due to erosion and deposition, valley walls can also be subject to higher erosive forces. This is typically seen when the channel reaches the *toe of the valley slope* and during high, overbank flow events. *

Major valley system:

The *valley systems* associated with Grindstone, Bronte or Sixteen Mile Creeks, including all tributaries.

Minor valley system:

All *valley systems* within CH's jurisdiction other than those associated with Grindstone, Bronte and Sixteen Mile Creeks.

Semi-confined valley System:

A *valley* at the transition between a *confined* and *unconfined system* that has characteristics of both types of *valley systems*. *

Slope Surface Erosion:

The process by which the surface of the valley slope is worn away. Factors affecting slope *surface erosion* include heavy rainfall which may saturate the slope, runoff from areas adjacent to the slope, direct discharge from pipes to the slope, and instabilities associated with tree loss. This erosion is generally surficial in nature but can contribute over time to deep seated failure. *

Stable Slope Allowance:

The stable slope allowance is the setback from the stable *toe of slope* that accounts for the stable inclinations of the slope.

Stable Top of Bank (STOB):

As it pertains to valleylands means,

(a) the physical *top of bank* where the existing slope is stable and not impacted by toe erosion; or,

(b) is defined by the *toe erosion allowance* plus the *stable slope allowance* where the existing slope is unstable and/or is impacted by toe erosion.

Surface Erosion:

The detachment and transport of soil particles by wind, water, or gravity. *

Toe Erosion Allowance:

The toe erosion allowance is the setback from the watercourse bank that accounts for the lateral migration of a stream over a 100 year period.

Toe of Slope:

The lowest point on a slope, where the surface gradient changes from relatively shallow to relatively steep.

Top of Bank (TOB):

The point of the slope where the downward inclination of the land begins, or the upward inclination of the land levels off. This point is situated at a higher topographic elevation of land than the remainder of the slope. There may be situations where there are interruptions in the valley slope by plateau (terrace) areas.

Unstable Slopes:

Unstable slopes are slopes steeper than their natural angle of stability. Over time, these slopes are subject to adjustment to obtain the natural stable inclination. *

Unconfined System:

Those systems where the watercourse is not located within a valley corridor with discernable slopes, but relatively flat to gently rolling plains and is not confined by valley walls. The watercourse can contain perennial, intermittent or ephemeral flows and may range in channel configuration, from seepage and natural springs to detectable channels. Within CH's watershed, all valleys less than 2 metres in height are considered unconfined systems.

Valleylands:

Depressional features associated with a river or stream, whether or not they contain a watercourse.

Appendix B – Slope Stability Rating Chart

SLOPE STABILITY RATING CHART			
Site Location:		File No.	
Property Owner:		Inspection Date:	
Inspected By:		Weather:	
1.	**SLOPE INCLINATION**		
	degrees	**horiz. : vert.**	
	a) 18 or less	3 : 1 or flatter	0
	b) 18 - 26	2 : 1 to more than 3:1	6
	c) more than 26	steeper than 2 : 1	16
2.	**SOIL STRATIGRAPHY**		
	a) Shale, Limestone, Granite (Bedrock)		0
	b) Sand, Gravel		6
	c) Glacial Till		9
	d) Clay, Silt		12
	e) Fill		16
	f) Leda Clay		24
3.	**SEEPAGE FROM SLOPE FACE**		
	a) None or Near bottom only		0
	b) Near mid-slope only		6
	c) Near crest only or, From several levels		12
4.	**SLOPE HEIGHT**		
	a) 2 m or less		0
	b) 2.1 to 5 m		2
	c) 5.1 to 10 m		4
	d) more than 10 m		8
5.	**VEGETATION COVER ON SLOPE FACE**		
	a) Well vegetated; heavy shrubs or forested with mature trees		0
	b) Light vegetation; Mostly grass, weeds, occasional trees, shrubs		4
	c) No vegetation, bare		8
6.	**TABLE LAND DRAINAGE**		
	a) Table land flat, no apparent drainage over slope		0
	b) Minor drainage over slope, no active erosion		2
	c) Drainage over slope, active erosion, gullies		4
7.	**PROXIMITY OF WATERCOURSE TO SLOPE TOE**		
	a) 15 metres or more from slope toe		0
	b) Less than 15 metres from slope toe		6
8.	**PREVIOUS LANDSLIDE ACTIVITY**		
	a) No		0
	b) Yes		6
SLOPE INSTABILITY RATING VALUES		**INVESTIGATION RATING SUMMARY**	**TOTAL**

Ref: Technical Guide - River and Stream Systems: Erosion Hazard Limit 2002 – Ontario Ministry of Natural Resources

February
2024

REPORT TO: **Conservation Halton Board**

REPORT NO: # CHB 01 24 09

FROM: Barbara J. Veale, Senior Director, Watershed Management & Climate Change

DATE: February 15, 2024

SUBJECT: **Watershed-Based Resource Management Strategy Workplan, Timeline, and Status Update**

Recommendation

THAT the Conservation Halton Board **receives for information the staff report entitled, "Watershed-Based Resource Management Strategy Workplan, Timeline, and Status Update";**

And

THAT the Conservation Halton Board **approves the proposed 2024 workplan and timeline for developing the Watershed-Based Resource Management Strategy.**

Executive Summary

Recent changes to the *Conservation Authorities Act* (CA Act) require that all conservation authorities (CAs) complete a Watershed-Based Resource Management Strategy (Watershed Strategy) by December 31, 2024. The legislation prescribes several components which must be included. At minimum, this strategy must address mandatory programs and services as prescribed by the legislation. The implications of climate change on the implementation of programs and services are important considerations. Provided that it is consistent with the 2023 Memorandums of Understanding (MOUs) for programs and services signed between CAs and their participating municipalities, the Watershed Strategy may have a broader scope. This enables CAs and their municipal partners to be responsive to natural resource issues and management needs unique to their watersheds.

In 2023, staff commenced work to support the development of Conservation Halton's (CH) Watershed Strategy. This work included the identification of key watershed-scale natural resource issues and vulnerabilities through the review of existing technical reports; discussions with CH technical staff; and consultation with municipalities, First Nations, and the public. This review also supported the development of a draft watershed characterization summary, currently in progress. In addition, draft guiding principles and objectives, based on the 2023 MOUs and CH's corporate Strategic Plan – Momentum, were prepared for public review and comment and were posted to CH's website in January 2024.

This report outlines the 2024 workplan and timeline for completing the Watershed Strategy for the Board's information and approval by the required deadline.

Report

Under recent changes to the CA Act and related regulations, all CAs in Ontario are required to complete a Watershed-Based Resource Management Strategy (Watershed Strategy) on or before December 31, 2024. The Watershed Strategy is required to include the following components:

1. Guiding principles and objectives that inform the design and delivery of the programs and services that the authority is required to provide.

2. A summary of existing technical studies, monitoring programs and other information on the natural resources the authority relies on within its area of jurisdiction or in specific watersheds that directly informs and supports the delivery of programs and services.

3. A review of the authority's programs and services provided for the purposes of,
    i. determining if the programs and services comply with the regulations made under clause 40 (1) (b) of the Act,
    ii. identifying and analyzing issues and risks that limit the effectiveness of the delivery of these programs and services, and
    iii. identifying actions to address the issues and mitigate the risks identified by the review and providing a cost estimate for the implementation of those actions.

