ENGINEERING | McMaster University

CIVENG 4A04 | GROUP 01

TERM PROJECT PRESENTATION

IMPACT OF WILDFIRES ON LOCAL HYDROLOGICAL PROCESSES

NOVEMBER 2020

wild·fire

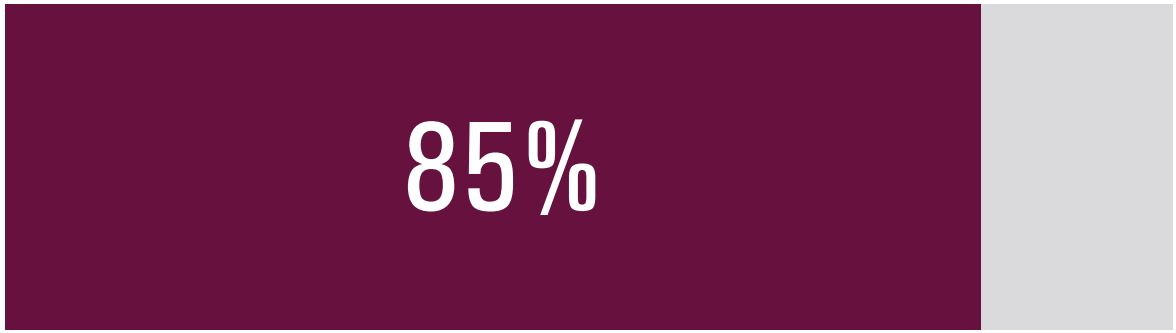
noun

an uncontrolled fire that burns in a natural area such as a forest, a shrub land, or a grassland. They are not limited to a particular continent or environment.

Similar: forest fire | vegetation fire | grass fire | bushfire | brush fire

CAUSES OF WILDFIRES 2000-2017

Source: Wildland Fire Management Information (WFMI) and the U.S. Forest Research Data Archive



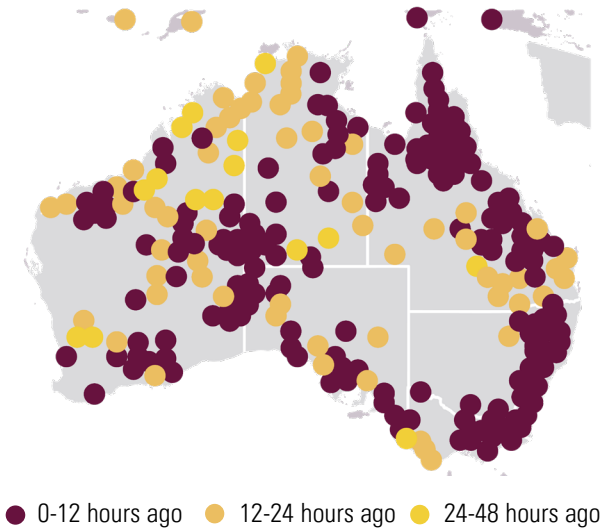
Human Causes
(e.g. arson, unattended campfires, equipment malfunctions, etc…)

Natural Causes
(i.e. lightening strikes)

WILDFIRES & CLIMATE CHANGE

Some Numbers & Statistics

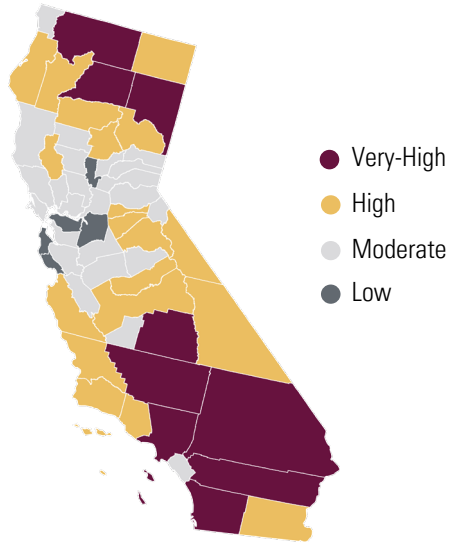
January 1, 2020: Active Fire Hotspots
Source: Landgate's MyFireWatch



