



CSA W224:24
National Standard of Canada



Coastal flood risk assessment for buildings and infrastructure



Legal Notice for Standards

Canadian Standards Association (operating as “CSA Group”) develops standards through a consensus standards development process approved by the Standards Council of Canada. This process brings together volunteers representing varied viewpoints and interests to achieve consensus and develop a standard. Although CSA Group administers the process and establishes rules to promote fairness in achieving consensus, it does not independently test, evaluate, or verify the content of standards.

Disclaimer and exclusion of liability

This document is provided without any representations, warranties, or conditions of any kind, express or implied, including, without limitation, implied warranties or conditions concerning this document’s fitness for a particular purpose or use, its merchantability, or its non-infringement of any third party’s intellectual property rights. CSA Group does not warrant the accuracy, completeness, or currency of any of the information published in this document. CSA Group makes no representations or warranties regarding this document’s compliance with any applicable statute, rule, or regulation.

IN NO EVENT SHALL CSA GROUP, ITS VOLUNTEERS, MEMBERS, SUBSIDIARIES, OR AFFILIATED COMPANIES, OR THEIR EMPLOYEES, DIRECTORS, OR OFFICERS, BE LIABLE FOR ANY DIRECT, INDIRECT, OR INCIDENTAL DAMAGES, INJURY, LOSS, COSTS, OR EXPENSES, HOWSOEVER CAUSED, INCLUDING BUT NOT LIMITED TO SPECIAL OR CONSEQUENTIAL DAMAGES, LOST REVENUE, BUSINESS INTERRUPTION, LOST OR DAMAGED DATA, OR ANY OTHER COMMERCIAL OR ECONOMIC LOSS, WHETHER BASED IN CONTRACT, TORT (INCLUDING NEGLIGENCE), OR ANY OTHER THEORY OF LIABILITY, ARISING OUT OF OR RESULTING FROM ACCESS TO OR POSSESSION OR USE OF THIS DOCUMENT, EVEN IF CSA GROUP HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, INJURY, LOSS, COSTS, OR EXPENSES.

In publishing and making this document available, CSA Group is not undertaking to render professional or other services for or on behalf of any person or entity or to perform any duty owed by any person or entity to another person or entity. The information in this document is directed to those who have the appropriate degree of experience to use and apply its contents, and CSA Group accepts no responsibility whatsoever arising in any way from any and all use of or reliance on the information contained in this document.

CSA Group is a private not-for-profit company that publishes voluntary standards and related documents. CSA Group has no power, nor does it undertake, to enforce compliance with the contents of the standards or other documents it publishes.

Intellectual property rights and ownership

As between CSA Group and the users of this document (whether it be in printed or electronic form), CSA Group is the owner, or the authorized licensee, of all works contained herein that are protected by copyright, all trade-marks (except as otherwise noted to the contrary), and all inventions and trade secrets that may be contained in this document, whether or not such inventions and trade secrets are protected by patents and applications for patents. Without limitation, the unauthorized use, modification, copying, or disclosure of this document may violate laws that protect CSA Group’s and/or others’ intellectual property and may give rise to a right in CSA Group and/or others to seek legal redress for such use, modification, copying, or disclosure. To the extent permitted by licence or by law, CSA Group reserves all intellectual property rights in this document.

Patent rights

Attention is drawn to the possibility that some of the elements of this standard may be the subject of patent rights. CSA Group shall not be held responsible for identifying any or all such patent rights. Users of this standard are expressly advised that determination of the validity of any such patent rights is entirely their own responsibility.

Authorized use of this document

This document is being provided by CSA Group for informational and non-commercial use only. The user of this document is authorized to do only the following:

If this document is in electronic form:

- load this document onto a computer for the sole purpose of reviewing it;
- search and browse this document; and
- print this document if it is in PDF format.

Limited copies of this document in print or paper form may be distributed only to persons who are authorized by CSA Group to have such copies, and only if this Legal Notice appears on each such copy.