4. A process for the periodic review and updating of the watershed-based resource management strategy by the authority that includes procedures to ensure stakeholders and the public are consulted during the review and update process.

In 2023, the focus was on developing MOUs for the delivery of Category 2 and/or 3 programs and services with participating municipalities, including the Halton Region, Peel Region, City of Hamilton, and Township of Puslinch. These high-level MOUs, approved by the participating municipalities and the CH Board, were posted to CH's website in December 2023. The MOUs support a wide range of programs and services for "the organization and delivery of programs and services that further the conservation, restoration, development and management of natural resources," in accordance with CH's statutory purpose as stated in the CA Act. The MOUs can be accessed via www.conservationhalton.ca/governance/. The Watershed Strategy will address the full range of programs and services required by legislation as well as those supported in the MOUs. It will also align with CH's existing Strategic Plan – Momentum.

Work Completed to Date

During 2023, CH staff focused on four (4) components to support the Watershed Strategy, including:

- Identification of key watershed-scale natural resource issues of concern,
- Creation of a stakeholder engagement approach,
- Development of preliminary guiding principles and objectives, and
- Assessment of the risks and vulnerabilities associated with climate change on the natural resources in CH's watersheds (described further in Report No. CHB 01 24 10).

Identification of Key Natural Resource Issues

Based on a review of available data, technical reports/studies, and discussions with staff, an initial list of twelve (12) key watershed-scale natural resource issues specific to CH's watersheds was developed. Key issues identified were:

- Flooding – Riverine
- Drought
- Valley Erosion
- Surface and Groundwater Quality – Chloride
  Surface Water Quality – Suspended Solids
- Surface Water Quality – Sedimentation
- Surface Water Quality – Total Phosphorus
- Surface Water Quality – Temperature (Thermal Pollution)
- Groundwater Quantity
- Degradation, Fragmentation, and Loss of Natural Features
- Invasive Species
- Biodiversity Loss

The key issues, vulnerable areas, and management implications were summarized in a draft "issues paper". The paper also acknowledged localized natural hazard issues such as dynamic beaches; shoreline erosion; shoreline flooding, surface/overland erosion, unstable bedrock (e.g., karst); and unstable soils which must be addressed through CH's programs and services.

The draft paper was posted to CH's website for public review and comment. This was an important step to confirm that the key issues identified reflected local concerns. Invitations were extended to municipal staff, First Nations, and other environmental groups to encourage them to provide input through a short survey that accompanied the paper. Through several social media posts, the public was also invited to provide feedback. The survey was available for review and input from October 27, 2023, through December 8, 2023.

A total of 159 responses were received, which exceeded expectations, although not every respondent answered every question. Respondents represented a diversity of interests including municipal staff and councillors, First Nations, CH staff and Board members, and others.

There was consensus among respondents that the twelve (12) key natural resource issues identified were important. Respondents ranked the issues. Responses were tallied using a weighted average. The top five (5) issues were 1) degradation/loss of natural features, 2) groundwater quality, 3) biodiversity loss, 4) riverine flooding, and 5) invasive species. Given these responses, groundwater quality (beyond chloride) will be added to the key natural issues to be addressed in the Watershed Strategy. Other issues of concern identified by respondents were valid (e.g., air quality, protection of archeological sites, noise pollution) but out of scope as they are within the mandate of other government agencies. The comments received will also be used to further describe nature and extent of the key natural resource issues.

In addition to inviting comments on the key watershed-scale natural resource issues, the survey also asked respondents to provide their opinions about CH's watershed monitoring priorities and partnership opportunities to help address and manage key issues. Five (5) monitoring priorities were identified, including:

- Coordinate monitoring efforts with municipalities and others to avoid duplication,

- Focus on identifying trends based on good data; share data and information regularly,
- Identify and fill gaps in the data with a focus on understanding the key watershed-scale natural resource issues,
- Identify natural assets on a watershed basis, and
- Collect and assess data to inform management actions and outcomes (adaptive management).

There was consensus that CH should continue to build partnerships with municipalities, government agencies, First Nations, land trusts, educational institutions, private sector, and others. It was recommended that the focus of these partnerships be on 1) coordinating activities, particularly with respect to climate change initiatives; 2) exploring opportunities for additional program funding and in-kind support; 3) hosting a shared repository of monitoring data, natural heritage information, and restoration opportunities; 4) undertaking Lake Ontario shoreline monitoring and management; 5) promoting volunteer opportunities (e.g., citizen science/community explorers); and 6) fostering and facilitating landowner stewardship activities. Several respondents mentioned that CH should take a lead role in assessing the impacts of climate change on natural systems and determining the value of natural assets on a watershed basis.

CH staff is currently analyzing responses and will be posting the results to the CH website in March 2024, along with a refined issues paper.

Stakeholder Engagement Approach

The Province requires CAs to “ensure stakeholders and the public are consulted during the preparation of the watershed-based resource management strategy in a manner that the authority considers advisable.”

In 2022, CH staff developed an internal guidance document to direct CH’s public engagement activities, which includes general steps for developing a meaningful public engagement approach. The document also includes best practices, tools, and implementation tips. Using this guidance, CH staff developed an inclusive engagement approach for several reasons:

- Obtaining new insights, ideas, and knowledge from partners and others to inform the Watershed Strategy,
- Building partnerships to coordinate and fund programs and services that advance common goals and objectives,
- Improving CH’s responsiveness and approach to addressing key watershed-scale resource management issues of public concern, and
- Improving transparency in planning and decision making.

Opportunities for municipalities, First Nations, community groups, and others to provide input and feedback on several components of the Watershed Strategy will be provided using a combination of online surveys, targeted workshops, focus groups, social media, and consultation with selected subject matter experts.

Proposed Guiding Principles and Objectives

Staff have drafted guiding principles and objectives to steer the design and delivery of CH’s programs and services. These proposed statements align with the legislation, the recently signed MOUs with

participating municipalities, and CH's Strategic Plan – Momentum, and were posted on CH's website for public review and comment on January 15, 2024 (www.conservationhalton.ca/watershed-strategy/). The deadline for comments was February 13, 2024. As with the issues paper, municipal staff, First Nations, and environmental groups were specifically invited to provide input.

Proposed Work Plan for 2024

A proposed work plan and timeline to complete the Watershed Strategy has been developed. It is anticipated that the strategy will be completed by mid-September 2023 for approval at the October 31, 2024, CH Board meeting. Remaining components to be completed include:

- **Watershed Characterization Summary** – based on the review of existing data, technical documents, feedback on the key watershed-scale natural resource issues, and consultation with CH staff, this characterization will 1) summarize the biophysical traits of CH's watersheds and how they influence the natural water cycle; 2) identify key impacts on natural processes which are influenced by human activities (including climate change); and 3) describe high-level trends, vulnerabilities, and risks.

- **Data and Monitoring Summary** – based on a comprehensive review of the existing watershed monitoring program, this summary will 1) identify monitoring gaps, 2) assess future monitoring needs focused on relevant data and analytical tools, and 3) provide suggestions for modernizing the program that will help with better identification and understanding of the drivers that shape the key watershed-scale natural resource issues.

