



UBC DESIGN CHALLENGE

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VANCOUVER CAMPUS

CHALLENGE BRIEF

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INTRODUCTION



This past summer has seen unprecedented dry weather across British Columbia. Vancouver implemented Stage 3 water restrictions in July allowing no lawn watering or car washing. This past winter, the local mountains only had 11% of the normal snowpack meaning that the reservoirs are not being refilled. Smoke from forest fires in other parts of the province blow into downtown with a smoky haze.

Just a couple of years ago, the City of Calgary, just on the other side of the Rockies from BC, was the centre of major flooding that cut off power to downtown, flooded large parts of the city and forced thousands of residents to evacuate. The city is still recovering and repairing damage caused by the floods.

Scientists predict that these events, once considered extreme, will become more and more common. Cities will feel the impact of both flooding and drought, also exacerbated by sea level rise in coastal cities. How will cities adapt? How will city planners ensure that their most vulnerable populations are protected? How can cities continue to deliver adequate supplies of drinking water during dry seasons? How will cities pay for adaptation measures? What can cities learn from other parts of the world that have been dealing with these issues for a long time? And, perhaps the largest challenge, how can cities prepare for both prolonged droughts and flash floods, events that may require very different adaptation measures?

Your challenge is to answer the question **How might urban centres prepare for future water crises – both flooding and drought?**

You may choose to look at the problem on UBC, in Metro Vancouver, across Canada or in a global context. You may choose to come up with a new product or business as a solution, or maybe a new service or even a new policy. The choice is up to you and your team.

Use the information provided here, your connections with the team of Expert Mentors and the exercises to come up with your solution.



CLIMATE CHANGE AND WATER



Climate change is expected to change precipitation patterns globally, which in turn will have an impact on water availability, important for human health, econ activity, ecosystem function, and geophysical processes. Generally, we are expected to see wet regions becoming wetter and dry regions drier. We are expected to deal with more frequent extreme weather events, such as storms, floods, as well as droughts in different places.

Among the biggest challenges for water managers today and into the future is dealing with increasing uncertainty – because of the so-called “non-stationarity” principle. This means that the climate of our present and future is sufficiently different from that of the past such that that we can’t use past data (including river flows and precipitation) to predict current and future water resources.

The relationship between climate change mitigation measures and water is a reciprocal one. Mitigation measures can influence water resources and their management, and it is important to realize this when developing and evaluating mitigation options. On the other hand, water management policies and measures can have an influence on greenhouse gas (GHG) emissions and, thus, on the respective sectoral mitigation measures; interventions in the water system might be counter-productive when evaluated in terms of climate change mitigation.

More reading:

- Bates, B., Kundzewicz, Z. W., & Wu, S. (2008). Climate Change and Water: Technical Paper of the Intergovernmental Panel on Climate Change. Intergovernmental Panel on Climate Change
- Milly, P. C. D., Betancourt, J., Falkenmark, M., Hirsch, R. M., Kundzewicz, Z. W., Lettenmaier, D. P., & Stouffer, R. J. (2008). Stationarity Is Dead: Whither Water Management? *Science*, 319(5863), 573–574. doi:10.1126/science.1151915



ONGOING WATER CHALLENGES



Water resources are already influenced by human activity. There include growing demands due to:

- population growth,
- Urbanization
- competing water users (agriculture, industry, residential users, the energy sector and others
- pollution from agriculture, industry, etc
- aging water infrastructure and underfinancing of the public water sector
- water is often underpriced, and therefore not used conservatively
- depleting groundwater resources

More reading:

- Vorosmarty, C., Lettenmaier, D., Levegue, C., Meybeck, M., Pahl-Wostl, C., Alcamo, J., et al. (2004). Humans Transforming the Global System. *Eos*, 85(48), 509–514

Floods

A variety of climatic and non-climatic processes influence flood processes, including river floods, flash floods, urban floods, sewer floods, glacial lake outburst floods.

Floods depend on precipitation intensity, volume, timing, phase (rain or snow), antecedent conditions of rivers and their drainage basins (e.g., presence of snow and ice, soil character and status (frozen or not, saturated or unsaturated), wetness, rate and timing of snow/ice melt, urbanization, existence of dykes, dams and reservoirs). Human encroachment into flood plains and lack of flood response plans increase the damage potential.

Globally, the number of great inland flood catastrophes during the last 10 years is twice as large per decade. as between 1950 and 1980

Dominant drivers of the upward trend of flood damage are socio economic factors such as economic growth, increases in population and in the wealth concentrated in vulnerable areas, and land-use change.



