



Groundwater Withdrawal Authorization Process: The Use of Indicators to Evaluate Cumulative Impacts

- **Work in progress** -

*National Dialogue on Ground Water
April 19, 2023*

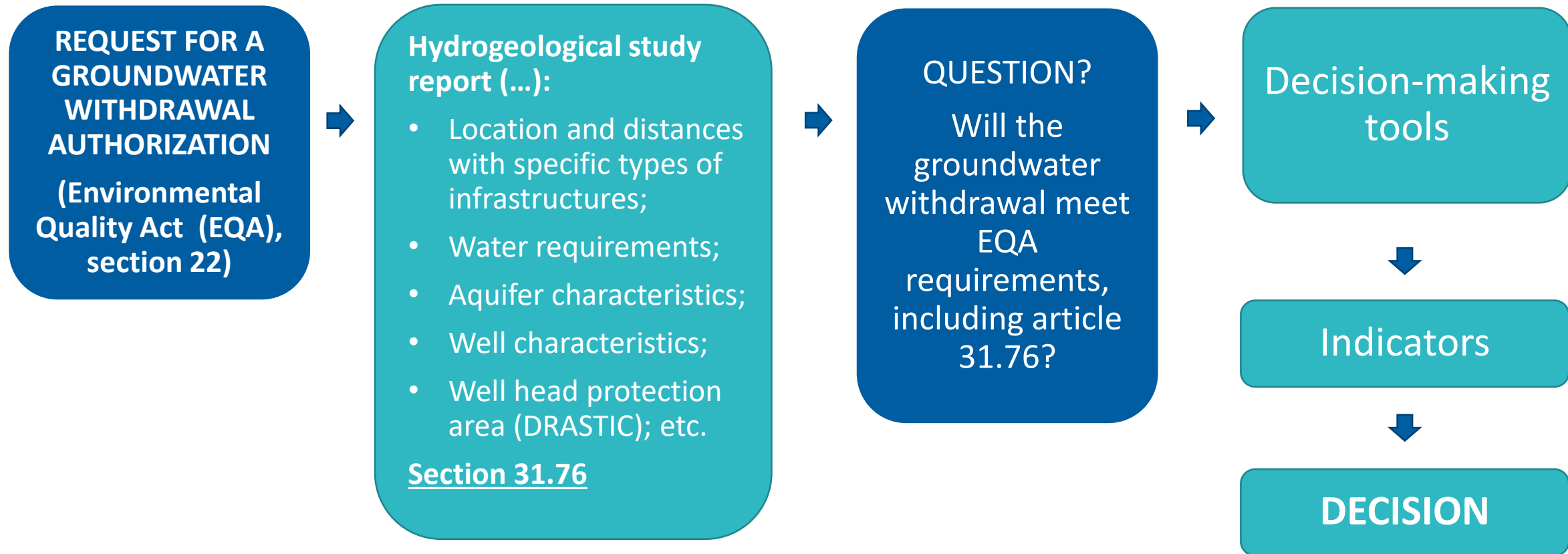
Martin Stapinsky, P. Geo., M. Sc., Ph. D.

MELCCFP - DGPE – Direction de l'eau potable, des eaux
souterraines et de surface

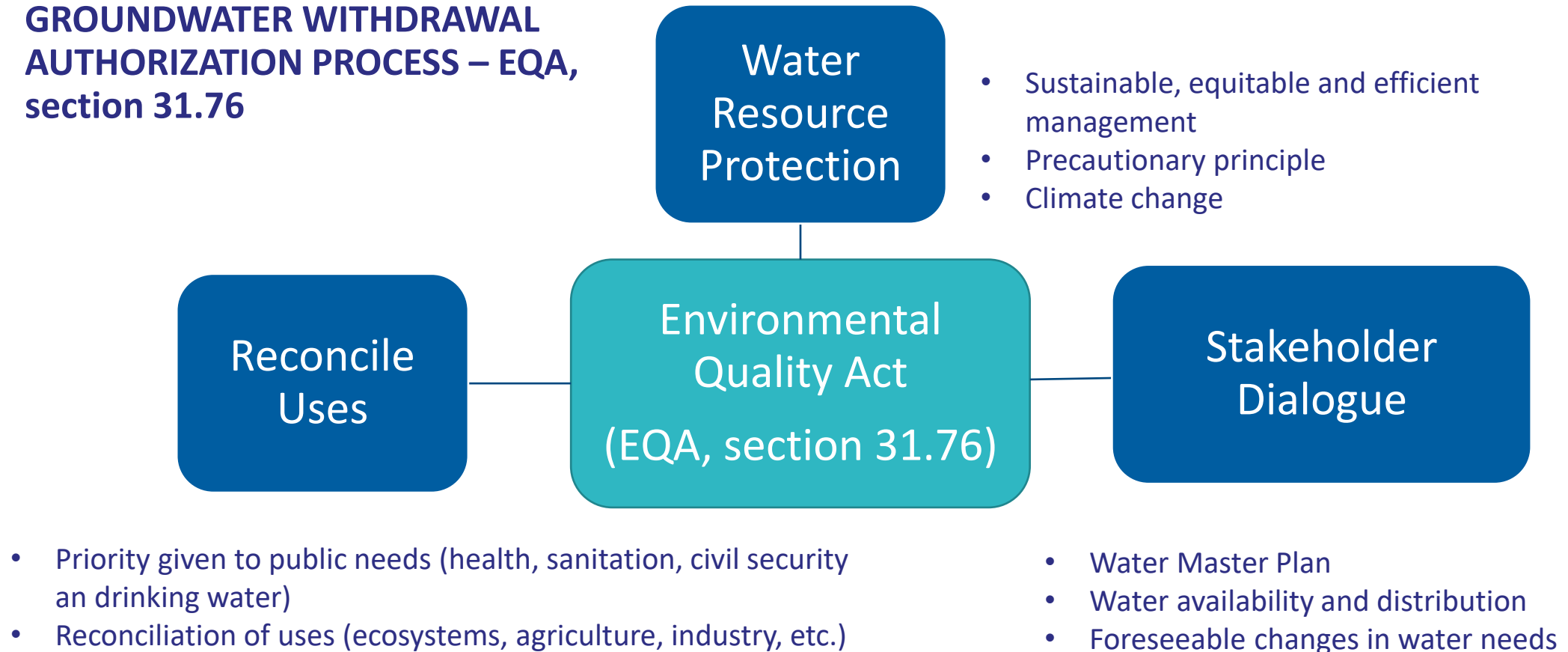
Summary

1. Groundwater Withdrawal Authorization Process
2. Decision-Making Framework
3. Groundwater Sustainability Indicators
4. Future Work
5. Conclusions

