

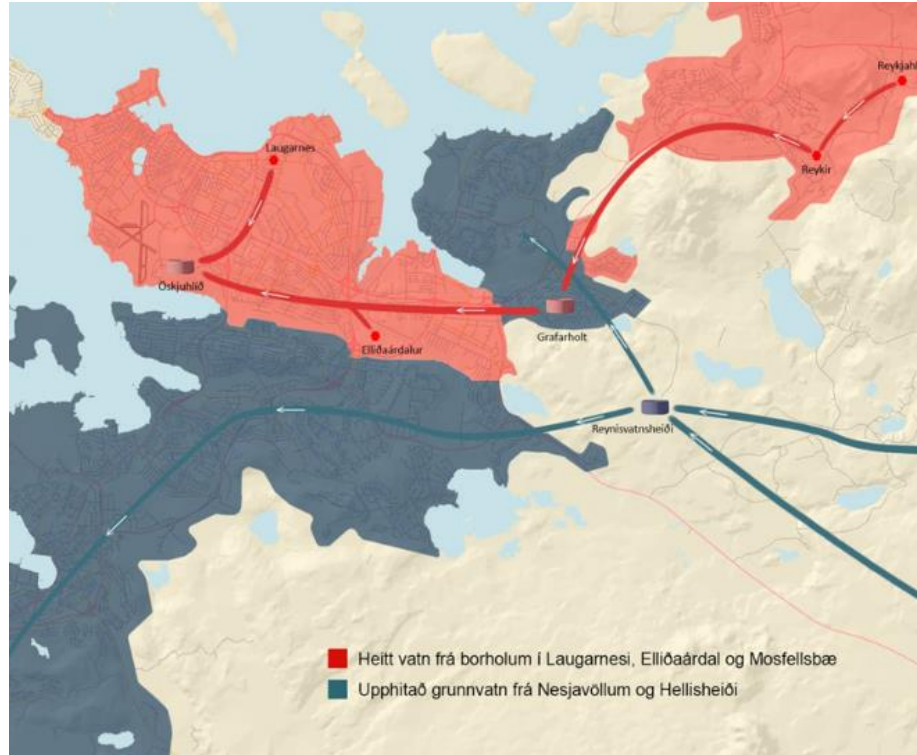
# Flexible Operation of a Dually Fed District Heating System

GEOHERMAL DISTRICT HEATING IN REYKJAVÍK

Dr. Arna Pálsdóttir

Sustainable District Energy Conference 2019

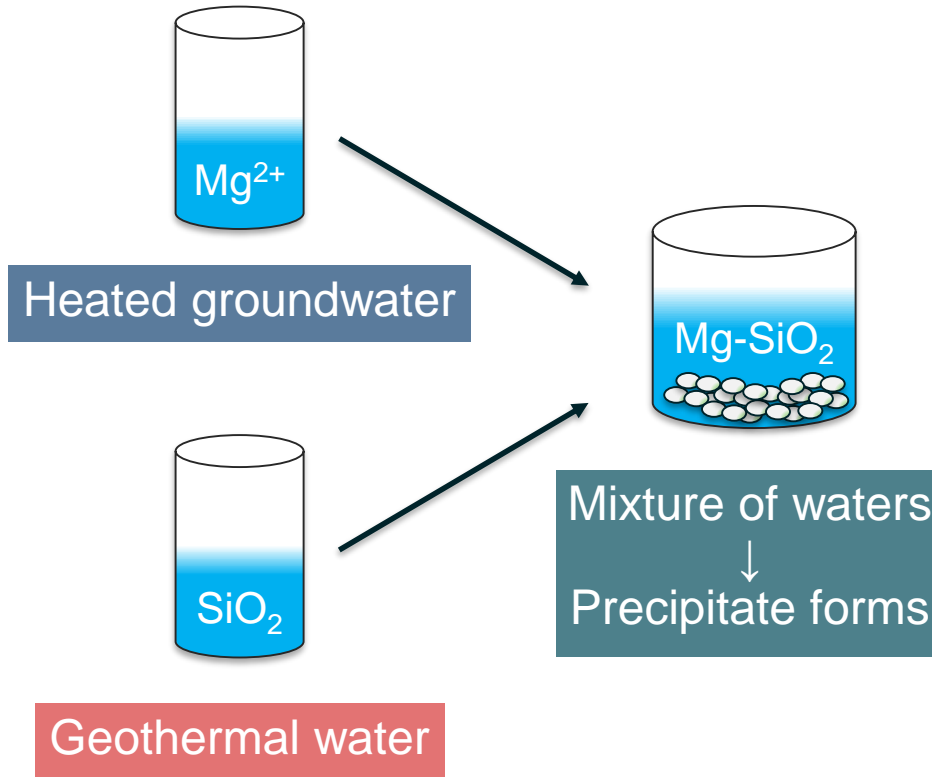
# Veitur operates a dually fed district heating system in Reykjavík