ONGOING WATER CHALLENGES.....continued



Droughts

Droughts can be meteorological (when precipitation is well below average), hydrological (low water levels), agricultural (low soil moisture) and environmental (a combination of the above). Droughts have become more common, especially in the tropics and subtropics, since the 1970s. Among the causes are: decreased land precipitation, increased temps, which enhance evapotranspiration and reduce soil moisture. The biggest driver is decreased precipitation (relative to soil moisture for instance)

Technically, a drought typically refers to a temporary decrease in water resources when compared to historical resources specific to a particular area, and are distinct from arid or desert ecosystems that by definition receive little precipitation. We can say that an area is experiencing long term drought if we know that the conditions were wetter at one point, even if the new, drier conditions are a long term change.

Droughts can be harmful as they stress all users of water, from urban, to industrial and agricultural. Perhaps the greatest global challenge stemming from droughts is how a decrease in water availability stresses the social, technological and policy frameworks in place to ensure that users of water receive the volumes that are necessary for the activities they want to use it for. Depending on the severity of the drought, as well as the robustness of the human systems in place to distribute and divide the water resources available, certain groups of water users could see their ability to use water diminish, either voluntarily or by necessity, which may not occur in a way equitable to all users, depending on the water policies in place. In cases where the human systems around water distribution are less resilient to the stress brought about by drought, conflict between users can occur, such as conflict between agricultural and municipal water users in California

More reading:

- Bates, B., Kundzewicz, Z. W., & Wu, S. (2008). Climate Change and Water: Technical Paper of the Intergovernmental Panel on Climate Change. Intergovernmental Panel on Climate Change.
- Trenberth, K. E., Dai, A., Rasmussen, R. M., & Parsons, D. B. (2003). The Changing Character of Precipitation. Bulletin of the American Meteorological Society, 84(9), 1205–1217.
- Rockström, J. 2003. Resilience building and water demand management for drought mitigation. Physics and Chemistry of the Earth, 28, 869-877.



WATER AT DIFFERENT SCALES



The challenges raised by flooding and drought affect people, and the planet, in very different ways at different scales. The solutions you come up with need to be appropriately scaled – where is the problem the greatest? Where can you have the biggest impact?

GLOBAL WATER CHALLENGES

Globally, freshwater systems face increasing pressures from water extraction, pollution, and changes in the timing, location, and magnitude of flows. These changes are having significant impacts on global biodiversity and human water security, with almost 80% of the world's population living in high threat areas.

North America's water resources are already over allocated, and climate change will exacerbate competition among water users in different sectors. Variations in wealth and geography also contribute to an uneven distribution of likely impacts, vulnerabilities, and capacities to adapt in both Canada and the USA. British Columbia is expected to see more severe spring floods on the coast and the interior, increased winter precipitation, more summer droughts along the south coast and the southern interior.

Although North America has considerable capacity to adapt to the water-related aspects of climate change, actual practice has not always protected people and property from the adverse impacts of floods, droughts, storms and other extreme weather events. Especially vulnerable groups include indigenous peoples and those who are socially or economically disadvantaged. Traditions and institutions in North America have encouraged a decentralized response framework where adaptation tends to be reactive, unevenly distributed, and focused on coping with rather than preventing problems. Examples of adaptive behaviour influenced exclusively or predominantly by projections of climate change and its effects on water resources are largely absent from the literature.

More Reading:

- Gupta, J., & Pahl-Wostl, C. (2013). Editorial on Global Water Governance. *Ecology and Society*, 18(4), art54. <http://doi.org/10.5751/ES-06115-180454>
- Tracking the Curse of Global Drought <http://www.bloomberg.com/features/2015-global-drought-stories/#intro>
- Vörösmarty, C.J., P.B. McIntyre, M.O. Gessner, D. Dudgeon, A. Prusevich, P. Green, S. Glidden, S.E. Bunn, C.A. Sullivan, C. Reidy Liermann, and P.M. Davies, (2010). Global threats to human water security and river biodiversity. *Nature*, 467: 555-561. doi:10.1038/nature09440
- Vörösmarty, C.J., Pahl-Wostl, C. and Bhaduri, A. (2013). Special issue: Aquatic and marine systems. *Current Opinion in Environmental Sustainability*, 5(6): 535-714. <http://www.sciencedirect.com/science/journal/18773435/5/6>



WATER AT DIFFERENT SCALES



CANADIAN WATER CHALLENGES

At a national level, efforts to deal with future expected floods and droughts are mostly folded into broader climate change adaptation frameworks, such as these from the Responses involve a variety of measures involving risks assessments (where a huge challenge is the inherent uncertainty of the magnitude of climate change impacts), improving storm water draining infrastructure in risky places, or flood-proofing neighbourhoods at risk. Insurance plays a big role of course - this issue is largely still on the table. For droughts, in Canada (in my opinion) we see rather conventional demand management strategies, I am not aware of significant innovation. As to challenges, I'd say, might be useful to talk about who is most at risk, as this is often First Nations communities, who are not well serviced to begin with. Other challenges involve competing demands for water among agriculture and the extractive sector maybe.