In addition, users may not and may not permit others to

- alter this document in any way or remove this Legal Notice from the attached standard;
- sell this document without authorization from CSA Group; or
- make an electronic copy of this document.

If you do not agree with any of the terms and conditions contained in this Legal Notice, you may not load or use this document or make any copies of the contents hereof, and if you do make such copies, you are required to destroy them immediately. Use of this document constitutes your acceptance of the terms and conditions of this Legal Notice.



Standards Update Service

CSA W224:24
August 2024

Title: *Coastal flood risk assessment for buildings and infrastructure*

To register for e-mail notification about any updates to this publication go to updates.csagroup.org.

The **List ID** that you will need to register for updates to this publication is **2431212**.

If you require assistance, please e-mail techsupport@csagroup.org or call 416-747-2233.

Visit CSA Group's policy on privacy at www.csagroup.org/legal to find out how we protect your personal information.

Canadian Standards Association (operating as “CSA Group”), under whose auspices this National Standard has been produced, was chartered in 1919 and accredited by the Standards Council of Canada to the National Standards system in 1973. It is a not-for-profit, nonstatutory, voluntary membership association engaged in standards development and certification activities.

CSA Group standards reflect a national consensus of producers and users — including manufacturers, consumers, retailers, unions and professional organizations, and governmental agencies. The standards are used widely by industry and commerce and often adopted by municipal, provincial, and federal governments in their regulations, particularly in the fields of health, safety, building and construction, and the environment.

More than 10 000 members indicate their support for CSA Group’s standards development by volunteering their time and skills to Committee work.

CSA Group offers certification and testing services in support of and as an extension to its standards development activities. To ensure the integrity of its certification process, CSA Group regularly and continually audits and inspects products that bear the CSA Group Mark.

In addition to its head office and laboratory complex in Toronto, CSA Group has regional branch offices in major centres across Canada and inspection and testing agencies in fourteen countries. Since 1919, CSA Group has developed the necessary expertise to meet its corporate mission: CSA Group is an independent service organization whose mission is to provide an open and effective forum for activities facilitating the exchange of goods and services through the use of standards, certification and related services to meet national and international needs.

For further information on CSA Group services, write to
CSA Group
178 Rexdale Boulevard
Toronto, Ontario, M9W 1R3
Canada

A National Standard of Canada is a standard developed by a Standards Council of Canada (SCC) accredited Standards Development Organization, in compliance with requirements and guidance set out by SCC. More information on National Standards of Canada can be found at www.scc.ca.

SCC is a Crown corporation within the portfolio of Innovation, Science and Economic Development (ISED) Canada. With the goal of enhancing Canada’s economic competitiveness and social wellbeing, SCC leads and facilitates the development and use of national and international standards. SCC also coordinates Canadian participation in standards development, and identifies strategies to advance Canadian standardization efforts.

Accreditation services are provided by SCC to various customers, including product certifiers, testing laboratories, and standards development organizations. A list of SCC programs and accredited bodies is publicly available at www.scc.ca.

Standards Council of Canada
600-55 Metcalfe Street
Ottawa, Ontario, K1P 6L5
Canada



Cette Norme Nationale du Canada est disponible en versions française et anglaise.

Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users to judge its suitability for their particular purpose.

®A trademark of the Canadian Standards Association, operating as “CSA Group”

National Standard of Canada

CSA W224:24

***Coastal flood risk assessment for
buildings and infrastructure***



*®A trademark of the Canadian Standards Association,
operating as "CSA Group"*



*Published in August 2024 by CSA Group
A not-for-profit private sector organization
178 Rexdale Boulevard, Toronto, Ontario, Canada M9W 1R3*

*To purchase standards and related publications, visit our Online Store at
www.csagroup.org/store/ or call toll-free 1-800-463-6727 or 416-747-4044.*

*ICS 03.100.01, 91.129.90, 13.020.30
ISBN 978-1-4883-4968-3*

*© 2024 Canadian Standards Association
All rights reserved. No part of this publication may be reproduced in any form whatsoever
without the prior permission of the publisher.*

