Climate Change Risks and Resilience Options for Canada's Built Infrastructure

IISD
International Institute for Sustainable Development

CLIMATE HAZARD	EXAMPLES OF INFRASTRUCTURE IMPACTS	EXAMPLES OF RESILIENCE OPTIONS
Wastewater and Stormwater Infrastructure	Higher temperature streams and decreased streamflow lead to more concentrated influent flows that are harder to disinfect	Apply natural infrastructure solutions (green roofs, urban forests) to increase assimilative capacity of receiving streams
	Exceeding stormwater/drainage systems	Reduce or green up impervious surfaces (e.g., roofs, parking areas)
	Increased frequency, duration, and severity of thermal cracking and rutting	Use phase-change materials to reduce the number of freeze/thaw cycles
	Damaged or flooded structures that reduce treatment efficiency	Hybrid built and natural infrastructure solutions (e.g., terraced berms, bulkheads, beach nourishment, offshore breakwaters)
Buildings	Increased indoor air temperature and reliance on cooling systems Accelerated ageing of building materials	Upgrade ventilation systems and install window shades Install thermally reflective material for the roof and facades of buildings
	Increased risk of flooded structures Roof collapse from heavier snow loads on roofs	Install backwater valves, sump pumps Retrofit at-risk structures to a higher standard
	Foundation and building damage from changes in freeze/thaw patterns and drying of soils	Select concrete mixture aggregates that perform better in freeze-thaw cycles
	Subsidence and buckling can damage foundations Loss of strength in building	Improve ventilation and adjustable structural posts Best design practices for foundations
	Erosion compromises the integrity of foundations Increased corrosion of metals	Protective structures/dikes/seawalls Metal product components with enhanced resistance to corrosion
	Loss of roof sheathing Windborne debris can shatter windows and damage exteriors	Reinforce roofs/hurricane straps and additional fasteners Install impact-resistant glass
Water Supply Infrastructures	Power outages due to storms affecting pumping stations Reduced structural integrity and/or accelerated deterioration of dams	Enhanced and redundant backup power supplies Adopt structural adaptations to dams, weirs, and drainage canals
	Rupture of water lines and storage tanks	Use of polystyrene insulation beneath roads
	Flooding of treatment plant infrastructure	Seawalls, dikes, floodwalls, levees, local surge barriers, etc.
	Reduced source of potable water Cracking of earthen dams, increasing flood risk	Demand management and use of natural infrastructure Structural adaptations to dams, weirs, and drainage canals

- Extreme heat, heat waves
- Seasonal temperature increases resulting in permafrost degradation and changing freeze-thaw cycles
- Changing precipitation patterns
- Drought
- Wildfires
- Sea ice changes
- Winter storms, ice storms, high velocity windstorms
- Permafrost degradation
- Storm surges, high tides, rising sea levels
- Fluctuations in inland water levels
- High winds

Source: bit.ly/CadInfra

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Land Transportation	Pavement softening, rutting, and bleeding Thermal rail expansion (buckling)	Use heat-tolerant pavement mixtures Use low-solar absorption rail coatings
	Increased risk of critical events (e.g., washouts) Increased ice accretion on cable-stayed bridges	Increase culvert capacities Use of cable coverings to shed accreted ice
	Shortened winter ice road season Soil and slope instability plus ground movement/ settlement	Transform ice roads into all-season roads Install geotextiles
	Causeways, bridges, and low-lying roads inundated or damaged	Build riprap and dikes
	Blocked roads, bridges, and railways due to debris or snow	Update vegetation management-related standards (e.g. plant different trees species along roads)
Marine Infrastructure	Soil and slope instability and ground movement/settlement due to permafrost melt	Thicken embankments and new infrastructure design suited to permafrost environments
	Inundation of ports and other coastal infrastructure Increased wave damage to docks and other mooring structures	Build flooding considerations into building and infrastructure design Actively restore shoreline habitat (i.e., dunes, salt marshes)
	Increased shipping traffic in Arctic waters due to less sea ice increasing demand for Northern ports	Demand forecasting and planning for Arctic shipping and port facilities
	Lower water levels leading to reduced vessel capacity	Invest in flow augmentation technologies, and increase dredging of channels
Energy and Information and Communications Technologies (ICTs)	Overheating in ICT data centres, exchanges, base stations Water level fluctuations and drier soils can increase internal erosion of embankment dams	Increase cooling system capacity Enhanced dam safety monitoring and management
	Displaced transmission tower foundations and damage to underground vaults and cable chambers	Modify structural designs to permit adjustment of towers when displacement due to permafrost thaw occurs
	Flooding of energy generation plants and substations and dam spillway gate performance issues Damage to copper and fibre-optic cables	Elevate substations and electrical infrastructure components and enhance dam safety monitoring and management Bury transmission and distribution lines
	Snapped power lines, broken or fallen utility poles, ice buildup on wind turbine blades	Install microgrids to enable communities to run on secondary sources when central grids fail
	Damage and/or destruction of lines and transmission poles Annealed or damaged conductors	Bury electrical grid to avoid damage from extreme heat and fire Keep fire-prone areas clear of brush

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