- **CH Programs and Services –** based on CH's inventory of programs and services and the MOUs signed with participating municipalities in 2023, this component will describe and summarize 1) existing programs and services; 2) identify gaps, vulnerabilities and risks which hamper the delivery of such; and 3) determine compliance with the regulations.

- **Climate Change Resiliency Strategy –** based on the insights and recommendations provided through the Climate Change Risk and Vulnerability Assessment to natural resources within CH's watersheds, this strategy will outline next steps for integrating expected climate change impacts into CH's resource management decision-making.

- **Future Actions –** based on the gaps and needs identified through the collective work done to date, this component will identify short-, medium-, and long-term actions and associated high-level cost estimates. It will also identify existing opportunities to adjust, scale-back, or expand CH's programs and services to ensure they are focused on relevant outcomes, meet legislative requirements, and align with the objectives agreed to in the MOUs signed with participating municipalities. These objectives include:

    - Ensure that environmental and watershed-related programs and services are effective, complementary, value-added, and customer-focused;
    - Eliminate unnecessary duplication and streamline environmental and watershed-related programs and services to optimize the use of existing resources and technical expertise and, where possible, coordinate efforts;
    - Continuously improve working relationships and enhance service performance;
    - Ensure natural resources are protected, managed, and/or restored using a watershed or systems-based approach and cost-effective solutions;

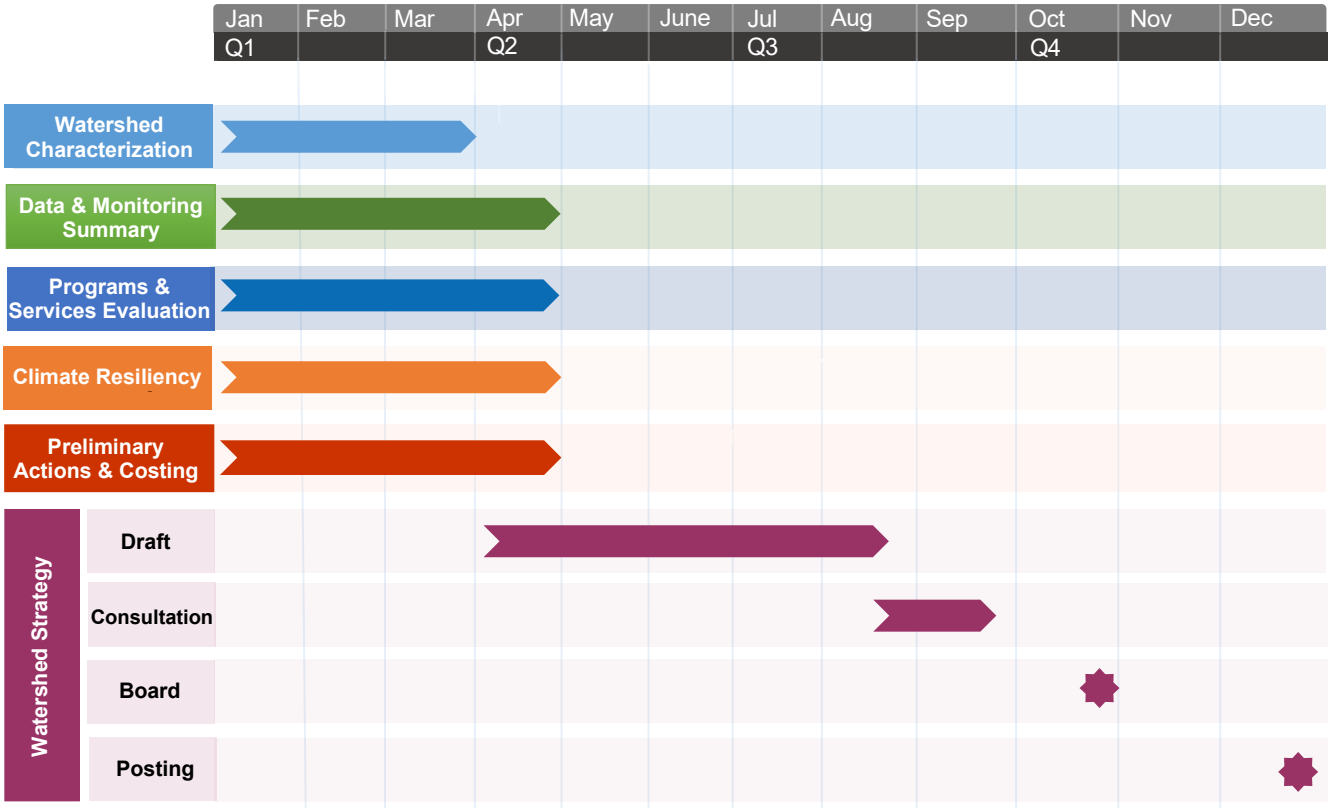
- Support the development of a collaborative watershed-based resource management strategy that addresses natural resource issues of interest and concern to participating municipalities; and
- Ensure relevant watershed resource data is collected using sound science and robust analytical tools and technologies and is shared to support decision-making and evaluation, and that related outcomes and progress are reported.

The timing and cost of any proposed changes to CH's programs and services will be verified and addressed through CH's annual budgeting process.

- **Watershed Strategy –** based on the analyses completed for the preceding components, a draft Watershed Strategy will be completed for public review and comment by the end of August 2024. This will ensure that sufficient time is provided for public review and feedback as well as editorial changes, as needed. Staff anticipate that a final draft will be completed for Board approval at the October 31, 2024, meeting.

Given the tight timeline for completion of the Watershed Strategy, CH staff will be working on several components concurrently as shown below. Progress reports will be provided at the Board meetings scheduled in June and September 2024.

Watershed Strategy Workplan & Timeline - 2024



*Consultation with municipalities & First Nations

Impact on Strategic Priorities

This report supports four (4) Momentum priorities including Natural Hazards and Water; Science, Conservation and Restoration; Education, Empowerment and Engagement; and Nature and Parks.

Financial Impact

There is no financial impact to this report.

Signed & respectfully submitted:

Barbara Veale, Senior Director,
Watershed Management & Climate Change

Approved for circulation:

Hassaan Basit
President & CEO/Secretary-Treasurer

FOR QUESTIONS ON CONTENT: Barbara Veale, Senior Director,
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February
2024

REPORT TO: **Conservation Halton Board**

REPORT NO: # CHB 01 24 10

FROM: Barbara J. Veale, Senior Director, Watershed Management & Climate Change

DATE: February 15, 2024

SUBJECT: **Watershed Climate Change Vulnerability and Risk Assessment**

Recommendation

THAT the Conservation Halton Board **receives for information the staff report entitled "Watershed Climate Change Vulnerability and Risk Assessment";**

And

THAT the Conservation Halton Board **endorses the recommendations included in the report entitled "Watershed Climate Change Vulnerability and Risk Assessment".**

Executive Summary

A Watershed Climate Change Vulnerability and Risk Assessment project was initiated in 2023 to identify where natural resources and ecosystems are most at risk to climate change. The project is a first step for developing a Watershed Climate Resiliency Strategy. This strategy will identify actions to improve the adaptive capacity and resiliency of Conservation Halton's (CH) watersheds to cope with and adapt to the impacts of predicted warmer, wetter, and wilder weather in southern Ontario and support the development of the Watershed-based Resource Management Strategy.