Australia's 2020 Wildfire Season

- June 2019 – March 2020
- Burnt 46+ million acres of land

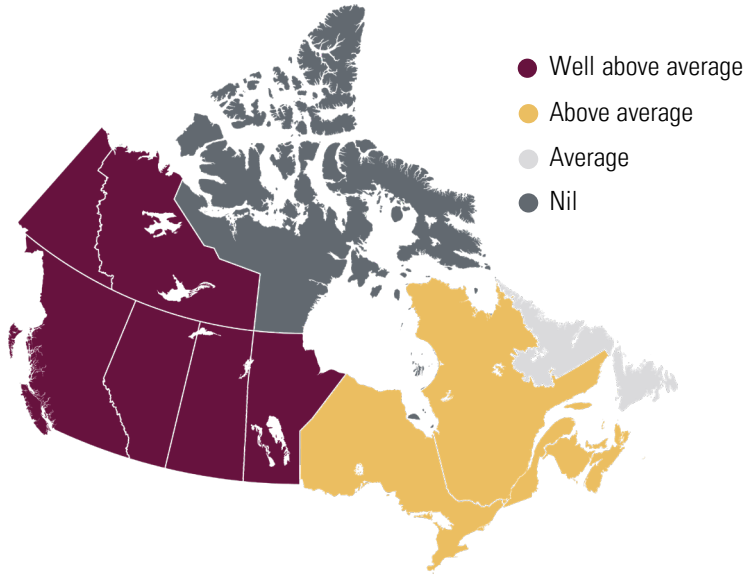
June 2020: Fire Season Forecast
Source: Cal Fire



California's 2020 Wildfire Season

- 9,279+ fires burning
- Burnt ~ 5% of California's total area
- x5 Record-breaking fires

August 2020: Fire Season Forecast
Source: Canadian Wildland Fire Information System



Wildfires in Canada

- Area burnt has doubled since 1970
- Average of ~ 6.2 million acres of land/year

WILDFIRES & HYDROLOGY

Presentation Overview and Principal Ideas

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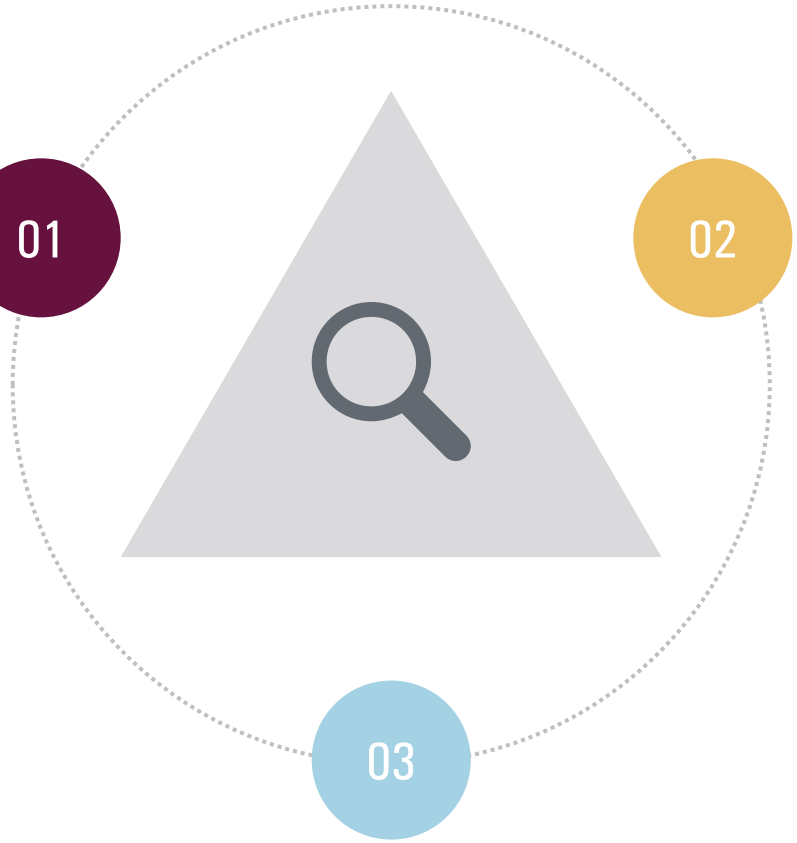
IMPACT OF WILDFIRES ON VARIOUS HYDROLOGICAL PROCESSES