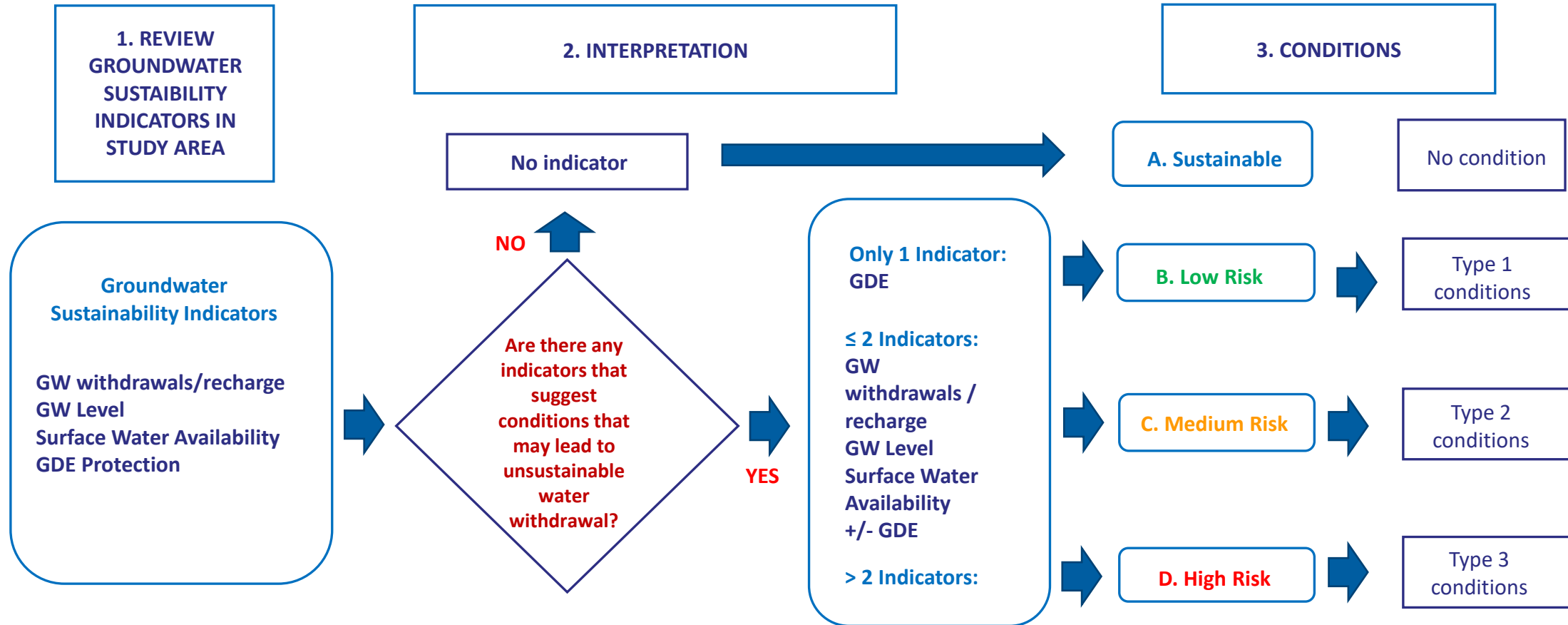
1. GROUNDWATER WITHDRAWAL AUTHORIZATION PROCESS



GROUNDWATER WITHDRAWAL AUTHORIZATION PROCESS – EQA, section 31.76



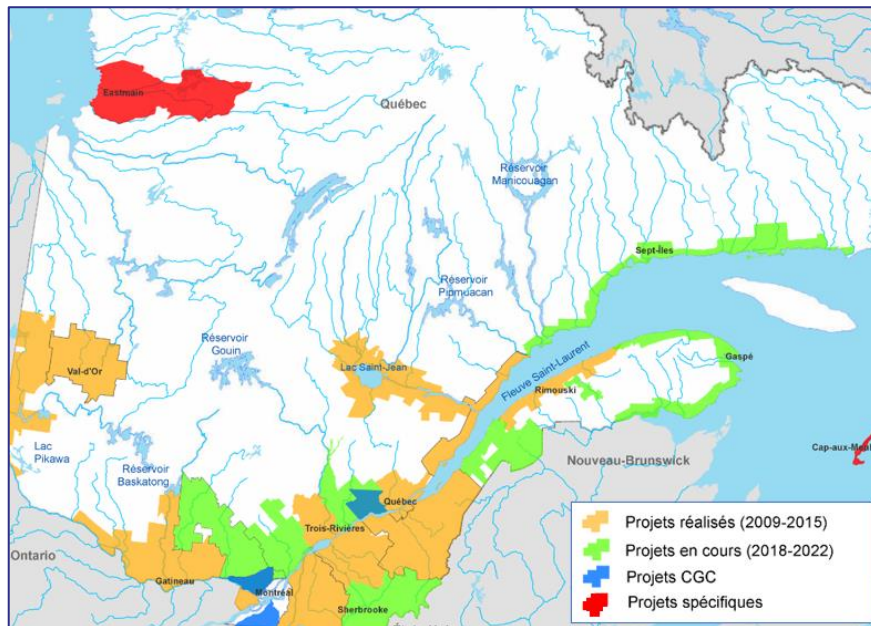
2. DECISION-MAKING FRAMEWORK



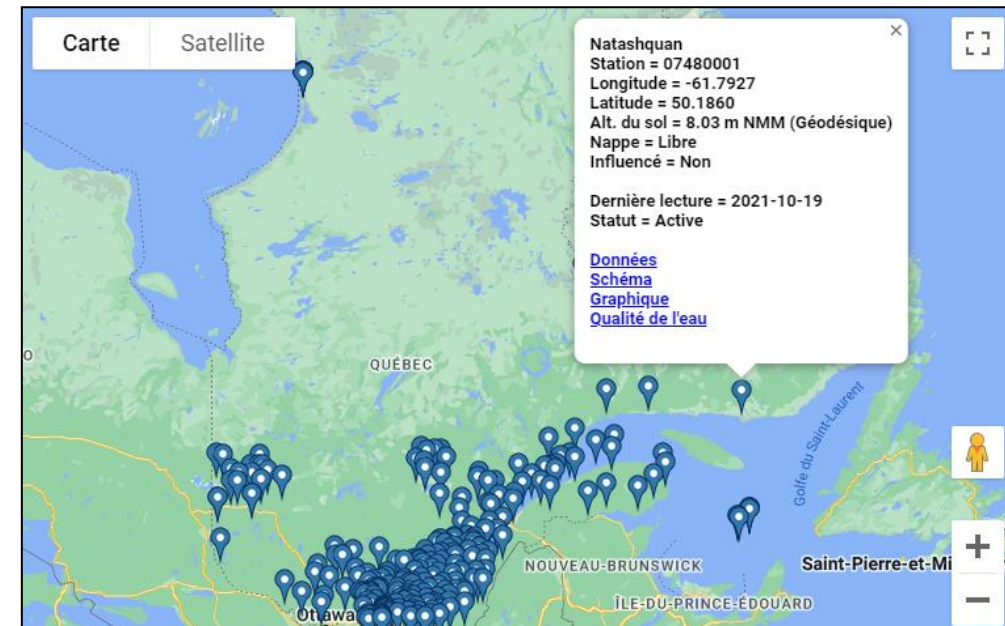
3. GROUNDWATER SUSTAINABILITY INDICATORS

Data sources:

Regional Hydrogeological
Mapping Projects (PACES)

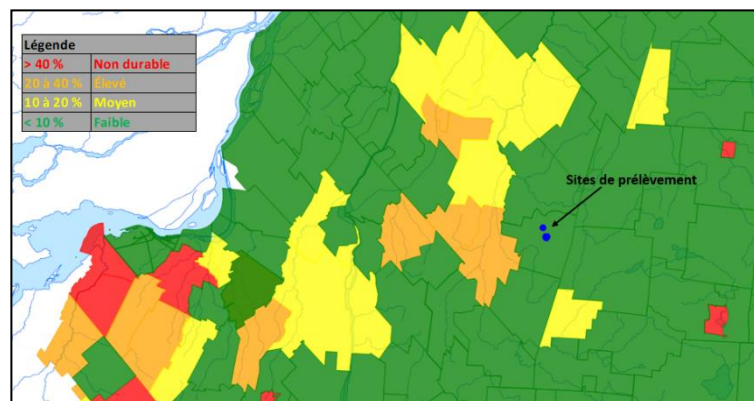


Quebec's Groundwater Monitoring
Network (RSESQ)



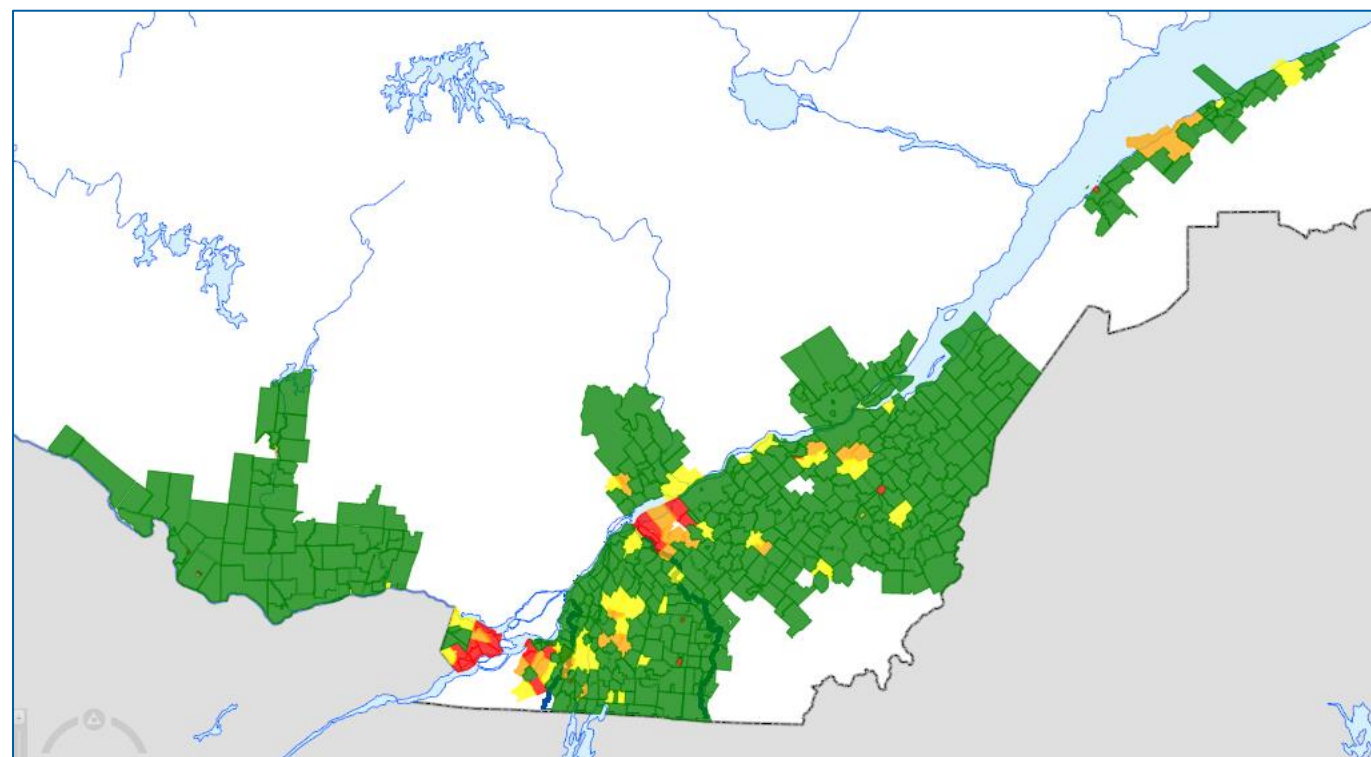
3. GROUNDWATER SUSTAINABILITY INDICATORS

Indicator: Total groundwater withdrawal/recharge (municipal scale)