The Climate Change Vulnerability and Risk Assessment uses a watershed level, qualitative approach to identify risks for natural resources. It adapted an established risk assessment process to offer a unique approach for evaluating climate risks and developing adaptation measures at a watershed scale. CH subject matter experts, municipal staff, and other stakeholders were engaged throughout the project to ensure that findings were based on the best available information.

Of a possible fifty-four (54) interactions between nine (9) natural resource groups and six (6) climate hazards, thirty-eight (38) interactions were identified as having high or very high risks using 2050 climate projections. The top three (3) climate hazards with the highest number of risk ratings in the "high" and "very high" categories were heat stress, rainfall, and seasonal changes.

The assessment report outlines the benefits and services that natural resources deliver and the probable consequences of climate change, and how these affect natural hazards and natural resources at the watershed scale. It also includes a summary of the most imminent climate change threats affecting forests, groundwater, lakeshore, meadows, ponds and lakes, streams, vernal pools, and wetlands (swamps and marshes).

The report provides management recommendations, aligned with CH's existing programs and services, which could be implemented to adapt to or buffer the impacts of climate change. These recommendations are grouped around flooding, erosion and sediment, water quality, aquatic and terrestrial ecology, biodiversity loss, and CH's services, and speak to themes including operations, monitoring, management, modelling, restoration, planning, and safety. Staff is seeking Board approval of these recommendations to support the development of the Watershed Climate Resiliency Strategy and Watershed-based Resource Management Strategy,

Report

Background

In 2023, staff initiated a Watershed Climate Change Vulnerability and Risk Assessment project to support the development of a Watershed Climate Resiliency Strategy for CH's watersheds.

Natural resources, like forests and wetlands, act as a protective shield against climate change impacts that can aggravate natural hazards such as flooding and erosion and pose risks to ecosystem health. The Watershed Climate Change Vulnerability and Risk Assessment identifies where natural resources and ecosystems are most at risk to climate change. The goals of the Watershed Climate Resiliency Strategy are to:

- Evaluate the gaps and opportunities associated with CH's current programs and services for addressing future climate change resource issues and risks, and
- Identify actions that will improve the adaptive capacity and resiliency of CH's watersheds to cope with and adapt to the impacts of predicted warmer, wetter, and wilder weather.

The Watershed Climate Resiliency Strategy will support the development of the Watershed-based Resource Management Strategy. More information about the workplan and timeline for completing this strategy is included in CHB 01 24 09.

The relationships between the Climate Change Vulnerability and Risk Assessment, Watershed Climate Resiliency Strategy and the Watershed-based Resource Management Strategy are shown in Figure 1 below.

Method

The Climate Change Vulnerability and Risk Assessment uses a watershed level, qualitative approach to developing risk rating scores for the following natural resource groups: forests, groundwater, lakeshore, meadows, pond/lakes, streams, wetlands (swamp/marsh), and vernal pools. Established risk management processes were adapted to offer a unique and comprehensive approach for evaluating climate risks and developing adaptation measures for these resources, something not frequently done on a watershed scale.

The project established six (6) climate hazards that can be described as interaction scenarios that more fully account for changing climate conditions that will impact natural resources and ecosystems. The six (6) climate hazards include dry conditions, heat stress, rainfall, seasonal changes, snowpack reduction, and wind.

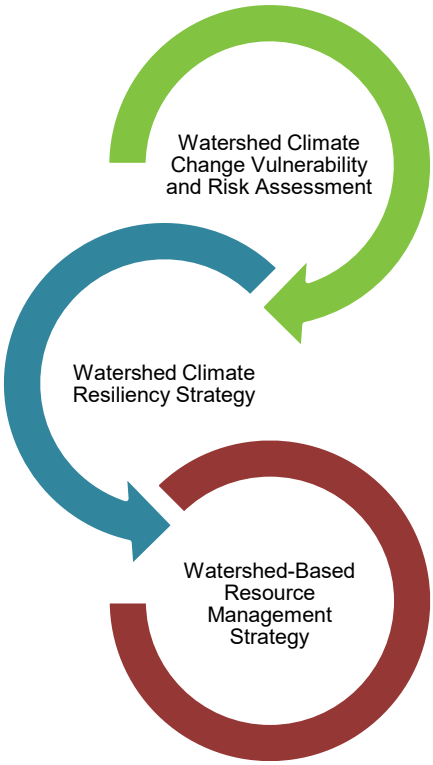

Figure 1: Study Connections and Sequencing

The risk assessment process identified expected interactions between natural resources and climate hazards. The consequences of each interaction were assessed and ranked using seven (7) categories:

- Flooding,
- Erosion and sedimentation,
- Human health and property,
- Terrestrial ecology,
- Aquatic ecology,
- Water quality, and
- CH services.

The risk assessment included calculating individual risk scores as a product of the consequences (severity) x likelihood (probability of occurrence), ranging from low to very high. To further prioritize risks, only interactions having a risk rating of at least one (1) high or very high were considered for further analysis.

Engagement was important in developing the Climate Change Risk and Vulnerability Assessment. CH subject matter experts were involved extensively. Municipal staff and other stakeholders were involved through a survey and two interactive workshops to gain insights and feedback and ensure that findings were based on the best available information.

Risk Assessment Results

A goal of the Climate Vulnerability and Risk Assessment was to identify the benefits and services of natural resources and how climate change affects them. Of a possible fifty-four (54) interactions between the nine (9) natural resource groups and six (6) climate hazards, thirty-eight (38) interactions were identified as having “high” or “very high” risks using 2050 climate projections. The number of interactions increased to forty-one (41) using 2080 climate projections: a result of increased risks for the climate hazards snowpack reduction and seasonal changes. The top three (3) climate hazards that resulted in the highest number of risk ratings for “high” and “very high” were heat stress, rainfall, and seasonal changes. The following sections provides a high-level summary of the most imminent climate change threats.

Forests

Forests in CH’s watersheds are under imminent threat from climate change, with a prominent risk being heat stress and dry conditions leading to increased vegetation mortality and fires. Climate hazards affect park accessibility and residents’ wellbeing, particularly given the expected escalation of heat stress through 2050. Broader impacts include diminished biodiversity and increased spread of invasive species.

Groundwater

Climate change poses severe threats to groundwater in CH’s watersheds. The risk assessment identifies multiple risks, including dry conditions, heat stress, seasonal changes, and snowpack reduction, which collectively endanger groundwater wells, leading to potential decreases in recharge and water supply. The risks intensify through 2050 and 2080 potentially impacting domestic water supply and causing distress for residents.

Lakeshore

Climate change poses a multitude of threats to CH’s shorelines, including risk of dry conditions, heat stress, rainfall, wind, seasonal changes, and snowpack reduction through both 2050 and 2080. The shoreline is heavily populated and frequently visited, facing risks such as flooding from water level increase, rainfall, and wind, which may impede access and increase physical hazards. Algal blooms and shoreline erosion are additional concerns resulting from heat stress and increased wind and possible high lake levels.