Contents

Technical Committee on Coastal Flood Risk Assessment for Buildings and Infrastructure 5

Preface 7

Sustainable Development Goals (SDG) Foreword 8

0 Introduction 9

1 Scope 9

1.1 Inclusions 9

1.2 Exclusions 9

1.3 Users 9

1.4 Applicability 10

1.5 Terminology 10

2 Reference publications 10

3 Definitions and abbreviations 13

3.1 Definitions 13

3.2 Abbreviations 14

4 Framework for coastal flood risk assessment 14

5 Public engagement planning and implementation 16

5.1 General 17

5.2 Engagement of Indigenous peoples 17

5.3 Communications and engagement specialists 17

5.4 Internal commitment, and determining the scope and purpose of engagement 17

5.4.1 General 17

5.4.2 Internal commitment 17

5.4.3 Scope and purpose of engagement 18

5.5 Interested parties 18

5.5.1 Identification of interested parties 18

5.5.2 Engaging interested parties 19

5.6 Determining level and scale of engagement 19

5.7 Public engagement plan 19

5.8 Inviting interested parties and decision-makers 19

5.8.1 Basic principles 19

5.8.2 Committee composition 20

5.9 Implementing a public engagement plan 20

5.10 Documenting activities 20

6 Risk-based design criteria 20

6.1 General 20

6.2 Contribution to strategic planning and risk management goals 21

6.2.1 General 21

6.2.2 Regional, systems-based approach to coastal management 21

6.2.3	Long-term flood risk management planning	21
6.3	Multiple coastal flood hazard AEPs	22
6.4	Changing natural hazards	22
6.4.1	Addressing climate change	22
6.4.2	Risks from other natural hazards	22
6.5	Criticality of buildings and infrastructure	22
6.6	Wider social and ecosystem risk-based criteria	25
6.6.1	General	25
6.6.2	Social risk-based criteria	25
6.6.3	Ecosystem criteria	25
7	Data assembly and gap analysis	25
7.1	General	25
7.2	Water level data	26
7.2.1	General	26
7.2.2	Available water level data	26
7.2.3	Water level data acquisition	26
7.2.4	Quality control of water level data	26
7.3	Meteorological data	27
7.3.1	General	27
7.3.2	Available meteorological data	27
7.3.3	Meteorological data acquisition	27
7.3.4	Quality control of meteorological data	28
7.4	Ice data	28
7.4.1	General	28
7.4.2	Available ice data	29
7.4.3	Ice data acquisition	29
7.4.4	Quality control of ice data	29
7.5	Wave data	29
7.5.1	Measured wave data	29
7.5.2	Modelled wave data	29
7.5.3	Available wave data	29
7.5.4	Wave data acquisition	29
7.5.5	Quality control of wave data	30
7.6	Tsunami data	30
7.6.1	General	30
7.6.2	Available tsunami data	30
7.6.3	Tsunami data acquisition	30
7.6.4	Quality control of tsunami data	30
7.7	Bathymetric and topographic data	30
7.7.1	General	30
7.7.2	Available bathymetric and topographic data	30
7.7.3	Bathymetric and topographic data acquisition	31
7.7.4	Quality control of bathymetric and topographic data	31
7.8	Aerial imagery	32
7.8.1	General	32
7.8.2	Available aerial imagery	32
7.8.3	Aerial imagery data acquisition	32
7.8.4	Quality control of aerial imagery	32

7.9	Climate change data	32
7.9.1	General	32
7.9.2	Available climate change data	32
7.10	Community planning, building, and infrastructure data	33
7.10.1	General	33
7.10.2	Available planning, building, and infrastructure data	33
7.10.3	Planning, building, and infrastructure data acquisition	33
7.10.4	Quality control of planning, building, and infrastructure data	33
7.11	Flood damage functions	34
7.11.1	General	34
7.11.2	Available flood damage functions	34
7.11.3	Flood damage data acquisition	34
7.11.4	Quality control of flood damage data	34
7.12	Socio-cultural, environmental, and indirect consequence data	34
7.12.1	General	34
7.12.2	Available socio-cultural, environmental, and indirect consequence data	35
7.12.3	Examples of socio-cultural, environmental, and indirect consequence data	35
7.12.4	Quality control of socio-cultural, environmental, and indirect consequence data	36