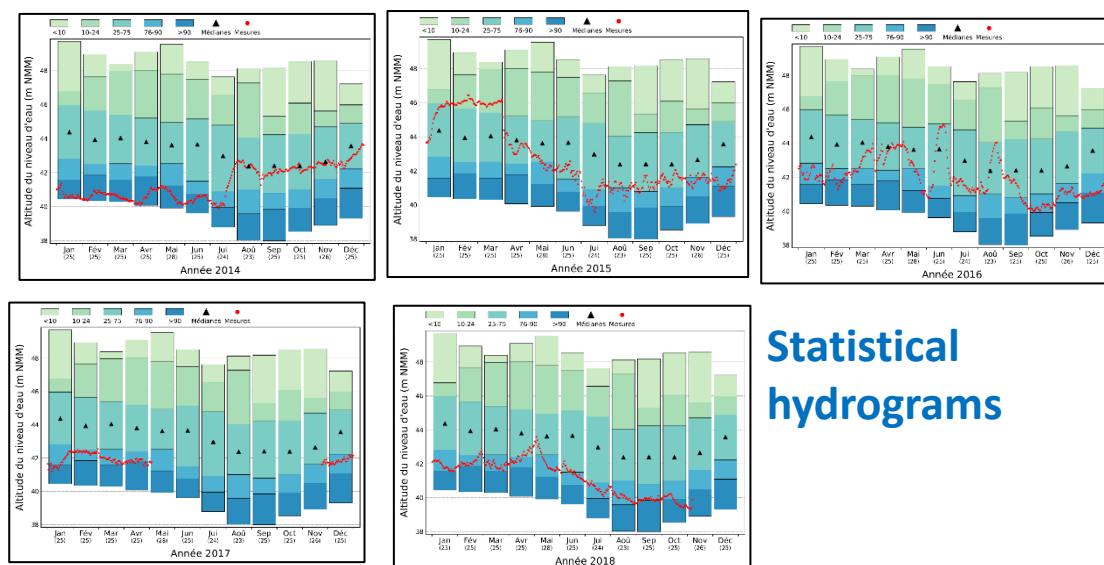
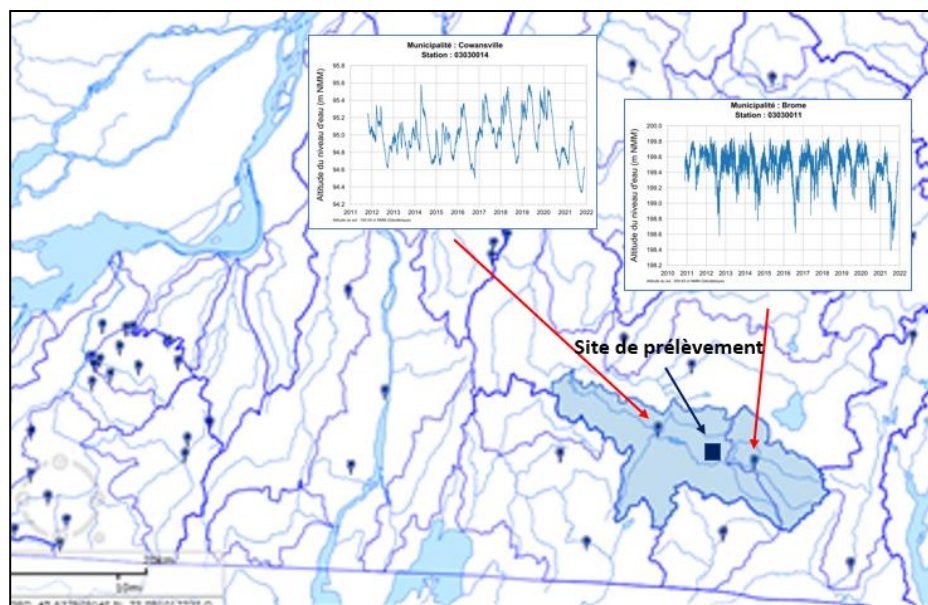
No : < 20% : Low pressure

Yes : ≥ 20 % : Under pressure



3. GROUNDWATER SUSTAINABILITY INDICATORS

Indicator: Groundwater level

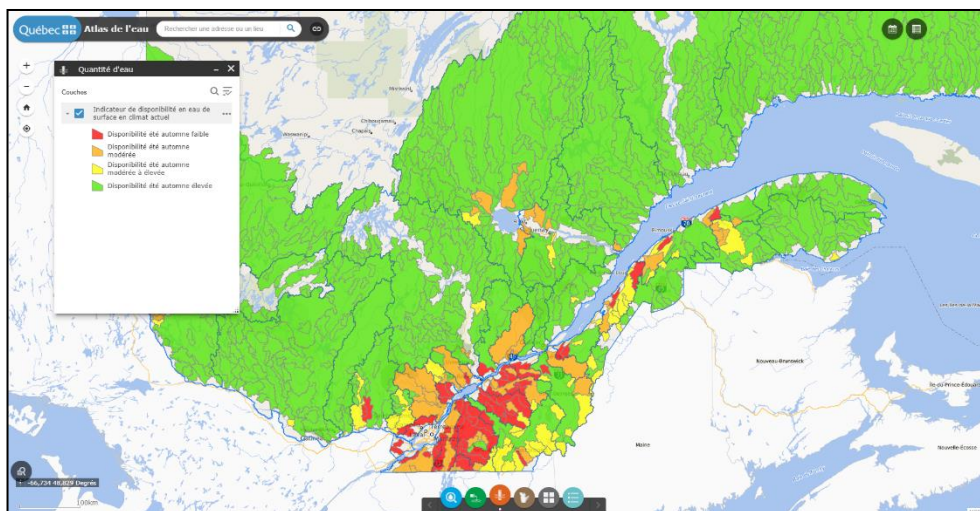


Statistical hydrograms

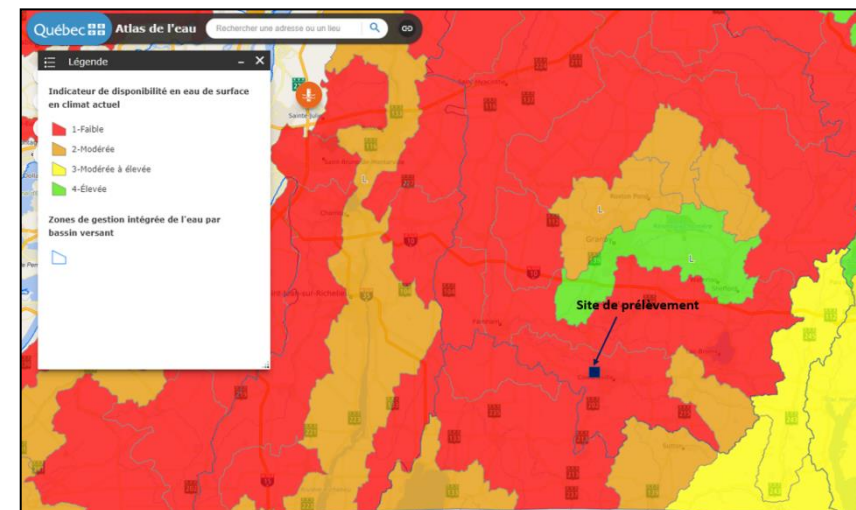
- No :** Water levels over the 5 last years: +/- stationary or no trend (decrease) and/or ≥ 3 years $>$ median
- Yes :** Water levels over the 5 last years: trend (decrease) and/or ≥ 3 years $<$ median

3. GROUNDWATER SUSTAINABILITY INDICATORS

Indicator: Surface-water availability



Source: MELCCFP, 2023



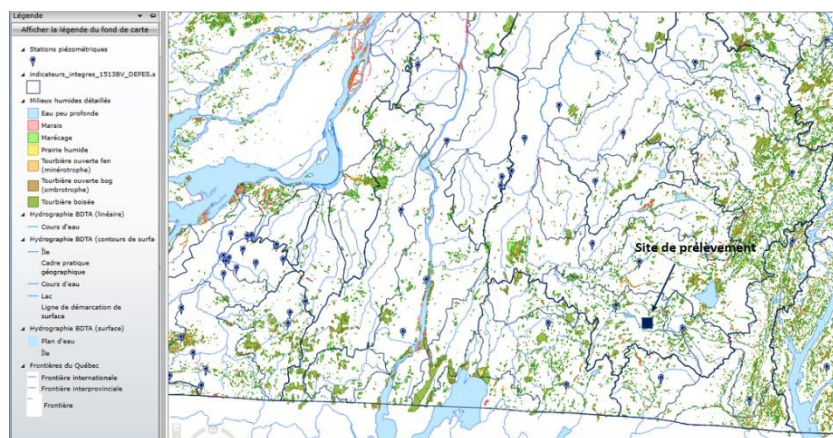
No : “Medium to high” or “High” availability

Yes : “Low” or “Medium” availability

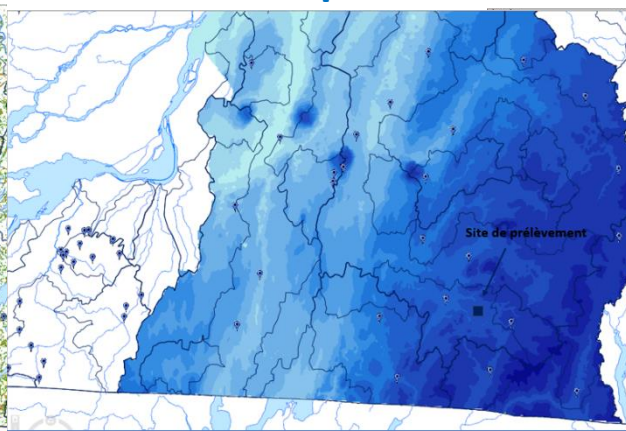
3. GROUNDWATER SUSTAINABILITY INDICATORS

Indicator: Groundwater-dependent ecosystems (GDE)

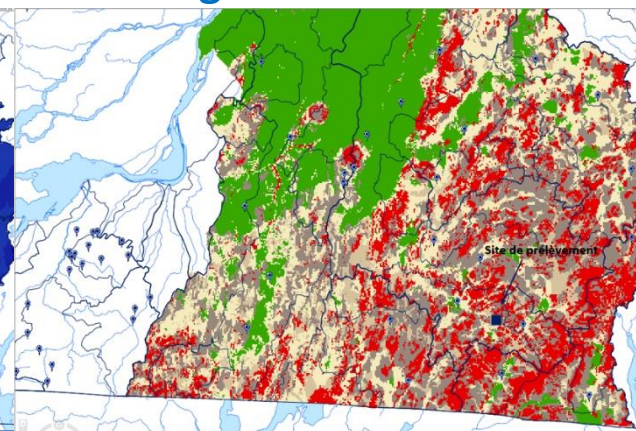
Wetlands (GDE)