Meadows

Meadows within CH’s watersheds face climate-related threats that have implications for both human health and terrestrial ecology. Risk to human health include the increased presence of ticks and an extended tick season due to seasonal changes and snowpack reduction by 2080. Heat stress may also predispose meadow terrestrial species to drying, potentially leading to die-offs and a loss of biodiversity. Seasonal changes may disrupt the synchronization of food and habitat availability for both meadow and migrating species.

Ponds and Lakes

Ponds and lakes within CH's watersheds confront a spectrum of climate-related challenges. Ponds and lakes are at risk of dry conditions, heat stress, rainfall, seasonal changes, and snowpack reduction through 2050 and 2080. Heat stress emerges as a pertinent threat by inducing elevated sediment and nutrient concentrations and algae blooms, potentially diminishing aesthetic appeal and curtailing public access to water bodies.

Streams

Streams in CH's watersheds face multifaceted threats from climate change. Increased rainfall may lead to floods risking human health and causing property damage. Through 2080, seasonal changes and snowpack reduction exacerbate these risks, affecting spring freshet, increasing runoff volumes, and elevating the potential for ice jams and erosion. Climate scenarios through 2050 and 2080 heighten the potential for flashier systems and increased water levels. Streams are at risk of dry conditions, heat stress, rainfall, seasonal changes, and snowpack reduction through 2050 and 2080.

Vernal Pools

Vernal pools are critical for various terrestrial and amphibian species and face significant climate threats. Vernal pools are at risk of dry conditions, heat stress, rainfall, seasonal changes, and snowpack reduction through 2050 and 2080. Dry conditions pose risks such as long-term damage to species if pools dry up earlier, impacting breeding habitats and causing die-offs. Heat stress increases water temperatures, reducing breeding habitats and causing further mortality.

Wetland – Swamp

Wetland swamps in CH's watersheds are under multiple climate threats, including dry conditions, heat stress, rainfall, seasonal changes, and snowpack reduction (2080). These threats, particularly dry conditions, and heat stress, may reduce water levels, potentially causing long-term damage or complete dry-out. Excessive rainfall, on the other hand, can lead to flooding, negatively impacting terrestrial vegetation and wildlife. Snowpack reduction poses a risk like that for vernal pools, potentially affecting early spring breeding amphibians.

Wetland – Marsh

Wetland marshes in CH's watersheds face multiple climate change threats. Through 2050, marshes are at risk of dry conditions, heat stress, and seasonal changes, impacting terrestrial and aquatic ecology. Dry conditions and heat stress may lead to reduced water levels, affecting vegetation and habitats for terrestrial species. Seasonal changes contribute to wildlife habitat disruptions, migration challenges, and altered breeding conditions. Snowpack reduction affects spring freshet crucial for early spring breeding amphibians. Through 2080, marshes face an elevated risk of snowpack reduction, potentially intensifying these challenges. These climate-induced threats not only impact terrestrial and aquatic ecosystems but also affect water quality, erosion, sedimentation, and flooding risks, highlighting the significance of marshes and the potential consequences for Conservation Halton's watersheds' ecological and human health and biodiversity.

Adaptive Capacity

Another goal of the Climate Change Vulnerability and Risk Assessment was to understand CH's watershed's adaptive capacity and provide management recommendations to strengthen and stretch it. In this context, adaptive capacity means a system's ability to adjust to climate change and avoid or reduce damages while taking advantage of opportunities. Adaptive capacity demonstrates how well a system (natural resource or ecosystem) can manage a change or disturbance.

CH already has programs and services that support adaptive capacity to climate change, as identified through CH's Strategic Plan and reported on through CH's Annual Reports. These programs and services include watershed monitoring, water control structures and operations, watershed planning, restoration programs, forestry management, landowner outreach, land management, and planning and regulations.

Recommendations

The Climate Change Vulnerability and Risk Assessment provides strategic recommendations for managing natural resources throughout CH's watersheds to enhance resilience to climate change impacts. The recommended actions represent a strategic and evidence-based response to address projected future climate risks to natural resources and the benefits and services they provide. The recommendations build on the adaptive capacity measures already in place and represent the continuing efforts and commitments already made by CH.

The assessment report recommends that the primary emphasis be on actions that reduce risk to public safety and property damage (e.g., flood and erosion risk mitigation). Secondary priorities should consider multiple benefits (e.g., ecology, recreation). While climate change risks are the focal point of this assessment, the cumulative impacts from urbanization and other land use activities need to be considered when assessing impacts to natural systems.

The following provides a high-level summary of the key recommendations. The Executive Summary attached to this report (Attachment 1: Conservation Halton Watershed Climate Change Vulnerability and Risk Assessment) provides a full list of recommendations.

General Recommendations

- Review and enhance monitoring programs to integrate climate change considerations,
- Renew watershed plans to encompass scenarios integrating climate change projections,
- Model hydrologic impacts of climate change on a watershed scale, and
- Continue coordination with municipal partners to share climate change data and develop collaborative strategies.

Flooding

- Continue updating, enhancing, and adjusting the operations of water control structures and flood forecasting and warning system in response to climate change effects;
- Continue monitoring (e.g., ice jams) and expand the hydrometric and weather station network to cover greater area of CH's jurisdiction to capture high-intensity, short duration, and localized storm events to enable timely responses to flood threats;

- Maintain and expand natural areas (e.g., forest, wetland) to help maintain hydrologic conditions in the watersheds;
- Continue regular updates of regulatory flood hazard mapping to reflect changes due to climate change; and
- Consider implementing flood risk mapping to support municipal emergency preparedness.

Erosion and Sedimentation

- Monitor the rate of shoreline erosion, monitor stream and valley slope stability, and regularly undertake recurring water course erosion surveys.

Groundwater

- Continue monitoring groundwater quantity and expand monitoring network at select locations; and
- Use existing and, where necessary, enhance groundwater models to better understand the interactions between surface and groundwater and assess important groundwater discharge reaches throughout the watersheds.

Water Quality

- Identify gaps in the water monitoring network and expand the network where needed to capture trends resulting from climate change; and
- Expand wetland monitoring, preservation, and improvement programs to mitigate against water quality impacts.

Aquatic Ecology

- Continue and adjust aquatic monitoring to identify climate change impacts on water quality, and aquatic habitats,
- Develop species-specific monitoring and restoration strategies for climate vulnerable species, and
- Model impacts of climate change on thermal dynamics of streams to identify reaches where targeted restoration efforts could maintain cold-water status under future climatic conditions.

Terrestrial Ecology

- Continue and adjust the Long-Term Environmental Monitoring Program (LEMP) to capture climate change trends;
- Model the impact of climate change on wildlife corridors and migration patterns;
- Continue existing programs designed to build resilient forests within the watersheds;
- Expand forest areas, where possible; and
- Prepare CH-owned forests against forest fires due to heat stress and precipitation changes.

Biodiversity Loss

- Continue and adjust wildlife habitat monitoring through LEMP and other monitoring initiatives, and
- Develop an invasive species strategy for CH lands.

Conservation Halton Services

- Prepare for and adapt services to respond to potential climate change impacts and changes (e.g., lack of snow for skiing, lack of forest cover or degraded areas due to heat stress, wind, and seasonal changes).