Geothermal water

Heated groundwater

# Waters can not be mixed

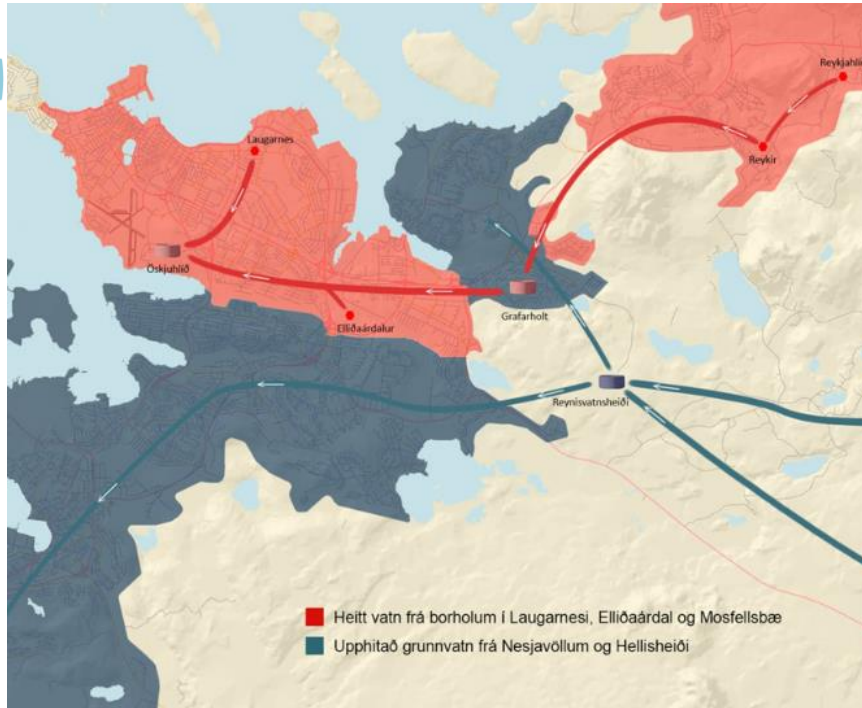


- Reduced delivery potential
- Damage to system components
- Damage on the consumer's side

# Inefficient to operate two systems

Geothermal water

Heated groundwater

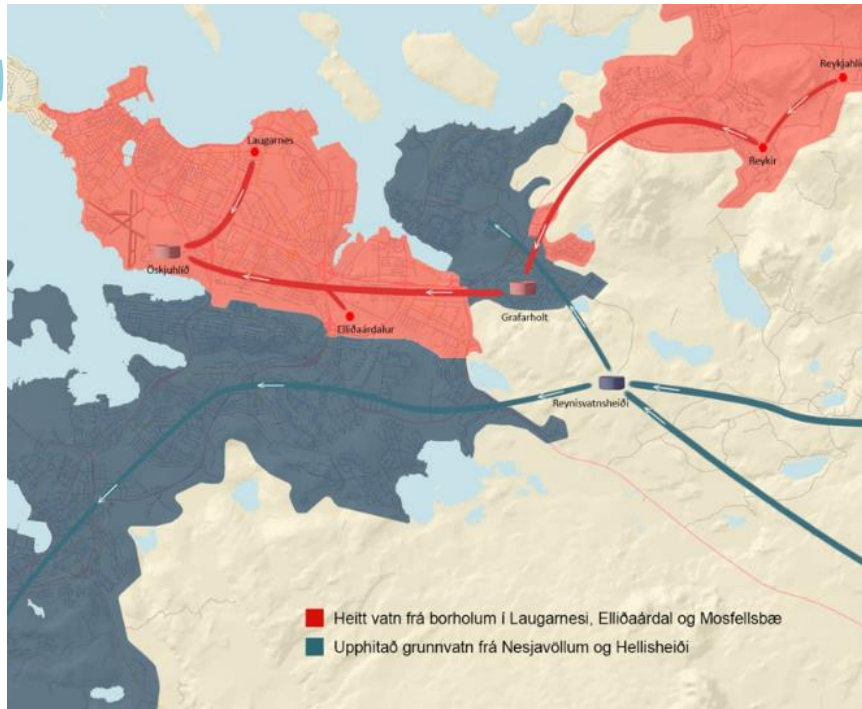


- Operational changes:
  - Heated groundwater as baseload
  - Geothermal water for peaking in winter