Precipitation and Interception

Evapotranspiration

Surface Runoff

Streamflow



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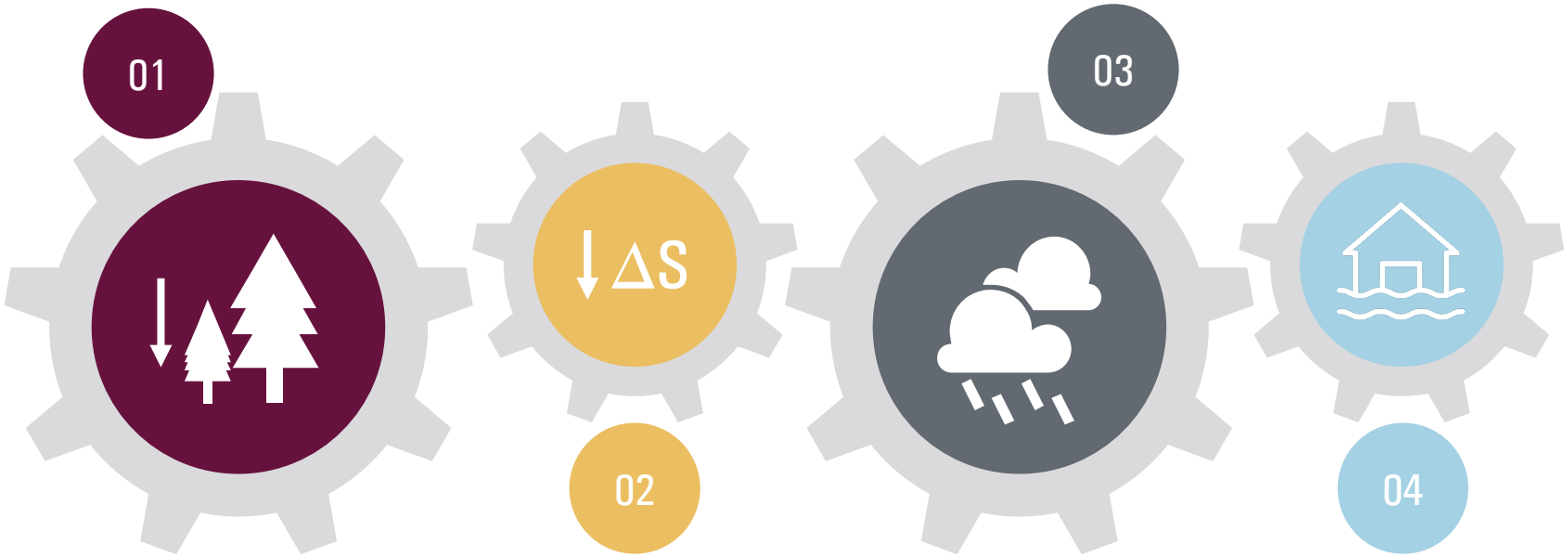
ADDRESSING THE NEED FOR CONTINUED RESEARCH

03

CURRENT RESEARCH AND FUTURE RESEARCH

WILDFIRES & HYDROLOGY

Precipitation, Interception, and Evapotranspiration Processes



CATCHMENT TERRAIN ALTERATIONS

Fires generally result in a loss of forest and vegetation cover.