8 Determining the level of analysis of the risk assessment 36

8.1	General	36
8.2	Factors affecting the level of analysis	37
8.2.1	Study objectives	37
8.2.2	Spatial extent of study area	37
8.2.3	Criticality of buildings or infrastructure	37
8.2.4	Data availability	37
8.2.5	Quality and specificity of available data	37
8.2.6	Financial, schedule, and resource capacity	37
8.3	Approaches to risk assessment	37
8.3.1	Qualitative risk assessments	37
8.3.2	Quantitative risk assessments	38
8.3.3	Consideration of risk as an evolving concept	38
8.3.4	Consideration of asset risk and systemic risk	38
8.4	Following a phased approach to risk assessment	38
8.4.1	General	38
8.4.2	Initial scoping phase	39
8.4.3	High-level risk assessment	39
8.4.4	Detailed asset risk assessment	39
8.4.5	Detailed systemic risk assessment	40

9 Hazard assessment 40

9.1	General	40
9.2	Hazard identification	40
9.2.1	General	40
9.2.2	Hazard sources	41
9.2.3	Hazard pathways	41
9.3	Defining hazard metrics	41
9.4	Hazard modelling and analysis	41
9.4.1	Assess meteorological and oceanographical conditions	41

9.4.2	Assess physical characteristics of the site as they affect coastal hazards	41
9.4.3	Assess nearshore conditions	42
9.4.4	Numerical model development	42
9.4.5	Numerical model calibration and validation	42
9.4.6	Source-pathway scenario analysis	42
9.4.7	Estimating annual exceedance probabilities	42
9.5	Coastal flood hazard mapping	42
10	Vulnerability and consequence assessment	42
10.1	General	42
10.2	Approach	43
10.3	Assessing exposure	43
10.4	Assessing vulnerability	43
10.5	Assessing consequences	43
10.5.1	General	43
10.5.2	Coastal storm floods	43
10.5.3	Tsunamis	43
10.5.4	Direct building damages	44
10.5.5	Direct infrastructure damages	44
10.5.6	Socio-cultural, environmental, and indirect economic consequences	44
10.5.7	Indirect impacts	44
10.5.8	Intangible consequences	44
10.5.9	Presenting information on vulnerability and consequences	44
11	Risk assessment	45
11.1	General	45
11.2	Qualitative assessment	45
11.3	Semi-quantitative assessment	45
11.4	Quantitative assessment	45
11.5	Risk matrices	45
11.6	Capacity for response and recovery	46
11.7	Risk assessment outputs	46
12	Risk management, mitigation, and adaptation	46
12.1	General	46
12.2	Nature-based approaches	46
12.3	Use of community and land use planning for flood risk reduction	46
12.4	Strategies to reduce residual flood risk	46
12.4.1	General	46
12.4.2	Risk avoidance	46
12.4.3	Resistance, resilience, and repairability measures	47
12.5	Managing residual risk	47

Technical Committee on Coastal Flood Risk Assessment for Buildings and Infrastructure