Piezometric map



Confining units



Source: adapted from INRS-ÉTÉ et al., 2013

No : Confined aquifer and upgradient GDE

Yes : Water table or semi-confined aquifer and downgradient GDE

3. GROUNDWATER SUSTAINABILITY INDICATORS

Advantages

- Available data
- Easy-to-understand
- Conservative results

Limitations

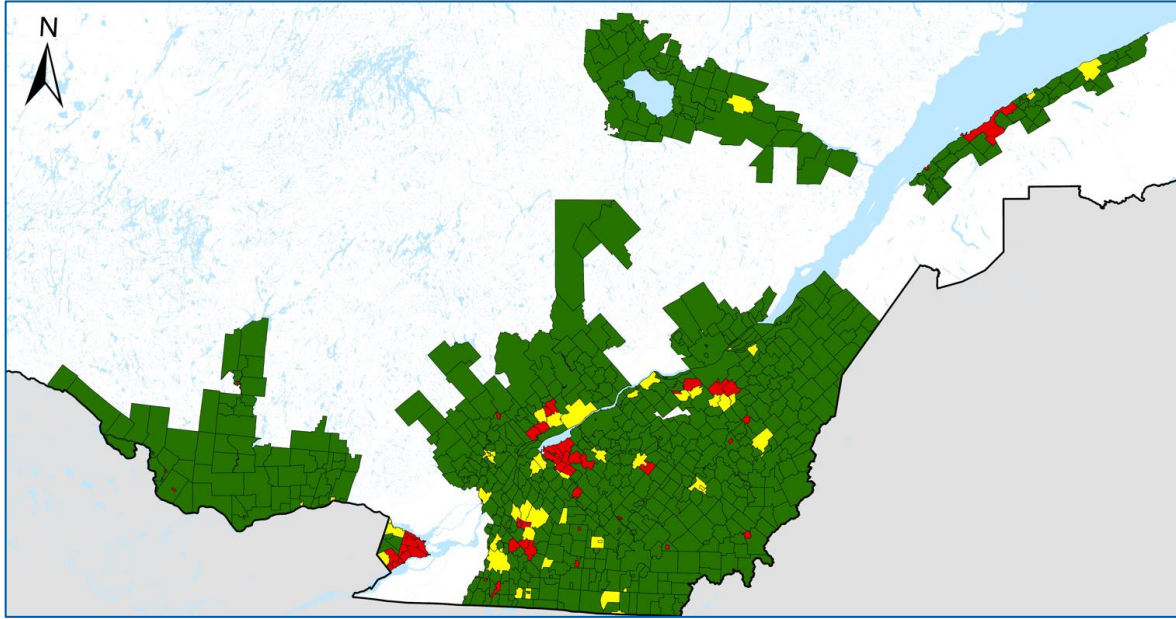
- Different approaches were used to prepare the indicators
- *Still requires an expertise for adequate interpretation*

4. FUTURE WORK

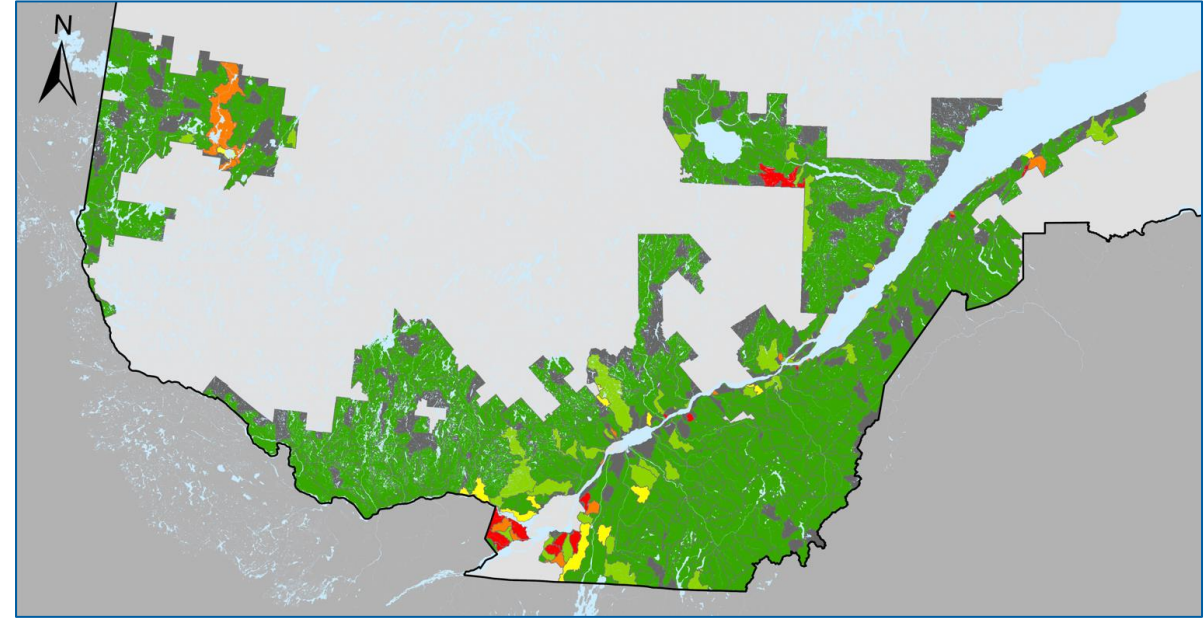
Objectives

- Standardize approach
- Simplify indicators
- Develop new indicators (surface and ground water)

