Ministry of Transportation and Infrastructure

INFORMATION BRIEFING NOTE

DATE: June 14, 2022

PREPARED FOR: Kaye Krishna, Deputy Minister of Transportation and Infrastructure
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ISSUE: System Based Approach for Climate Resilient Infrastructure Report

PURPOSE: Provide a summary of the report.

SUMMARY:

- **BC, in collaboration with Infrastructure Canada (INFC), engaged a consultant to explore systems-based approaches (SBA) for climate-resilient infrastructure systems and services.**
- **The report provided a review of twenty reports and case studies from various jurisdiction that analyzed responses to climate events, specifically focusing on preparation, response, recovery and rebuilding efforts.**
- **A future Phase 2 would expand the functional analysis, organize the analysis and provide recommendations in the context of the BC rebuild efforts.**

BACKGROUND:

In February 2022, BC (Ministry's of Transportation and Infrastructure (MOTI) / Municipal Affairs (MUNI)) and Infrastructure Canada (INFC) established a staff working group to collaborate on strategies for flood recovery, climate mitigation and adaptation. The key objective of the working group is to develop efficiencies between the Government of Canada and BC in support of the infrastructure recovery and resilience and to support a Canada-BC Deputy Minister's committee focused on the event.

The working group engaged IBI Group / Ramboll Consulting, an engineering firm with experience in climate resiliency and infrastructure planning, policy and implementation. The engagement was to conduct a literature review of systems-based approaches to risk management in response to climate events, highlight lessons learned and identify best practices from other jurisdictions that have experienced similar events that could be applied to resilient infrastructure management in a BC and Canada context. Appendix 1 provides an executive summary of the report.

PAST INTERACTIONS:

- None.

DISCUSSION:

The report is divided into four main sections: report methodology, highlights from the literature review, functional analysis of recommendations and conclusion / supporting materials.

Methodology

Reference materials and case studies were initially selected based on three categories: examples of system-based approaches that demonstrated climate change resilience; case studies describing extreme weather or climate events and general literature on climate preparedness, response, recovery and rebuilding. From this initial analysis, short-listed reports were further scored against three criteria: relevance to Canada, SBA and source quality. Based on this scoring, materials were narrowed to 20 reference materials and case studies from various jurisdictions across the world including Global (UN, World Bank, OECD), European, North America, and Asia & Oceania. Materials include both academic studies, government reports, white papers

Ministry of Transportation and Infrastructure

and case studies of recent events. Appendix 2 provides a list of references and case studies used in the report.

Literature Review

The literature review focused on categorizing material information and recommendations using five themes: technical, financial, policy and legal, socio-economic and governance and institutions. Each review provided a summary of the report's key findings, recommendations and best practices that are relevant to the Canadian context.

Functional Analysis of Recommendations

Key recommendations from the 20 documents were presented using a function analysis to convey the key findings. Some of the systems functions identified in the review are presented below.

Understand Need	Modify Building Codes	Measure Progress	Empower Locals	Regulate Industry
Regulate Resilience	Identify Risks	Set Standards	Clarify Roles	Retrofit Infrastructure
Leverage Nature based solutions	Address Agriculture	Stress-test systems	Integrate Plans	Pre-establish Incident management
Build-back-better infrastructure	Synergize Disciplines	Regulate Industry	Promote Innovation	Leverage social media / real-time information
Leverage Technology	Optimize Data	Raise Awareness		Establish frameworks
Price Risks	Renew Strategy	Set Policy		Expand Collaboration

These were categorized geographically in the report and could be synthesized in a future stage of work.

Conclusion and Future Phase.

This report summarizes the key findings from an international literature review to research the use of system-based approaches to mitigate the impacts of climate change. It includes a synthesis for each of the 20 documents reviewed in detail, a narrative highlighting some noteworthy content, and an initial functional analysis.

BC and INFC have provided initial feedback to the consultant team and a further draft reflecting BC and INFC's comments is expected on June 17. The updated draft report will reflect refocusing the report from a national (Canada) to BC perspective as well as bringing forward the functional analysis to earlier sections within the report.