Next Steps

Staff will draft a Watershed Climate Resiliency Strategy considering the findings of the Climate Change Vulnerability and Risk Assessment report, input and feedback received from CH and municipal staff, and other relevant documentation. Staff is seeking Board approval of the recommendations contained in the Climate Change Vulnerability and Risk Assessment as the foundation for building the Watershed Climate Resiliency Strategy. The Executive Summary and Full Report for the Watershed Climate Change Vulnerability and Risk Assessment will be posted to CH's website by the end of February 2024.

Impact on Strategic Priorities

This report supports four (4) Momentum priorities including Natural Hazards and Water; Science, Conservation and Restoration; Education, Empowerment and Engagement; and Nature and Parks.

Financial Impact

There is no financial impact to this report.

Signed & respectfully submitted:

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Attachments:

Attachment 1: Conservation Halton Watershed Climate Change Vulnerability and Risk Assessment

CONSERVATION HALTON WATERSHED CLIMATE CHANGE VULNERABILITY AND RISK ASSESSMENT

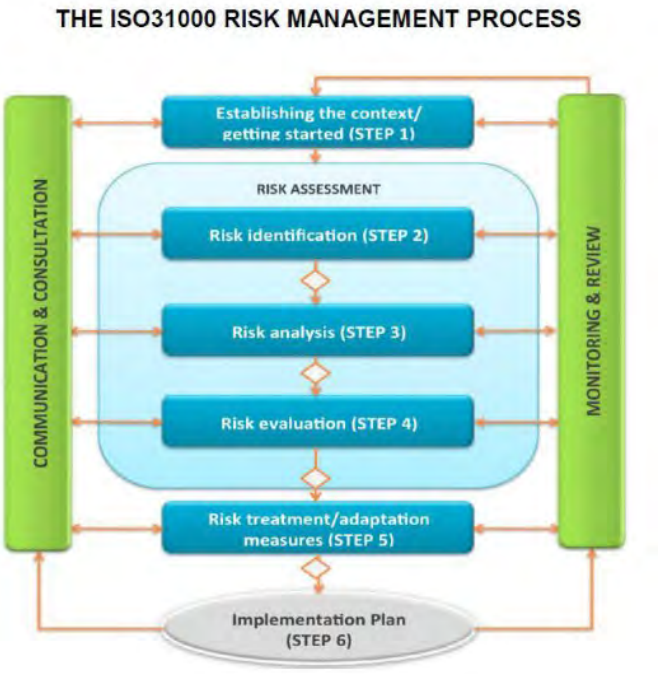
EXECUTIVE SUMMARY

Conservation Halton serves the local community by offering essential services designed to tackle and alleviate environmental challenges, especially those intensified by climate change. These challenges, like threats to human health, property, and the well-being of terrestrial and aquatic ecosystems, are on the rise. Conservation Halton provides programs to enhance the resilience of the watershed's ecosystem. This, in turn, safeguards local communities from the adverse effects of increasingly unpredictable, warmer and wetter weather patterns associated with climate change. Through this process it has become clear that the natural resources at the watershed level provide critical services to the residents of these watersheds and need to be maintained, protected and expanded.

This Climate Change Vulnerability and Risk Assessment, developed in collaboration with Conservation Halton, aims to evaluate the potential future climate risks to the natural resources in their watersheds. The goal is to identify where vulnerability and risk is highest to natural resources and recommend additional actions that can be taken to boost adaptive capacity and resilience. These actions will assist Conservation Halton in maintaining and protecting their jurisdiction's natural resources and the associated services that these resources provide in a changing climate. Natural resources, like forests and wetlands, act as a protective shield against climate change impacts, such as flooding, affecting residents across the watershed. By prioritizing actions that enhance the ability of these resources and employing environmental science Conservation Halton can fortify the resilience of watershed ecosystems. This is in alignment with Conservation Halton's Strategic Plan Momentum (Conservation Halton, 2024), and aims to reduce the negative effects of climate change on local communities.

Methodology

The risk assessment methodology is based on the International Organization for Standardization (ISO) 31000 risk framework (see below). This process involved continuous engagement with Conservation Halton staff. The risk management process was focused on natural resources, where the Climate Change Vulnerability and Risk Assessment offers a unique and comprehensive approach for evaluating climate risks and developing adaptation measures for these resources, which is something not frequently done on a watershed scale.



Reference: https://www.iso.org/obp/ui/#iso:std:iso:31000:ed-2:v1:en

The recommendations from this assessment build on existing programs and services implemented or planned by Conservation Halton. The assessment pinpoints areas where climate hazards and impacts on natural resources may affect Conservation Halton's ability to deliver services.

Communication and collaboration with stakeholders were central to the assessment process. Internal stakeholders, including those within Conservation Halton, and external stakeholders, particularly local municipalities within Conservation Halton's jurisdiction, were actively involved. The organization's in-depth understanding of its natural resources, watersheds, programming, operations, and services played a pivotal role in crafting the Climate Change Vulnerability and Risk Assessment. This internal knowledge provided valuable insights utilized throughout the assessment. It was key to understand where there has been historical experience with vulnerability in the current climate, and how existing and planned programs may enhance adaptive capacity of Conservation Halton.

A strategic review of legislative requirements and previous reports was conducted to better understand the context around climate change and adaptation within Conservation Halton’s jurisdiction. This involved considering national and provincial climate change guidelines, as well as reviewing previous work by Conservation Halton in assessing the vulnerabilities of the watersheds and the inventories of natural resources. In Ontario, Conservation Halton operates under the Conservation Authorities Act, which has as its purpose "to provide for the organization and delivery of programs and services that further the

conservation, restoration, development and management of natural resources in watersheds in Ontario." Section 21 of the Act sets out the range of programs and services that Conservation Authorities can provide. Specific programs and services that a conservation authority must provide includes the consideration of climate change as set out in O. Reg. 686/21. In addition, the legislation allows for a delivery of additional programs and services provided that agreements between the conservation authority and their participating municipalities for their delivery are in place. This enables conservation authorities and their municipal partners to be responsive to natural resource issues and management needs unique to their watershed.

Conservation Halton is currently developing a Watershed-based Resource Management Strategy as required by legislation. The purpose of this initiative is to ensure compliance with the legislation, identify those issues and risks that limit the effectiveness of programs and services, and identify actions and associated costs to address the issues and mitigate risks.

Natural Resources

The selection of key natural resources for this assessment was collaboratively developed during an early workshop with Conservation Halton's staff. These resources hold substantial importance and provide various benefits across Conservation Halton's watersheds. The significant natural resources considered in the assessment include:

- Forests
- Groundwater
- Lakeshore
- Meadow
- Pond/Lake
- Stream
- Wetland – Swamp
- Wetland – Marsh
- Vernal Pools

Climate Hazards

As part of the strategic context review, Matrix identified climate hazards that played a crucial role in shaping the risk assessment stage. To understand how each potential hazard might change in the future due to climate conditions, Matrix considered the historical record and utilized best practice climate change projections under a high emissions scenario. This involved selecting specific climate variables or parameters that best capture the conditions and drawing information from nationally recognized climate data portals and published material. Matrix assessed how these variables are likely to change in the mid-term (30 years) and long-term (60 years) future.