CATCHMENT STORAGE CAPACITY

Decrease of interception storage capacity.

SURFACE-WATER BALANCE

Increase in the net amount of precipitation reaching the soil surface.

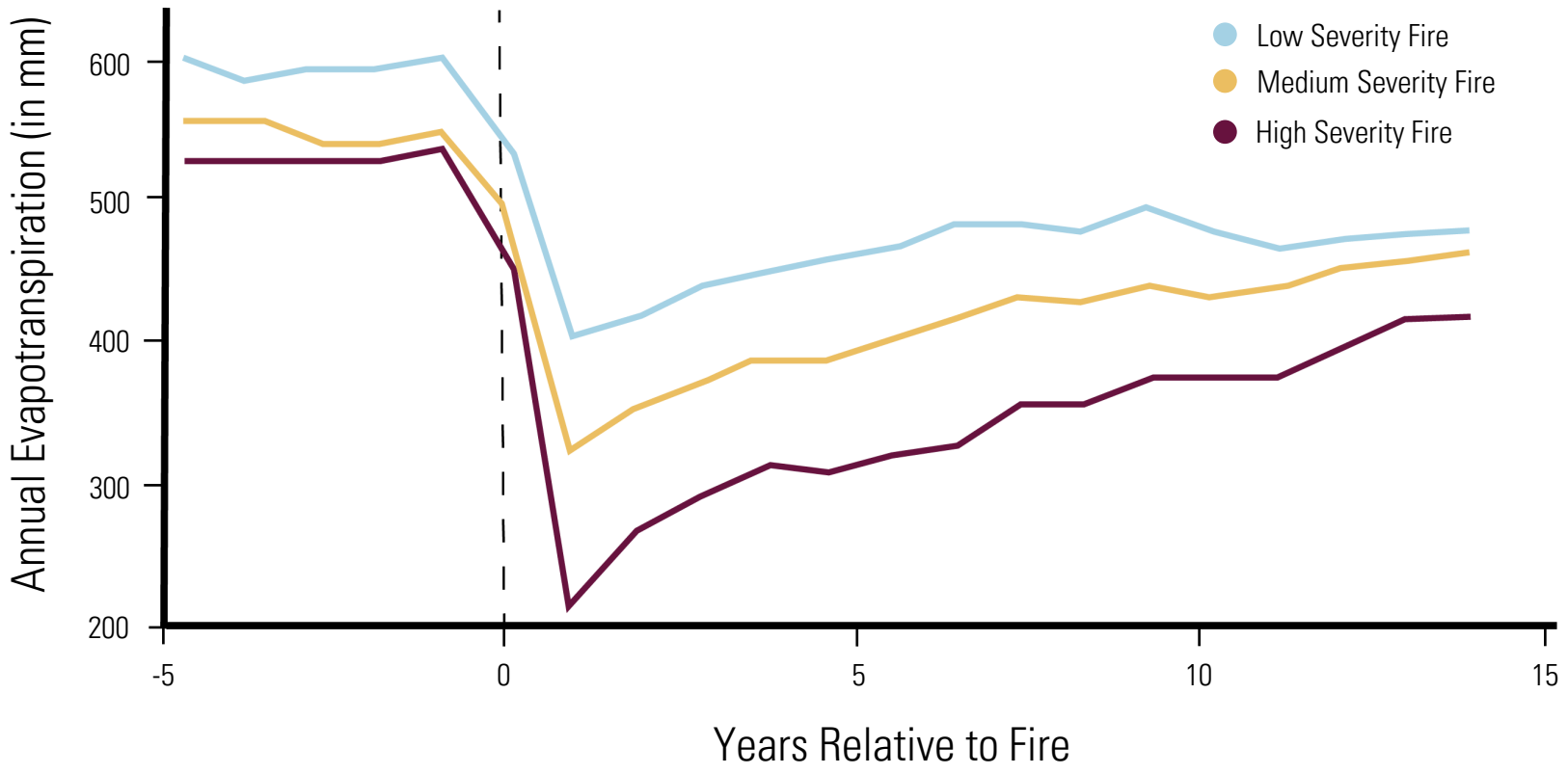
SHIFT OF WATERSHED'S HYDROLOGIC RESPONSE

The impact of smaller N and i = the impact of larger N and i.