A future phase two would build on the initial finding by incorporating feedback to expand and further refine the system functions. The goal would be to identify clear opportunities to implement scalable and flexible systems-based frameworks to improve resiliency of infrastructure in BC / Canada and cover the entire event timeframe from preparation to post-event recovery and rebuild.

GBA+ OR DIVERSITY AND INCLUSION IMPLICATIONS:

The systems-based approach to infrastructure risk management will include considerations of diversity and equity through a broad engagement of stakeholders and application of best practices.

FINANCIAL IMPLICATIONS:

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Phase 1 of the report will cost approximately s.13; s.17 with funding provided from BC's Transportation Investment Plan. Cost of subsequent phases will be contingent on the future scope of the engagement.

Attachments: (if applicable)

1. Executive Summary
2. Summary of Referenced Reports
3. Systems Based Approaches for Climate Resilient Infrastructure Part 1: Literature Review for the Canadian Context.

PREPARED BY:	REVIEWED BY:	DATE:
James Postans, Executive Director Planning & Programming Branch	Kevin Volk, ADM Integrated Transportation and Infrastructure Services	22-Jun-14

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Appendix 1 – Systems Based Approaches - Executive Summary

This report contains a review of systems-based approaches that could be applied in Canada to improve the resiliency of infrastructure to climate change. It contains examples of scalable (multilevel) and flexible (multi-context) systems-based approaches which cover the lifecycle of climate related events: from pre-event preparation, through initial response, to post-event recovery and the eventual rebuild.

This report was prepared to inform the work of the Committee of Deputy Ministers on Rebuilding of Public Infrastructure and to assist in the development of a National Adaptation Strategy (NAS) by Infrastructure Canada. It contains a review of systems-based approaches for climate resilient infrastructure, with the aim of identifying scalable solutions that could be delivered as part of the NAS, and which support BC's infrastructure rebuild program.

Our approach began with an international review of literature to identify examples of best practice, focusing on the use of systems-based approaches to adapt to climate change, case studies that describe the response to specific extreme weather or climate events with potential to impact Canada, and content relating to climate preparedness, response, recovery and rebuild.

An initial set of over a hundred documents was reduced to a shortlist of twenty, comprising a mixture of technical reports, frameworks, and case studies. Each shortlisted document was then synthesized to capture relevant information, and extract it to a new report using a common framework, structured around the themes used by the Resilient Natural and Built Infrastructure Advisory Table (i.e. technical, financial, policy & legal, socio-economic, governance & institutions).

Each synthesis ends with a short summary, noting the main conclusions and key takeaways, and including any interesting information that doesn't fit into the framework provided. A full set of twenty synthesis reports is included as an Appendix to this document; the main body of this report contains relevant examples and notable findings from the review.

As a goal of this project is to identify best practices and determine their applicability and relevance to Canada; we elected to define System Functions by using two-word phrases that reduce complex concepts into simpler expressions to describe components of a system. Our initial analysis produced a sample-set of almost fifty examples of potential System Functions, shown below. Our intention is to expand on these initial findings, incorporating any feedback; and to further refine the System Functions in order to connect examples of international best practices back to the Canadian National Adaptation Strategy.