While there were subtle differences in historical records and future projections across Conservation Halton's watersheds (e.g., above and below the Niagara Escarpment), there was an overall high level of uniformity in the changes in future climate conditions and the likelihood of occurrence between data portals and previous studies for most parameters. The following climate hazards are the ones that best quantified the impact on natural resources in Conservation Halton's watersheds:

- Dry Conditions
- Rainfall/Riverine Flooding
- Heat Stress
- Seasonal Changes
- Snowpack Reduction
- Wind

Of these hazards, Snowpack Reduction and Seasonal Changes were the only climate parameters to have a higher likelihood of occurrence scoring value in the 2080s in comparison to the 2050s, whereas for the others the projected change was similar for both future time periods.

Consequences of Climate Change

Matrix used the likelihood scores along with the consequence scores to determine the level of risk Conservation Halton faces regarding future climate conditions that could adversely impact natural resources, ecosystems, and the services dependent on them. The vulnerability and risk assessment process allowed Matrix to leverage existing knowledge and evidence concerning future climate projections and the natural functions of the watershed and helped identify and prioritize climate risks. During the risk identification step, Matrix pinpointed where climate hazards could potentially impact natural resources. Out of the 54 potential combinations of climate hazards and natural resource types, Conservation Halton staff confirmed that only one case had no interactions, while 53 cases exhibited interactions.

Consequences arise when there is an interaction between a climate hazard and a natural resource that causes a measurable shift in the natural resource's condition and performance and the level of services that they provide. The consequences were placed into seven categories used in calculating the risk rating:

- Human health and property
- Terrestrial ecology
- Aquatic ecology
- Water quality
- Erosion and sedimentation
- Flooding
- Conservation Halton services

These categories helped assess the magnitude, extent, or duration of consequences, providing a comprehensive framework for evaluating the overall risk associated with climate hazards and their impacts on natural resources.

Climate Change Impacts

The Project Team collaborated with subject matter experts from Conservation Halton to gather insights and assign values to consequences for interactions between natural resources and climate hazards under each of the seven categories identified. This step was crucial in harnessing the diversity of expertise across watershed managers and technical experts in assessing the potential impacts of climate change on these natural resources. Once consensus was reached on consequence scores, the next step was calculating risk scores.

The watershed level assessment considered factors like land use and vulnerable areas defined by Conservation Halton and by mapping natural resource location onto the watershed. This qualitative analysis aimed to discuss risks across the watersheds, identifying areas that might be more vulnerable than others. This comprehensive approach ensured a thorough understanding of the potential impact of climate hazards on natural resources throughout Conservation Halton's watersheds.

After assessing vulnerability and risk at the watershed level, Matrix evaluated adaptive capacity by examining programs and services already provided by Conservation Halton that enhance the resilience of the watersheds. The adaptive capacity measures are linked to the following areas:

- Conservation Halton's Programs and Services
- Flood forecasting and warning
- Flood and erosion control
- Drought/low water program
- Management of Conservation Authority-owned land
- Drinking Water Source Protection
- Surface and groundwater monitoring programs
- Ecological monitoring programs
- Regulating the impacts of development and activities in hazard areas
- Watershed strategies

Findings

The risk assessment findings show how natural resources may be affected by different climate hazards. In consultation with Conservation Halton staff, it was decided to focus on interactions that had a "high" (15+) or "very high" (20+) risk rating. The analysis revealed 38 interactions for 2050 climate projections and 41 interactions for 2080 projections. The only change between 2050 and 2080 was that some risks, like Snowpack Reduction and Seasonal Changes, became more likely and received higher risk ratings. Heat

stress, rainfall, and seasonal changes were the top three climate hazards associated with high and very high-risk ratings. This information helped prioritize where to focus efforts in managing climate-related risks.

Recommendations

This section provides the recommendations emerging from this risk assessment, supported by input from subject matter experts across diverse fields from Conservation Halton and Matrix. Most of these recommendations are not standalone initiatives but represent the continuation of ongoing efforts and commitments already made by Conservation Halton. Examples of ongoing and relevant programs include the 2020 *Strategic Forest Management Plan* and the 2023 report *Effects of Climate Change on Biodiversity within Conservation Halton's Watersheds*.

The recommendations considered the adaptive capacity measures and existing studies by Conservation Halton that also propose recommendations for the watersheds. The discussion includes suggestions on how Conservation Halton can enhance existing programs and studies to contribute to the development of a Watershed-based Resource Management Strategy.

General Recommendations

These initial general recommendations are provided to give overarching guidance to assist in building Conservation Halton's adaptive capacity to a changing climate. More detailed recommendations follow.

- Review all monitoring programs to integrate climate change considerations by evaluating monitoring network density, data collection methods, measurement parameters, and monitoring protocols. Identify key indicators and assess spatial and temporal scales for aligning with projected climate change impacts. Enhance monitoring efforts with emerging technologies and data sharing mechanisms to inform adaptive strategies and sustainable management practices.

- Renew Watershed Plans for each of Conservation Halton's watersheds to encompass scenarios integrating climate change projections, land use changes, and natural resource scenarios reflecting climate change impacts. These plans will anticipate hydrological shifts and ecological impacts within the watershed. Integrate land use and natural resource scenarios to assess potential stressors and inform adaptive management strategies for sustainable watershed management amidst evolving environmental conditions.

- Model hydrologic impacts of climate change on a watershed scale. Utilize climate projections and hydrological models to simulate changes in rainfall intensity, duration, and frequency over time. Incorporate Intensity-Duration-Frequency (IDF) curve shifts into planning and risk assessment frameworks to enhance resilience against extreme weather events and mitigate potential flood risks associated with climate variability.

- Continue to coordinate with municipal partners to share climate change data and develop collaborative strategies. Create a hub for climate change data and watershed-scale assessments to facilitate information sharing and decision-making among stakeholders. Ensure accessibility and compatibility of data formats to allow for analysis and integration into municipal planning processes. Foster informed actions and resilience-building efforts across interconnected communities and watersheds.

Flooding

1. **Operations:**

   - Consider how climate change impacts flood risk and may necessitate changes in the operation of water control infrastructure

   - Continue updating Conservation Halton's flood forecasting and warning system to reflect any changes in seasonality or rainfall patterns that may emerge from climate change.

   - Consider reviewing the operational requirements for water control infrastructure to meet the seasonal, recreational and flood mitigation needs while considering the potential of low water levels due to climate change.

2. **Monitoring**:

   - Continue to monitor ice jams as seasonal changes and snowpack reduction exacerbate risks, reducing spring freshet, increasing runoff volumes, and elevating the likelihood of ice jams, erosion, and flooding.

   - Expand weather station network to provide coverage over a greater area of the jurisdiction to capture high-intensity, short duration, and localized storm events to enable timely responses to flood threats. This will increase the data for flood forecasting and warning, as well as hydrologic model calibration.

3. **Manage**: Maintain and expand natural areas (forest, wetland, etc.) to help maintain the hydrologic conditions in the watersheds. The water retention services of these areas help mitigate current flood risk and will be critical in providing adaptive capacity to intensive rainfall events under future climate conditions.

4. **Modelling:** Regularly update regulatory flood hazard mapping around ponds and streams to reflect the changes due to climate change.