Groundwater withdrawal/Recharge

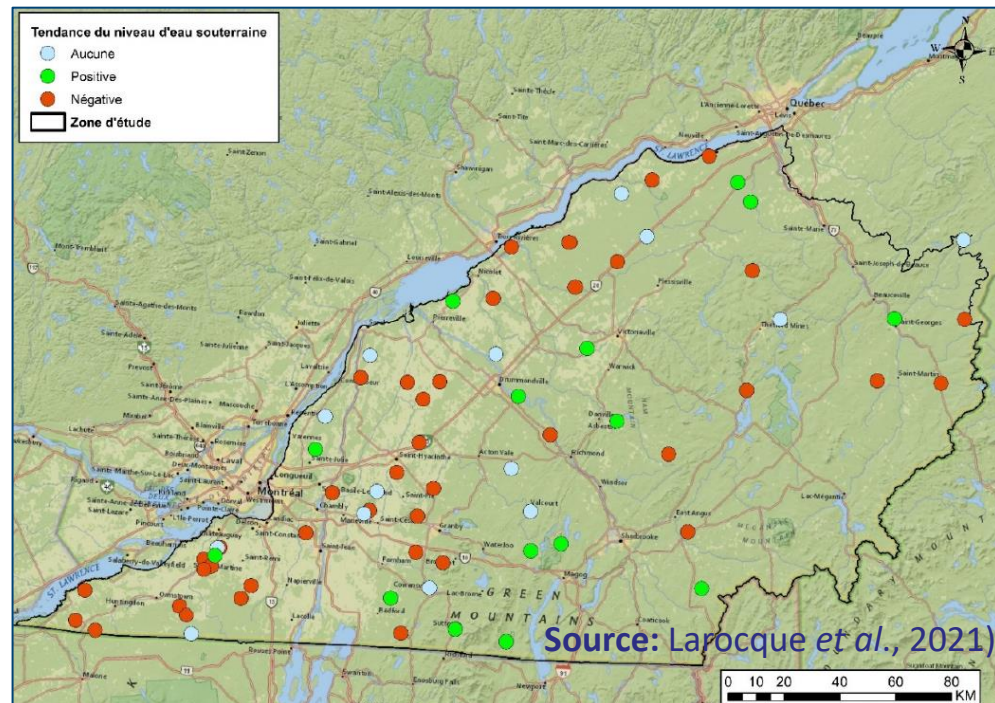


Municipal scale

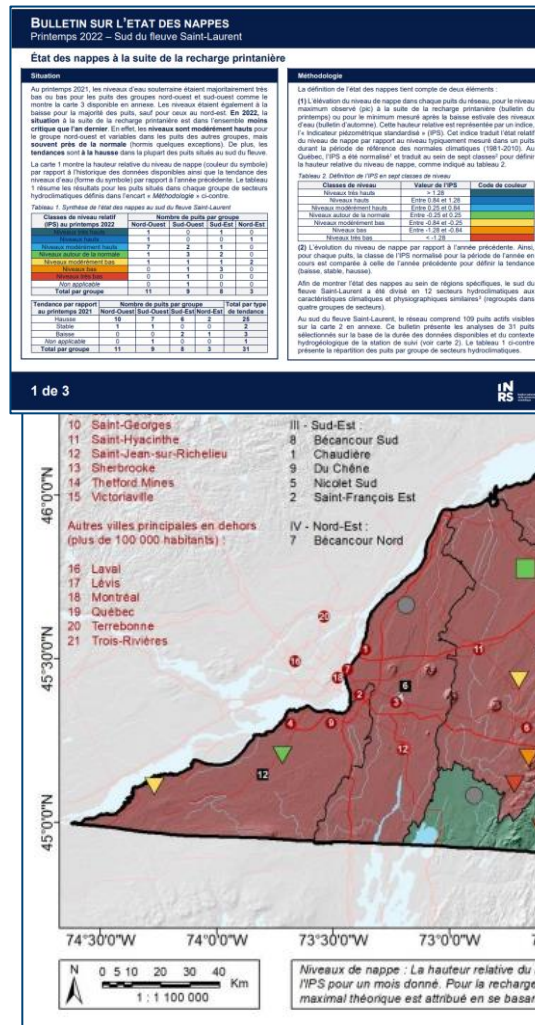


Sub-watershed scale

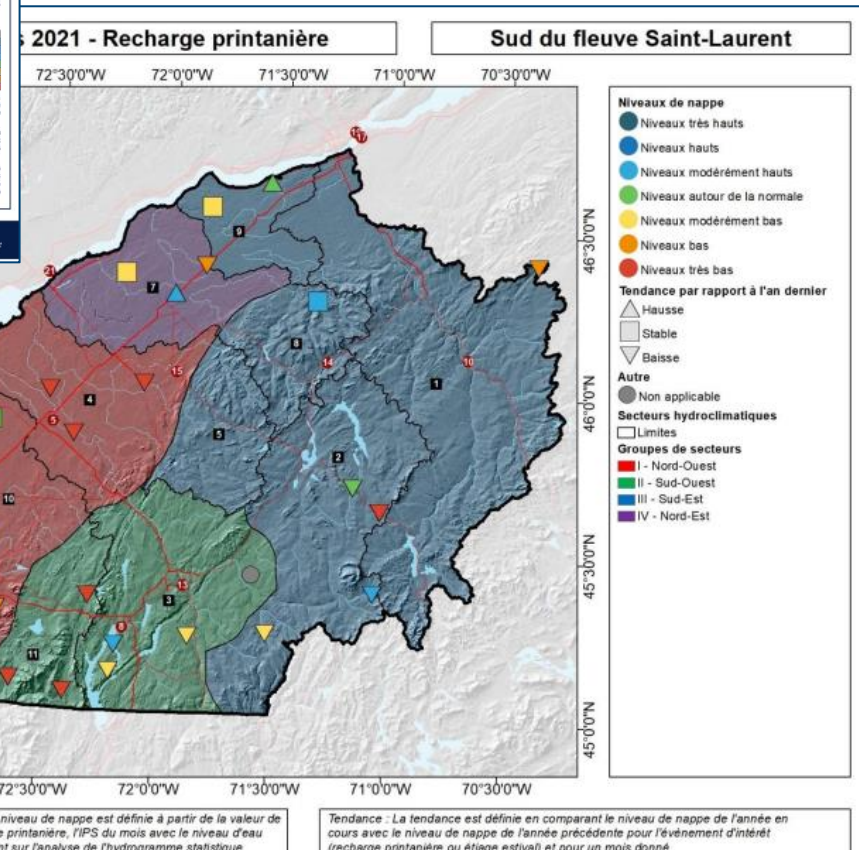
Groundwater Level (trends)



Long-term trends



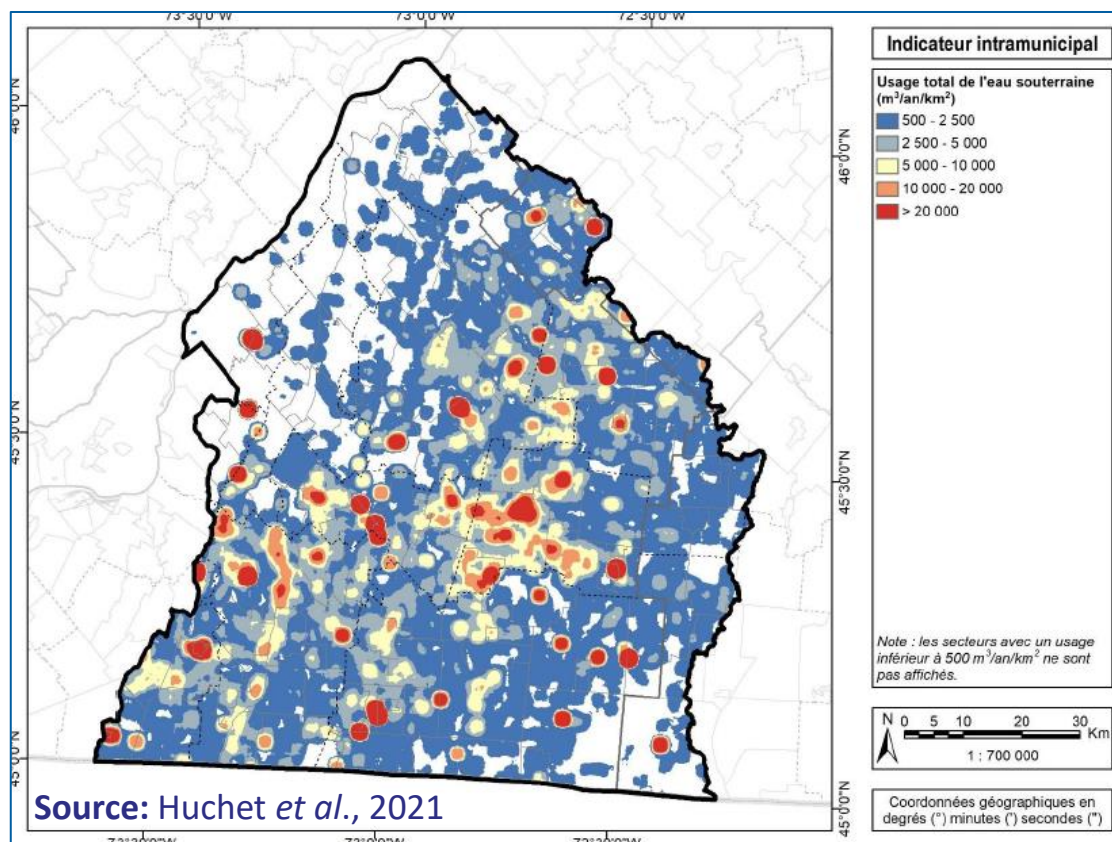
Groundwater Bulletin (Spring 2022)



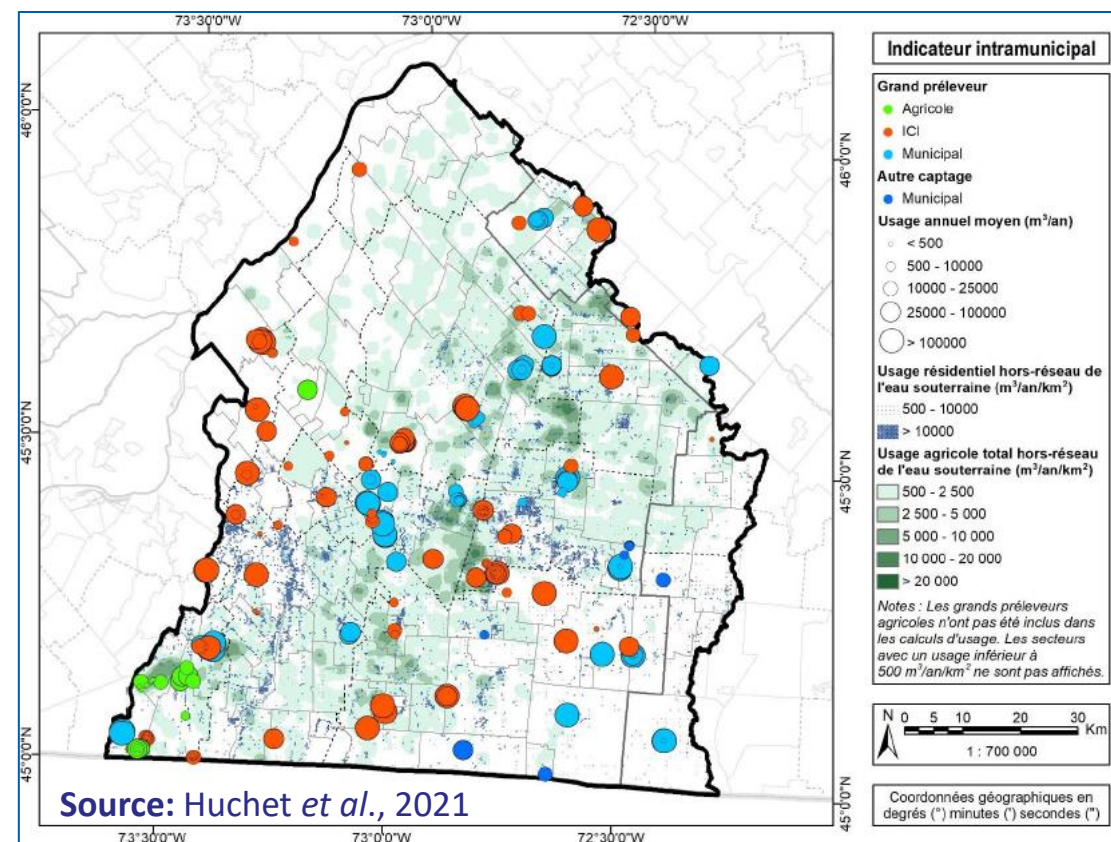
Source: Huchet et al., 2021

Hydroclimatic regions with representative monitoring wells

Intra-municipal Indicators



Total groundwater withdrawal density



Groundwater uses and intensity

5. CONCLUSIONS

- The decision-making framework and indicators are useful for the purposes of section 31.76 of the LQE, in particular, regional water issues and potential cumulative impacts and user conflicts
- However, it is incomplete, because it does not efficiently address land development and long-term issues (*i.e.*, climate change)
- The key parameter for all indicator development is:
 - Withdrawal sites (location and yield)
- More work needs to be done to simplify current indicators and develop new ones:
 - Ex: land use evolution, GDE mapping, surface and ground water)



Thank you!

Questions?