BRITISH COLUMBIA | Ministry of Transportation and Infrastructure

Appendix 2 – Summary of Referenced Reports

ID	Report	Region
05	**Lifelines: Resilient Infrastructure Opportunity** *World Bank (Stéphane Hallegatte, Jun Rentschler, & Julie Rozenberg). 2019.* Available: https://openknowledge.worldbank.org/handle/10986/31805	World
71	**A Catalogue of Nature-based Solutions for Urban Resilience** *World Bank and GFDRR. 2021.* Available: https://openknowledge.worldbank.org/handle/10986/36507	World
93	**Global Compendium of good practices on post disaster recovery** *European Union, United Nations, and World Bank. 2020.* Available: https://www.latinamerica.undp.org	World
69	**Climate-resilient Infrastructure - Policy Perspectives** *OECD. 2019.* Available: https://www.unisdr.org	World
18	**Climate Change Adaptation: A Priorities Plan for Canada** *B. Feltmate and J. Thistlethwaite, University of Waterloo, Canada. 2012.* Available: https://uwaterloo.ca/environment/sites/ca.environment/files/uploads/files/CCAP-Report-30May-Final.pdf	Canada
07	**Systems Approach to Management of Disasters – A Missed Opportunity?** *S. Simonovic, Journal of Integrated Disaster Risk Management. 2015.* Available: https://www.idrimjournal.com/article/11677-systems-approach-to-management-of-disasters-a-missed-opportunity	Canada
21	**A Managed-Participatory Approach to Community Resilience: NY Rising** *Simon McDonnell, et al; Governor's Office of Storm Recovery (New York) & Rockefeller Institute of Government. 2016.* Available: https://stormrecovery.ny.gov/sites/default/files/crp/community/documents/2016-06-Managed-Participatory_Approach.pdf	NY, USA
23	**California Climate Adaptation Strategy** *California Natural Resources Agency. 2021.* Available: https://climateresilience.ca.gov/	CA, USA
24	**Louisiana Climate Action Plan** **Our Land and Water: A Regional Approach to Adaptation** (part of Louisiana's Strategic Adaptations for Future Environments. *Louisiana Office of Community Development & the Foundation for Louisiana. 2009.* Available: https://lasafe.la.gov/.	LA, USA
40	**Anticipate, React, Recover: Resilient Infrastructure Systems** *National Infrastructure Commission. 2020.* Available: https://nic.org.uk/app/uploads/Anticipate-React-Recover-28-May-2020.pdf	UK
44	**National Climate Adaptation Strategy 2016: "Adapt with ambition"** *Ministry of Infrastructure and the Environment. 2016.* Available: https://klimaatadaptatienederland.nl	Netherlands
57	**Plan National D'Adaptation au Changement Climatique** (French National Adaptation Plan for Climate Change) *National C Ministère de la Transition Ecologique et Solidaire. 2018.* Available: https://www.ecologie.gouv.fr	France
54	**Copenhagen Cloudburst Management Plan** *Technical and Environmental Administration at the City of Copenhagen. 2012.* Available: https://en.klimatilpasning.dk	Denmark
102	**Australian Emergency Management Arrangements Handbook** *Australian Institute Disaster Resilience. 2019.* Available: https://www.aidr.org.au/media/1764/aidr_handbookcollection_australian-emergency-management-arrangement_web_2019-08-22_v11.pdf	Australia

Page 5 of 26

BRITISH COLUMBIA | Ministry of Transportation and Infrastructure

74	**Preparing for a Climate Resilient Singapore** *E. K. Ludher, K. F. Hsu, N. Sim; Centre for Livable Cities Singapore. 2021.* Available: https://www.clc.gov.sg	Singapore
ID	**Case Study**	**Region**
86	**Fort McMurray Wildfire: Learning from Canada's costliest disaster** Institute for Catastrophic Loss Reduction. 2019 Available: https://www.zurichcanada.com/-/media/project/zwp/canada/docs/english/weather/fort-mcmurray-report_canada.pdf	Canada
87	**Forewarned and Forearmed - The Calgary Emergency Management Agency and the 2013 Flood** *"Calgary's Flood Resilient Future" - Expert Management Panel on River Flood Mitigation. 2014* Available: https://www.calgary.ca/UEP/Water/Documents/Water-Documents/Flood-Info-Documents/Expert-Management-Panel-Report-to-Council.pdf	Canada
28	**Rapid attribution analysis of the extraordinary heatwave on the Pacific Coast of the US and Canada in June 2021** *Philip, S. Y. et al. 2021 (in review)* Available: https://doi.org/10.5194/esd-2021-90	Canada / USA
30	**Adapting to Climate Change in the Upper Mississippi River Basin: Exploring Stakeholder Perspectives on River System Management and Flood Risk Reduction** *Tamsen Reed et al; Environmental Health Insights v14. 2020.* Available: https://journals.sagepub.com/doi/10.1177/1178630220984153	USA
65	**High Water 2021 - Facts & interpretation** *Expertise Netwerk Waterveiligheid. 2021.* Available: https://klimaatadaptatienederland.nl	Netherlands