   - Continue updating regulatory flood hazard mapping around streams to reflect the potential changes due to climate change. Consider implementing flood risk mapping to support municipal

emergency preparedness. This will reduce risks to human health and property, with increased flooding potential impacting emergency services and property damage.

- Use future climate scenarios, natural resource scenarios and hydrologic and hydraulic models to identify potential flood risk zones. This would identify possible water depth and velocity in flooded areas. This information can be used for emergency preparedness and risk management.

- Use hydrologic modelling to measure the potential impacts and help inform possible mitigation measures of climate change on wetlands. This would include reviewing ecologic impacts to wetlands and the ability of wetlands to mitigate flooding through vegetation changes and potential degradation.

Erosion and Sedimentation

1. **Monitoring**:

    - Monitor the rate of shoreline erosion. Study the potential for an increase in shoreline erosion from intensified storm surges and wave action, compromising shoreline integrity. Investigate strategies to mitigate shoreline erosion.

    - Monitor stream and valley slope stability to provide important information for flood and erosion control to allow for the development of effective strategies to manage the impacts of increased bankfull erosion flow events.

    - Undertake regular recurring water course erosion surveys and mitigate situations that introduce or aggravate the erosion hazard and associated impacts on infrastructure and valley ecology along accessible creek reaches.

Groundwater

1. **Monitoring:** Continue monitoring groundwater quantity through the Provincial Groundwater Monitoring Program and expanded locations at selected wetlands.

2. **Groundwater Discharge:** Utilize, and where needed, enhance existing groundwater models to better understand the interactions between surface and groundwater and assess and map out important groundwater discharge reaches throughout the watersheds. Validate modelling with surface water monitoring and aquatic information.

Water Quality

1. **Planning**: Continue to incorporate groundwater quality and quantity planning in the development of the Watershed Plans for the watersheds within Conservation Halton's jurisdiction.

2. **Surface Water Monitoring**: Identify gaps in the surface water quality monitoring network and expand the monitoring network with a goal of identifying and possibly mitigating trends resulting from climate

change. Assess the monitoring network for its ability to capture water quality trends. Continue monitoring surface water for the temperature impacts associated with reduced groundwater flow or the impacts of higher temperature groundwater. Continue monitoring water temperatures, water levels, erosion and pollutant loading in ponds/lakes for any negative impacts on biodiversity due to climate change.

3. **Wetlands Monitoring and Improvement:** Expand wetland monitoring, preservation and improvement programs to mitigate against water quality impacts. Monitor outfall of swamps that have historic records of water quality monitoring for the measurement of any reduction in water quality due to the impacts of climate change on the ability of swamps to provide the service of water quality improvement. Preserve and enhance natural wetlands to maintain the water quality improvements provided by these ecosystems, wherever possible. Increase wetland habitat to increase the water quality benefits and mitigate potential impacts from climate change on existing wetlands and possibly improve the water quality by a greater degree.

Aquatic Ecology

1. **Monitoring:** Continue and adjust, if needed, various monitoring programs being executed within the watersheds and implement a process to identify climate change impacts through these programs. Specific monitoring programs include:

    - Continue and adjust, if needed, the aquatic monitoring system that includes regular assessments of stream levels, rainfall patterns, water temperature, erosion dynamics, and water quality to assess aquatic biodiversity for changes due to climate change.

    - Continue and adjust, if needed, monitoring for impacts of climate change causing a reduction in fish spawning habitats due to the degraded quality of aquatic ecosystems in marshes.

2. **Restoration**: Implement the recommendations in the report *Effects of Climate Change on Biodiversity within Conservation Halton's Watersheds 2023* to "Develop species-specific monitoring and restoration strategies for target species at risk and climate-vulnerable species on Conservation Halton lands." Implement this recommendation for species impacted by the climate change effects on aquatic habitat including vernal pools.

3. **Modelling:** Undertake modelling of future climate scenarios to better understand and predict the impacts of climate change on the thermal dynamics of streams. Identify the risk of specific streams no longer being refugia for cold-water species. This will allow for identification of reaches where targeted restoration efforts would be beneficial to maintain a cold-water status under future climatic conditions.

Terrestrial Ecology

Forests

Recommendations for forests are particularly relevant for the large tracts of forest located above the Niagara Escarpment in northern Bronte Creek and the northwestern areas of Sixteen Mile Creek. These represent the largest areas of forest cover in Conservation Halton's jurisdiction.

1. **Monitoring**: Continue monitoring forest health using the Long-term Environmental Monitoring Program (LEMP) and other monitoring initiatives, including invasive species

2. **Wetland Monitoring:** Continue and adjust, if needed, Conservation Halton's Long-term Environmental Monitoring Program to monitor vernal pool, swamp and marsh habitats particularly for early spring breeding amphibians due to changes in snowpack and seasonality.

3. **Habitat Corridors:** Model the impact of climate change on wildlife corridors and migration patterns by integrating species-specific habitat suitability models, climate projections, and landscape connectivity analyses. Incorporate future climate scenarios to assess potential shifts in habitat ranges and corridor effectiveness.

4. **Build Resiliency**: Continue with existing programs designed to build resilient forests within the watersheds:

    - Implement the recommendations outlined in the 2020 *Strategic Forest Management Plan* to build forest resiliency against climate change. This will be accomplished through building the forest's resilience using effective management practices and by incorporating mitigation and adaptation strategies.

    - Implement recommendations from the *Effects of Climate Change on Biodiversity within Conservation Halton's Watersheds report*, focusing on enhancing forest resilience in particular Recommendation 5: "Develop a Seed Strategy for Conservation Halton's tree planting program to ensure that planting stock is adapted to future climate conditions."

5. **Expand Forests:** Expand forested areas through strategic land acquisition, when possible, to mitigate any forest losses due to climate change or even expand forested area to improve habitat connectivity and provide high quality contiguous habitat.

6. **Protect Against Fire**: Prepare for the onset of forest fire conditions due to heat stress and precipitation changes on Conservation Halton owned lands.

Biodiversity Loss

1. **Monitoring**: Maintain ongoing wildlife habitat monitoring in the Long-term Environmental Monitoring Program (LEMP) and other monitoring initiatives.

2. **Implement the recommendations in the Conservation Halton study**: *Effects of Climate Change on Biodiversity within Conservation Halton's Watersheds 2023*, pertaining to terrestrial biodiversity loss and climate change.

3. **Develop Invasive Species Strategy**: Develop an Invasive Species strategy and cooperate with other levels of government to coordinate efforts on detection, protection against, and destruction of invasive species.

Conservation Halton Services

1. **Adapt services:**

   - Assess potential alterations to visitor experiences, considering the potential impact on park revenue due to the lack of forest cover or degraded natural areas.

   - Prepare for potential impacts on Conservation Halton's services, including beach closures, infrastructure maintenance, reduction in availability of snow for skiing, and visitor experiences, due to heat stress, wind, and seasonal changes.

2. **Safety:**

   - Continue to implement signage and safety programs warning users of Conservation Halton's trails and natural areas to inform of ticks and the potential for Lyme disease.

   - Consider addressing the potential of safety concerns on lakeside authority property due to the potential for increased risk of tripping and falling due to precipitation, waves, and wind, impacting human health and safety.