REFERENCES

- Huchet, F., Gosselin, J., Raynauld, M., Domaine, J., Lefebvre, R., 2021. *Outil de support à l'analyse des demandes d'autorisation de prélèvement d'eau – développement d'une méthodologie pour déterminer les pressions sur les ressources en eau souterraine et les zones de gestion particulière*. Institut National de la Recherche Scientifique, Québec, Août 2021, 344 p.
- INRS-ÉTÉ, CGC, IRDA et OBV Yamaska, 2013. *Portrait des ressources en eau souterraine en Montérégie Est, Québec, Canada*. Rapport de recherche R-1433 préparé dans le cadre du PACES, juin 2013, 283 p.
- Larocque, M., Gagné, S., Dubois, E., Vu, T.A. 2021. *Recharge des aquifères et contribution des eaux souterraines aux débits de base des cours d'eau - conditions passées, actuelles et futures en présence de changements climatiques – Rapport final*. Rapport déposé au Ministère de l'Environnement et de la Lutte contre les changements climatiques. Université du Québec à Montréal, Montréal, Québec. 154 p.
- MELCCFP, 2023. Atlas de l'eau. Consulté le 18 avril 2023. <https://services-mdelcc.maps.arcgis.com/apps/webappviewer/index.html?id=371faa9786634167a7bdefdead35e43e>

Flood Hazard Identification and Mapping Program (FHIMP)

Updates and Looking Ahead



Juno Garrah, Policy Analyst (GeoBase/CCMEO/NRCan)

National Dialogue on Groundwater hosted by the Geological Survey of Canada

April 19, 2023



Natural Resources
Canada

Ressources naturelles
Canada

Canada

Providing context:
FHIMP Overview

FHIMP Updates:
Engagement



Next Steps for FHIMP

Groundwater Flooding
and FHIMP

FHIMP Updates: Program Implementation



NRCan's Flood Mapping Mandate

Protect homes and communities from the impacts of climate change by:



Completing work with provinces and territories to develop flood maps for **higher-risk** areas



Advancing work to complete flood mapping **nation-wide**



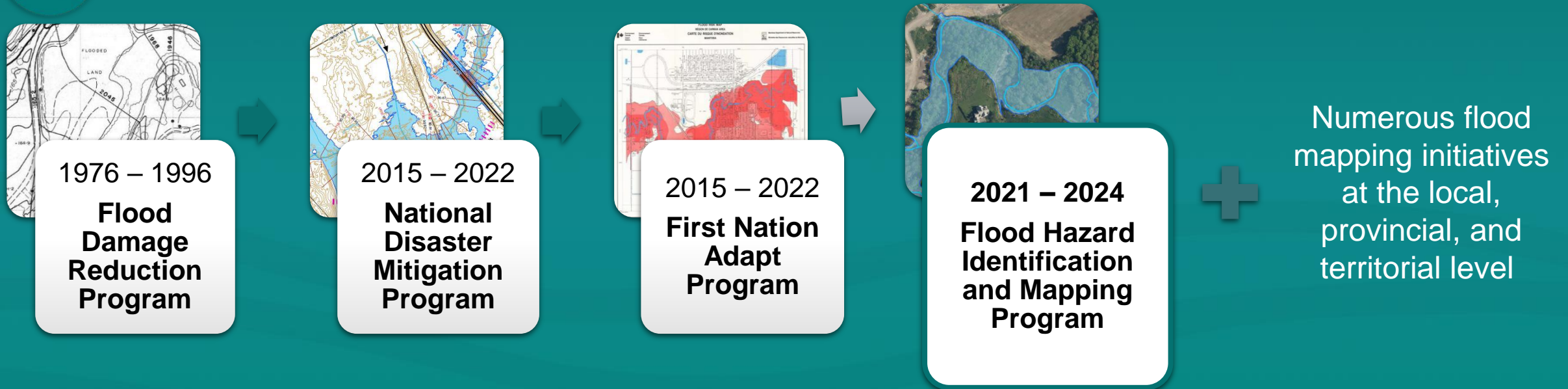
Supporting the development of a portal to provide **centralized access to information** on flood risks

- Minister of Natural Resources Mandate Letter, December 2021





State of Flood Mapping



- 586 studies now compiled in CCMEQ's **National Flood Hazard Data Layer (NFHDL)** : flood hazard information storage
- Many maps from FDRP era still in use across Canada (1976-1996)
- **Significant leadership** will help address existing flood mapping gaps and renew them when required



Flood Hazard Identification and Mapping Program (FHIMP) Overview

- **\$63.8M total (2021-22 – 2023-24)**
- NRCan lead, with support from Environment & Climate Change Canada and Public Safety Canada
- Complementary to the Emergency Management Strategy, National Risk Profile
- FHIMP projects align with the Federal Flood Mapping Guidelines and will be added to the NFHDL
- Builds on shared expertise, including support in Indigenous engagement from CIRNAC
- **\$30.1M** flood mapping projects in higher-risk areas, cost-shared with PTs
 - 50-50 with provinces, 75-25 with territories



*Federal Flood Mapping Guidelines
FHIMP alignment highlighted*



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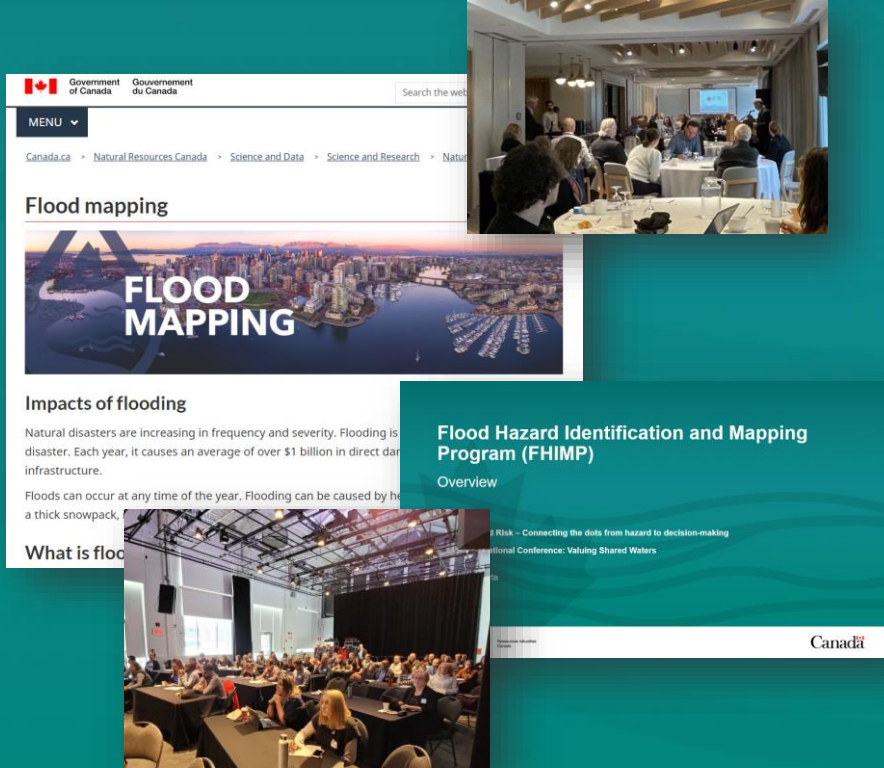
FHIMP Partners

Today's presentation

Natural Resources Canada	<p>Development and implementation of flood hazard mapping program with provinces and territories;</p> <p>Engage with jurisdictions to identify and implement priority projects;</p> <p>Cost-share flood mapping activities; and</p> <p>Ensure flood mapping information dissemination.</p>
Environment and Climate Change Canada (ECCC)	<p>Atmospheric and water data, modelling, water resources engineering, and further develop and advise on science and climate change knowledge; and</p> <p>Engage academia, provide expertise, inform flood mapping engineering methods.</p>
Public Safety Canada (PS)	<p>Governance, policy and alignment with initiatives under Canada's Flood Risk Plan</p> <p>Ensure no overlap with National Disaster Mitigation Program; and</p> <p>Preliminary scoping towards a Canada-Wide Flood Risk Portal.</p>



FHIMP Update: Engagement



- Successful National Information Session, CWRA webinars & conference, Atlantic Flood Mapping Conference, Industry Day, and more!
 - Over ~ 500 flood mapping stakeholders engaged in these sessions
- FHIMP social media and webpage campaigns
- Met with every PT, 100+ bilats
- Drafted 22 agreements supporting a mixture of 200+ flood mapping related projects in 175+ locations across Canada

Flood Hazard Identification and Mapping Program (FHIMP)