CASE STUDY:

EVAPOTRANSPIRATION VS. TIME, SIERRA NEVADA (1985-2017)

Source: Center for Ecosystem Climate Solutions



WILDFIRES & HYDROLOGY

Surface Runoff Process

01

CATCHMENT TERRAIN ALTERATIONS

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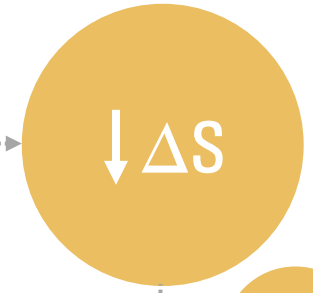

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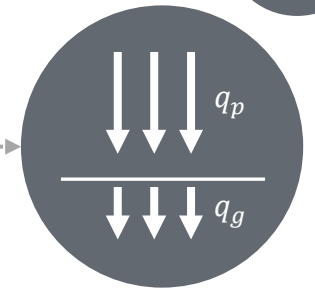
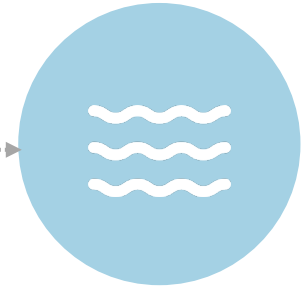


SURFACE-WATER BALANCE

Infiltration flux cannot keep up with precipitation flux.

THE RESULT

Following a fire, a rise in surface water runoff is observed (2-3 years).



WILDFIRES & HYDROLOGY

Hydrophobicity and Surface Run-off Generation

Source: L.F. DeBano, Journal of Hydrology (2000)