More Reading:

- UBC Program on Water Governance <https://watergovernance.ca/publications/#water-in-canada>
- Federation of Canadian Municipalities
<http://www.fcm.ca/home/issues/environment/climate-change-adaptation.htm>
- City of Vancouver Climate Change Adaptation Strategy
<http://vancouver.ca/green-vancouver/climate-change-adaptation-strategy.aspx>
- Water and First Nations
https://watergovernance.ca/wp-content/uploads/2010/04/Primer_reserve-drinking-water-issues.pdf
- In Globe debate, leaders ignore Canada's No. 1 resource:
<http://www.theglobeandmail.com/news/politics/in-globe-debate-leaders-ignore-canadas-most-precious-resource-water/article26442039/>
- What the California drought means to Canadians
<http://www.theglobeandmail.com/globe-debate/what-the-california-drought-means-for-canadians/article23820879/>

WATER AT DIFFERENT SCALES



METRO VANCOUVER WATER CHALLENGES

Vancouver can also experience drought conditions, despite how much water there appears to be around.

- BC's new Water Sustainability act <http://engage.gov.bc.ca/watersustainabilityact>
- BC's water plan: <http://www.livingwatersmart.ca/drought/>
- The personal aspect:
<http://news.nationalpost.com/news/canada/i-use-logging-camp-language-on-them-b-c-gardener-81-has-no-shame-in-using-own-water-despite-bullying>
- Level 4 Drought Declared:
<http://www.cbc.ca/news/canada/british-columbia/level-4-drought-declared-for-south-coast-and-lower-fraser-1.3153654>
- Current water restrictions information:
<http://vancouver.ca/home-property-development/about-the-watering-restrictions.aspx>
- Vancouver's water department:
<http://vancouver.ca/home-property-development/water-and-sewer.aspx>
- Water services for Metro Vancouver:
<http://www.metrovancouver.org/services/water/Pages/default.aspx>
- Series of videos on innovative stormwater management in the Vancouver area:
<http://mlws.landfood.ubc.ca/videos/>
- Preparing the water system for increased demand driven by a rising population, climate change
http://www.vancouver.sun.com/technology/specialreportplanninggrowthmetrovancoverdemandwater/11366229/story.html?_lsa=30e4-80f8

UBC WATER CHALLENGES

Water is a pressing issue here on campus. There are a number of initiatives already underway.

More reading

- Water initiatives at the UBC campus <https://sustain.ubc.ca/campus-initiatives/water>
- Video on regenerative sustainability and CIRS
<https://vimeo.com/channels/blueisthenewgreen/107942165>
- Information on how sustainable water design was integrated into the CIRS building
<http://cirs.ubc.ca/building/building-manual/rainwater-system> and
<http://cirs.ubc.ca/building/building-manual/reclaimed-water>



PRODUCT, SERVICE OR POLICY



There are a number of ways to approach this challenge. You may come up with a new product or company. Or perhaps a service is what is needed. Or maybe you think that a policy solution is what is required. Here are few examples of each to get you started

PRODUCT

- Permeable membranes for road surfaces
- Green roofs
- Rain gardens/swales
- Rainwater collection for building use
- Xeriscaping
- Water meters
- Restored/created wetlands
- Grey-water reuse and recycling facilities (e.g. toilets)
- Water efficient utilities (e.g. toilets, showerheads)
- Fish ladders

SERVICE

- Restoring urban watersheds as a flood prevention strategy. One of the main reason for urban flooding is actually the amount of impervious surface (roads, etc.) that essentially channel water's flow through the city. Building natural spaces that slow down the flow of water actually mitigates peak volumes and speed of water flow. In Vancouver, Evergreen does this work ([see http://www.evergreen.ca/our-impact/greenspace/restoring-urban-watersheds](http://www.evergreen.ca/our-impact/greenspace/restoring-urban-watersheds))

POLICY

Remember that new products and services often fail not because of the technology but due to not integrating culture, socio-economic factors, gender and many other issues into implementation plans. Is a change in policy required? Examples might be :

- Water restrictions
- Planning ordinances
- Public awareness campaigns
- Behaviour change strategies

More Reading:

- Brown, H. (2014). Next Generation Infrastructure (pp. 1–252). Washington: Island Press





“There is one thing stronger than all the armies in the world, and that is an idea whose time has come”

-- Victor Hugo



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