Types of Activities Conducted



Data Acquisition

All forms of data or information required for flood hazard mapping



Flood Hazard Mapping

All steps of an engineering assessment for flood hazard mapping



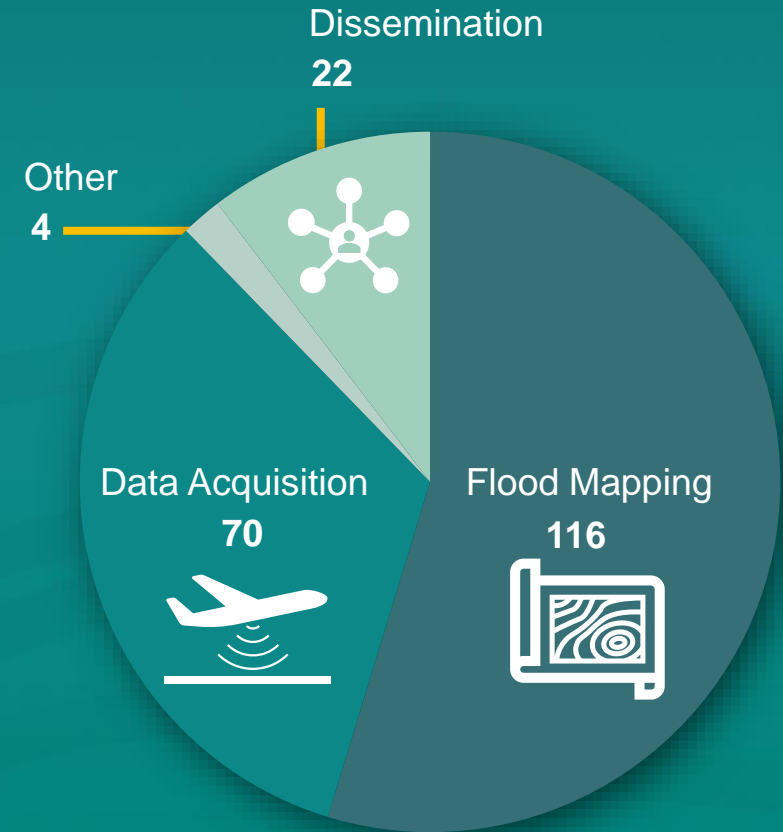
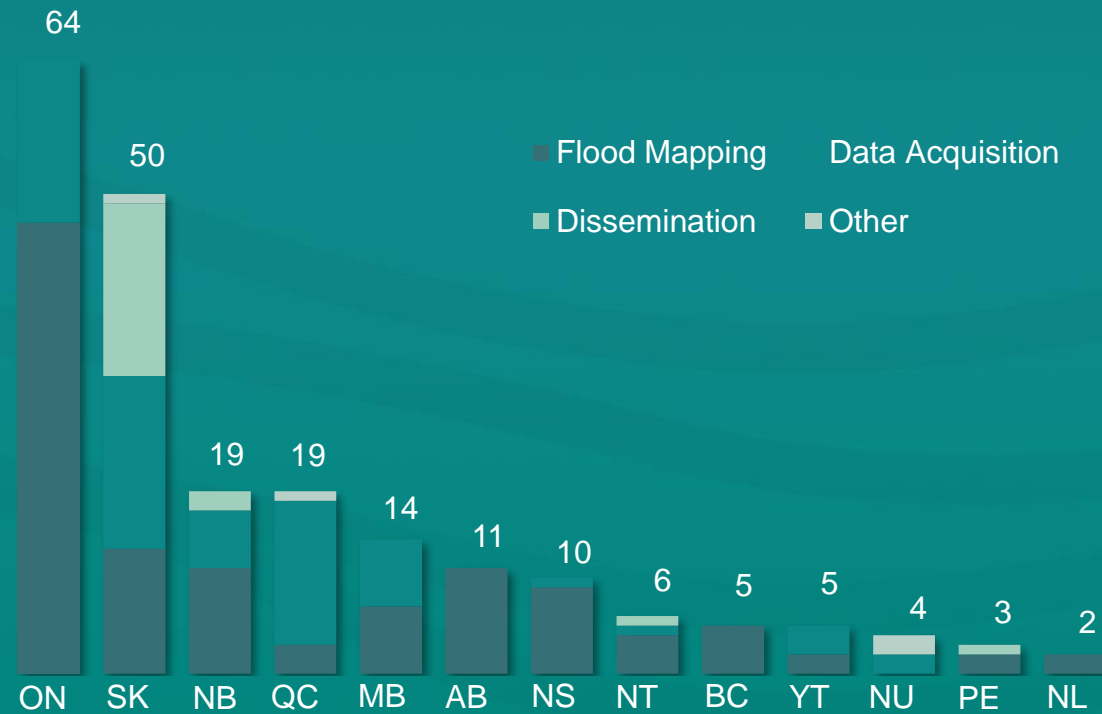
Information Dissemination

Distribution of flood hazard information to the public

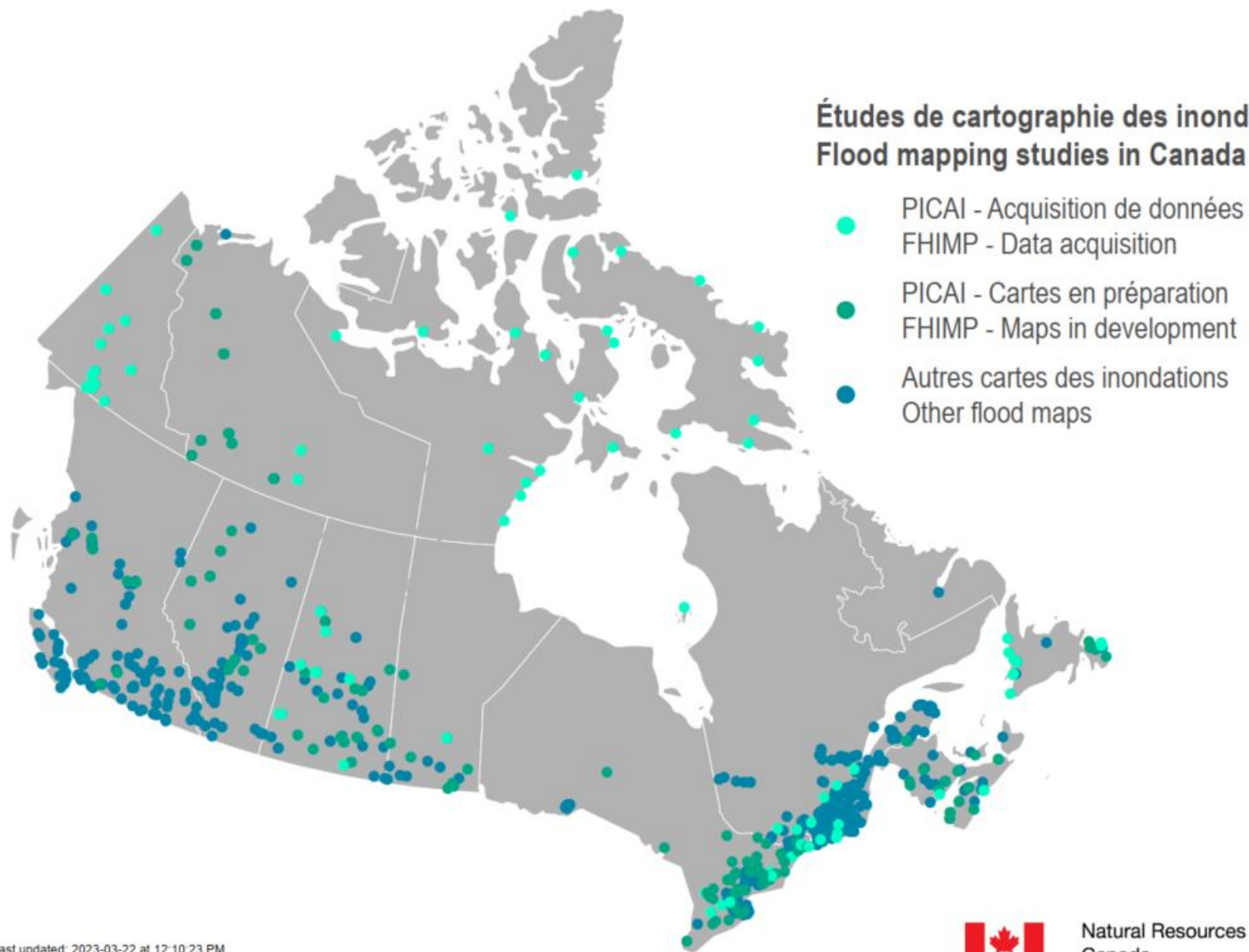


FHIMP Update: Program Implementation

Types of projects



Études de cartographie des inondations au Canada Flood mapping studies in Canada



Last updated: 2023-03-22 at 12:10:23 PM



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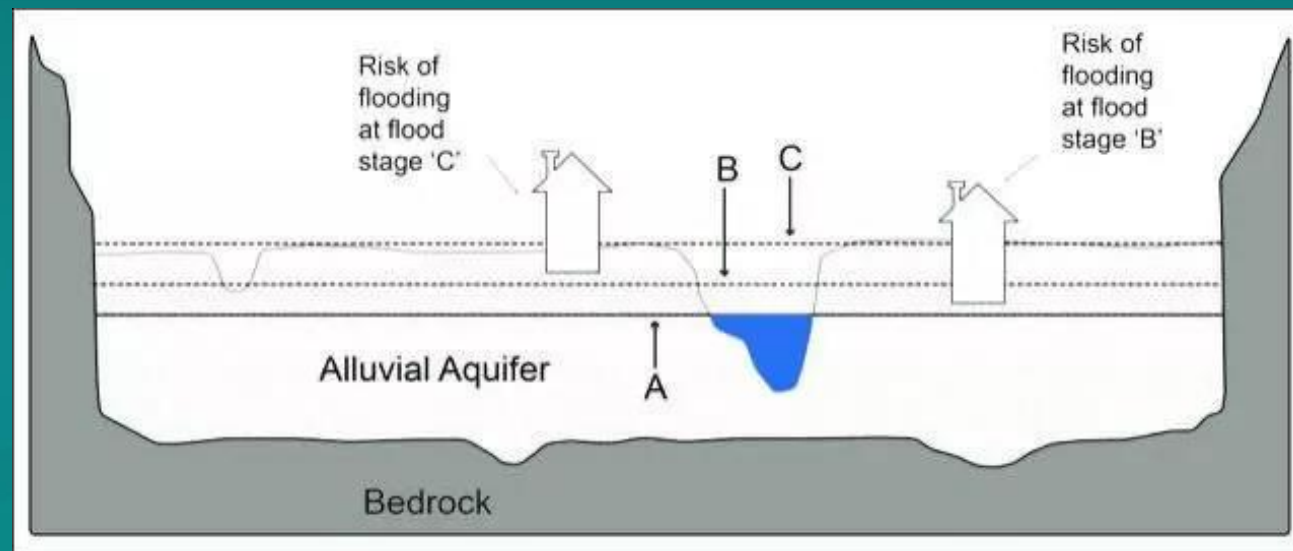
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Groundwater and Flooding