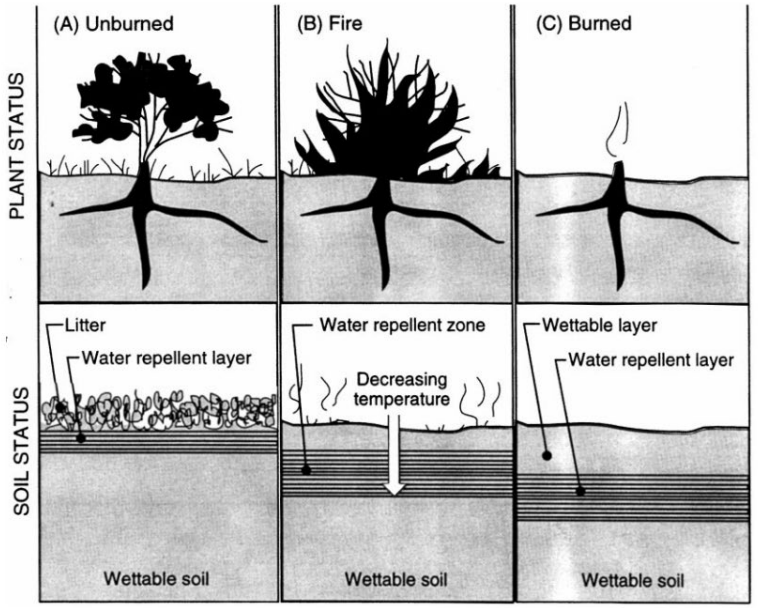
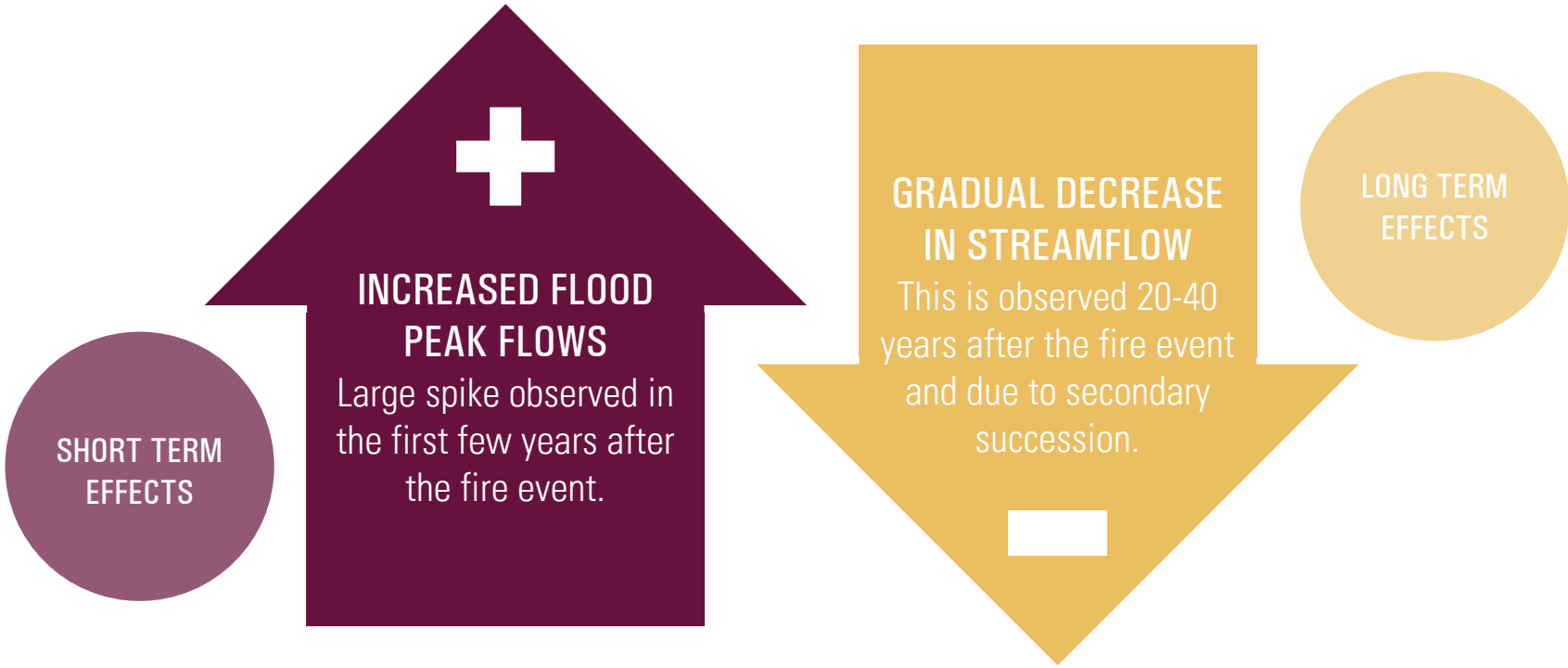


Fig. 1. (A) Soil water repellency in unburned brush is found in the litter, duff, and mineral soil layers immediately beneath the shrub plants. (B) When fire burns, hydrophobic substances are vaporized, moving downward along temperature gradients. (C) After the fire has passed, a water repellent layer is present below and parallel to the soil surface on the burned area (adapted from DeBano, 1981).