J. Wiebe	Environment and Climate Change Canada Gatineau, Québec, Canada <i>Category: Government and/or Regulatory Authority</i>	<i>Chair</i>
A. Danyluk	City of Vancouver Vancouver, British Columbia, Canada <i>Category: Municipalities and Broader Public Sector</i>	
M. Davies	Coldwater Consulting Ltd. Ottawa, Ontario, Canada <i>Category: Service Industry</i>	
D. Didier	Université du Québec à Rimouski (UQAR) Rimouski, Québec, Canada <i>Category: Research/Testing</i>	
J. Eyquem	Intact Centre on Climate Adaptation, University of Waterloo Montréal, Québec, Canada <i>Category: Research/Testing</i>	
S. Ferguson	National Research Council Canada Ottawa, Ontario, Canada <i>Category: Research/Testing</i>	
B. Greenan	Fisheries and Oceans Canada Halifax, Nova Scotia, Canada <i>Category: Government and/or Regulatory Authority</i>	
N. Hastings	Natural Resources Canada (NRCan) Vancouver, British Columbia, Canada <i>Category: Government and/or Regulatory Authority</i>	
C. Jones	Central Lake Ontario Conservation Authority Oshawa, Ontario, Canada <i>Category: Municipalities and Broader Public Sector</i>	
D. Kolijn	DHI Water & Environment Inc. Vancouver, British Columbia, Canada <i>Category: Service Industry</i>	

R. Mulligan	Queens University Kingston, Ontario, Canada	<i>Non-voting</i>
M. Osler	City of Surrey Surrey, British Columbia, Canada <i>Category: Municipalities and Broader Public Sector</i>	
J. Shoubridge	Thrive Consulting Whistler, British Columbia, Canada <i>Category: Service Industry</i>	
M. Tétégan Simon	Valores Research Institute Shippagan, New Brunswick, Canada <i>Category: Research/Testing</i>	
J. Van de Valk	Public Safety Canada North Vancouver, British Columbia, Canada <i>Category: Government and/or Regulatory Authority</i>	
P. Zuzek	Zuzek Inc. Waterdown, Ontario, Canada <i>Category: Service Industry</i>	
P. Steenhof	CSA Group Ottawa, Ontario, Canada	<i>Project Manager</i>

Preface

This is the first edition of CSA W224, *Coastal flood risk assessment for buildings and infrastructure*.

The purpose of this Standard is to

- a) provide guidance on coastal flood risk assessment; and
- b) inform the planning and design of buildings and infrastructure potentially exposed to coastal flood hazards.

CSA Group acknowledges that the development of this Standard was made possible, in part, by the financial support of the National Research Council Canada (NRC). This Standard was developed from the NRC publication *Coastal flood risk assessment guidelines for building and infrastructure design: Supporting flood resilience on Canada's coasts*. Users will note that while much of the information has been updated and edited for clarity and brevity, key concepts from the NRC report have been retained.

This Standard was prepared by the Technical Committee on Coastal Flood Risk Assessment for Buildings and Infrastructure, under the jurisdiction of the Strategic Steering Committee on Natural Resources, and has been formally approved by the Technical Committee.

This Standard has been developed in compliance with Standards Council of Canada requirements for National Standards of Canada. It has been published as a National Standard of Canada by CSA Group.

Notes:

- 1) *Use of the singular does not exclude the plural (and vice versa) when the sense allows.*
- 2) *Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.*
- 3) *This Standard was developed by consensus, which is defined by CSA Policy governing standardization — Code of good practice for standardization as “substantial agreement. Consensus implies much more than a simple majority, but not necessarily unanimity”. It is consistent with this definition that a member may be included in the Technical Committee list and yet not be in full agreement with all clauses of this Standard.*
- 4) *To submit a request for interpretation of this Standard, please send the following information to inquiries@csagroup.org and include “Request for interpretation” in the subject line:*
 - a) *define the problem, making reference to the specific clause, and, where appropriate, include a graphical image;*
 - b) *provide an explanation of circumstances surrounding the actual field condition; and*
 - c) *where possible, phrase the request in such a way that a specific “yes” or “no” answer will address the issue.*

Committee interpretations are processed in accordance with CSA Directives and guidelines governing standardization and are available on the Current Standards Activities page at standardsactivities.csagroup.org.

- 5) *This Standard is subject to review within five years from the date of publication. Suggestions for its improvement will be referred to the appropriate committee. To submit a proposal for change, please send the following information to inquiries@csagroup.org and include “Proposal for change” in the subject line:*
 - a) *Standard designation (number);*
 - b) *relevant clause, table, and/or figure number;*
 - c) *wording of the proposed change; and*
 - d) *rationale for the change.*