- Groundwater flooding can occur **in the absence of surface water flooding** and **extend to areas beyond overland flooding**
- A survey of homes flooded during the 2013 Calgary floods showed 88% reporting experiencing groundwater flooding **first**, with 12% *only* experiencing groundwater flooding

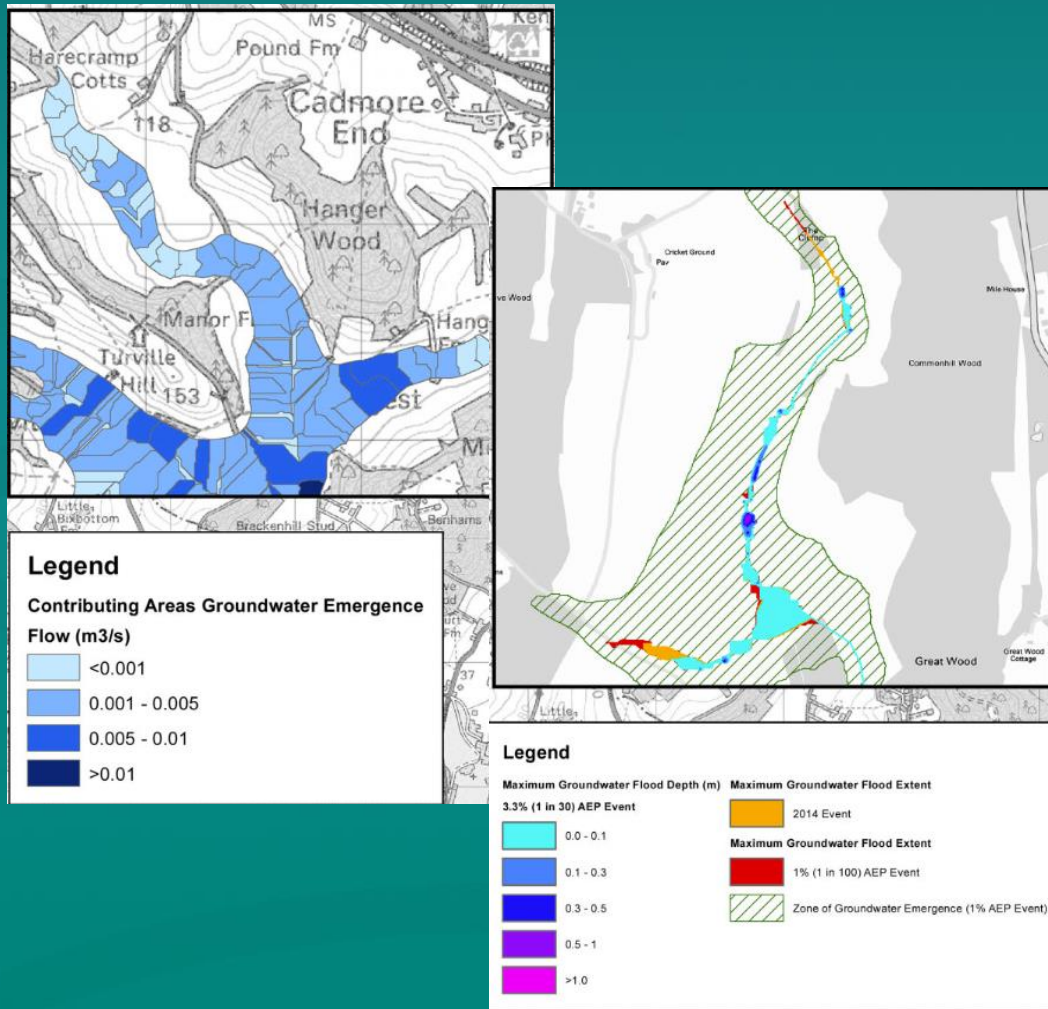


- City of Calgary estimates 30-40% of flood damages are caused by groundwater, yet **often excluded from flood insurance coverage and flood hazard mitigation strategies**
- Can be improved through monitoring (adapting existing groundwater well sampling sites), as well as adaptation strategies (building codes, especially surrounding appropriate basement depth)



Groundwater Flood Mapping

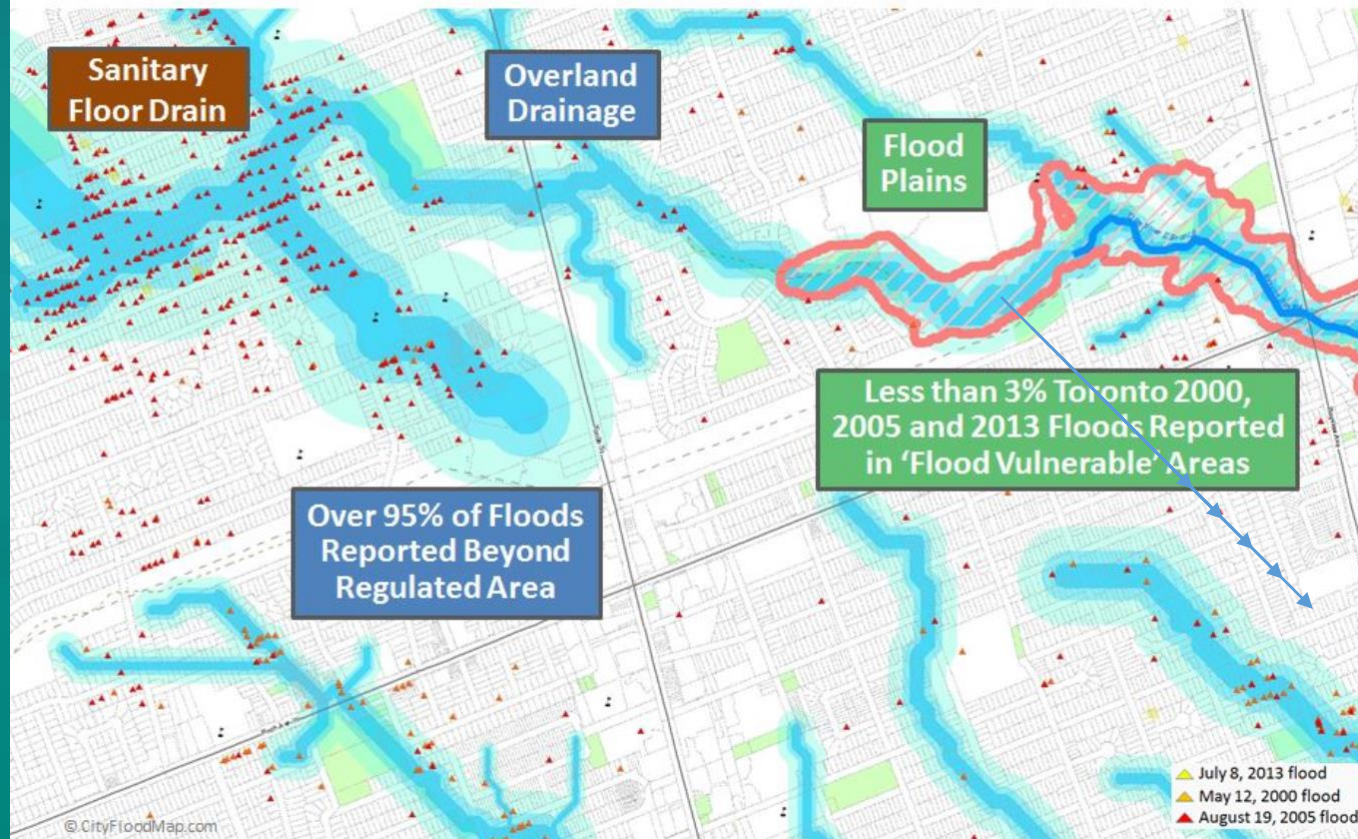
- Groundwater flood maps, where they exist, have far less detail than fluvial and surface water flooding
 - Do **not** assign probabilities to flows or provide information on depth or extent
 - Simply delineate a broad area of possible emergence
- For use by risk management authorities, need to estimate groundwater emergence and flow, coupling hydrogeological models with hydraulic surface flow models
 - "No cost-effective and rapidly applicable tool exists for accurate simulation of the spatial and temporal extent of groundwater flooding" (Morris et al., 2018)
- Private options exist for groundwater flooding maps (e.g. JBA), especially in the UK, but no maps for Canada
 - No guidance in federal flood mapping guidelines





Groundwater and FHIMP

Many Urban Ontario Priorities Beyond Flood Plains



- FHIMP is focused on creating regulatory flood maps for high-risk flood plain areas
- **95% of floods reported in Toronto beyond regulated area**
 - No regulations on groundwater, storm water, sewer backup flooding in Canada
 - Managed at municipal level
 - Data (where it exists) available from insurance industry, municipalities
- **Ideas? Advice? FHIMP wants to hear about your work on groundwater flooding**





Next steps for FHIMP

- Public release of data dissemination environment and research by 2023-24
- NRCan continuing to activities advancing flood hazard mapping in Canada:
 - NFHDL; National Elevation Strategy; Federal Guidelines Series; Emergency Flood Mapping Support; Innovation (AI); Data & Products; etc.
- Advancing FHIMP announced under National Adaptation Strategy
- **Funding extension to 2027-2028** with implementation details to come
- **Additional G&C funding will be available through NRCan and ECCC for research related to flood mapping and modelling**





Upcoming NRCan Webinars and Events

Participation in upcoming conferences:

- Association of State Floodplain Managers Annual Conference (May 2023)
- Canada Water Summit (June 2023)
- CWRA National Conference (June 2023)
- Canadian Institute of Planners National Conference (June 2023)
- Coastal Zone Canada Annual Conference (June 2023)
- And more



Thank you

For any questions:

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Q's



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