WILDFIRES & HYDROLOGY

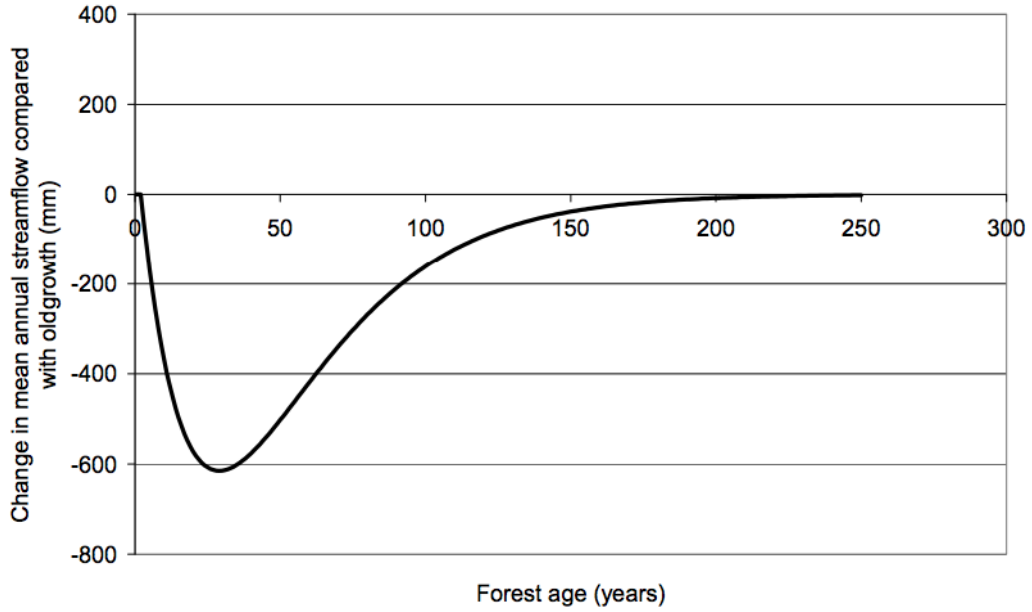
Streamflow Processes



CASE STUDY:

STREAMFLOW CONDITIONS VS. TIME

Source: Melbourne Water Corporation for Catchment Hydrology

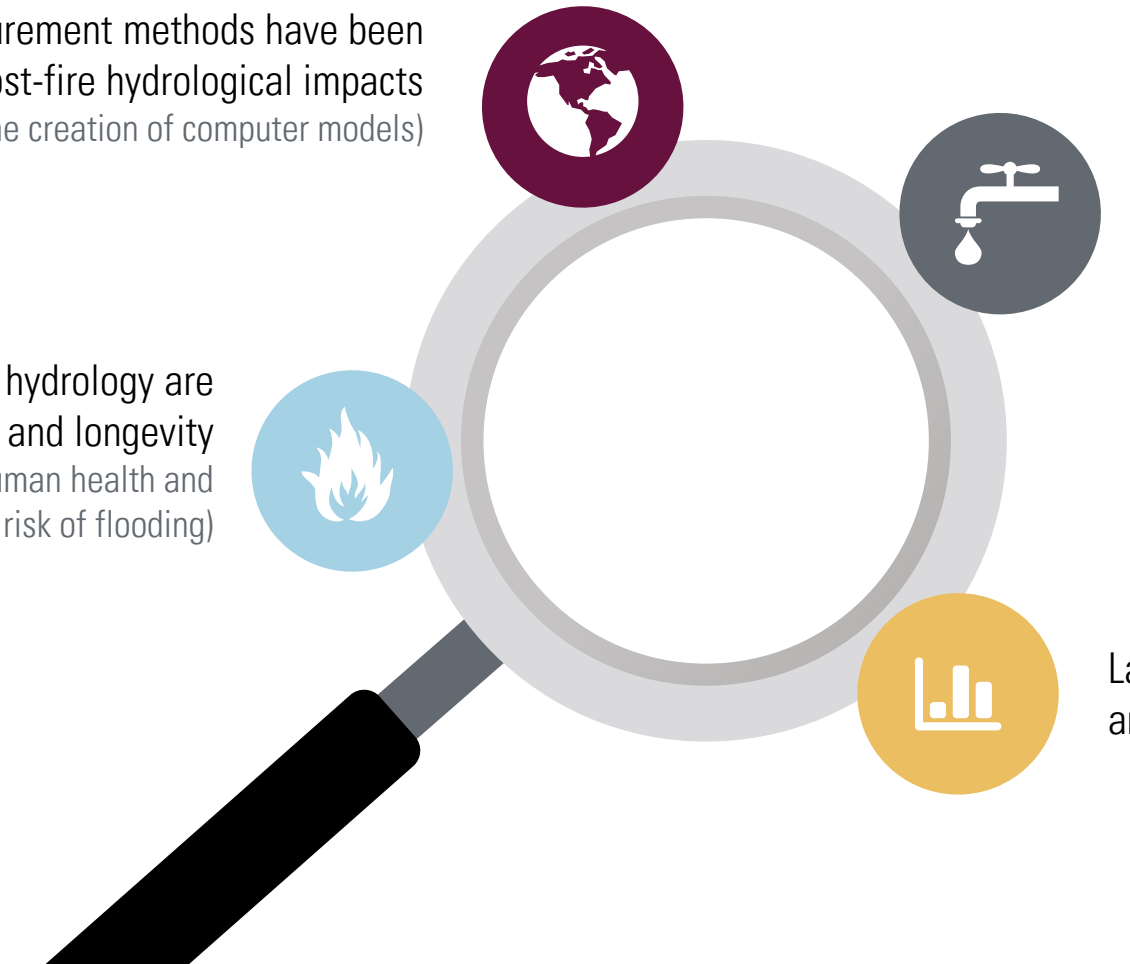


GAPS IN THE LITERATURE

A Need for Future Research

No standard measurement methods have been developed to measure post-fire hydrological impacts
(needed for comparison and the creation of computer models)

The impacts wildfires have on hydrology are increasing in magnitude and longevity
(impacts decrease water quality, human health and safety, and increase risk of flooding)



A better understanding of post-fire hydrological processes and how they are related is required to establish more effective water resource management systems

Lack of data available to build computer models and difficult accessing existing data

GAPS IN THE LITERATURE

Current and Future Research Focuses

François-Nicolas Robinne, PhD

Postdoctoral Fellow, University of Alberta

Areas of Research: Spatial analysis, Land system science, Fire risk modeling, Water resource management

IDENTIFY & ORGANIZE

Similarities and differences in post-wildfire responses between different regions to determine common patterns and invariants that can explain cause and effect relations.

QUANTIFY FUNCTIONAL RELATIONS

Precipitation, basin morphology, runoff connectivity, contributing area, surface roughness, depression storage, and soil characteristics.

STANDARDIZE MEASUREMENT METHODS

To ensure the collection of uniform and comparable data. Resolution of these issues will help to improve future models of post-wildfire hydrological processes.

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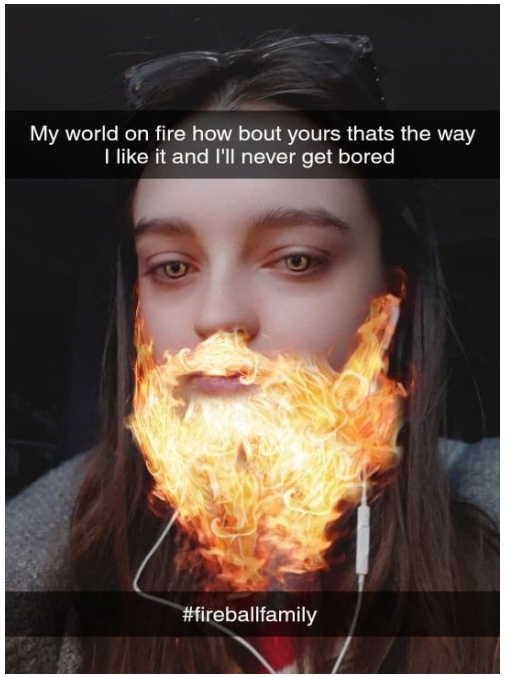
ANY BURNING QUESTIONS?

Q&A Session



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