# Better resource utilization

Geothermal water

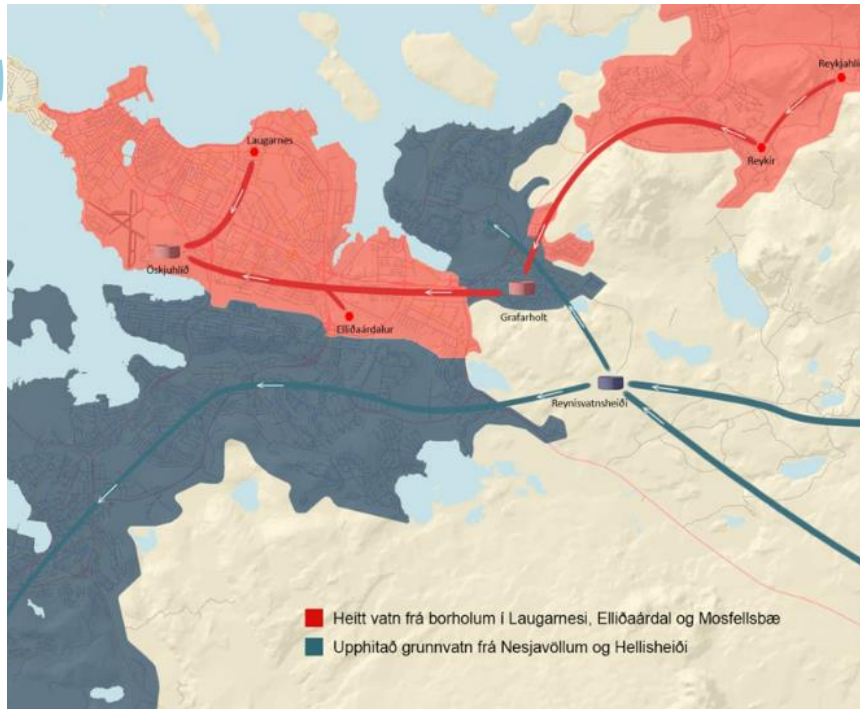
Heated groundwater



- Low temperature fields rest in the summer
- Minimize water disposal at power plants

# Pilot study

Before



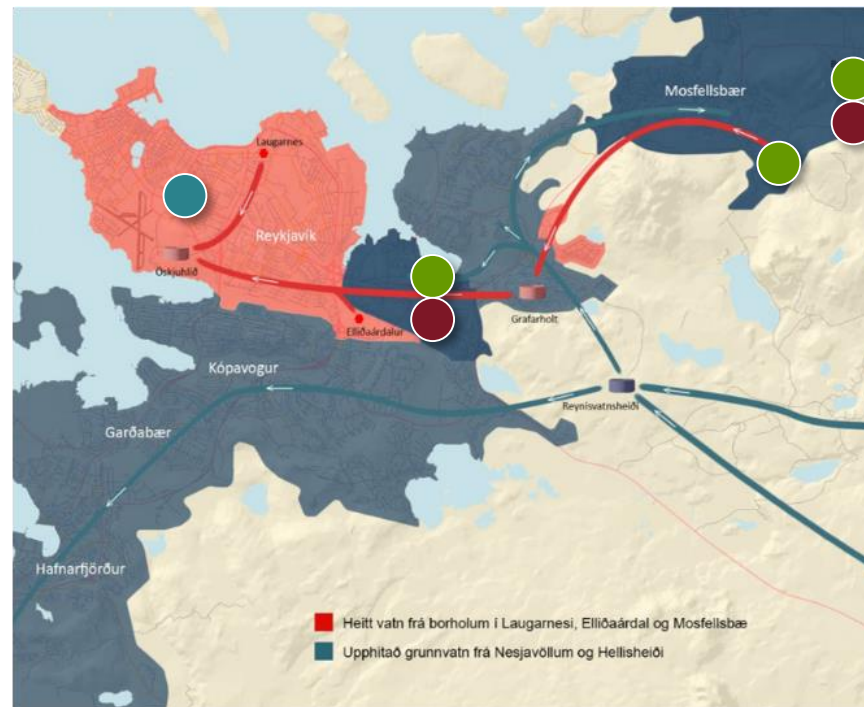
Geothermal water

Heated groundwater

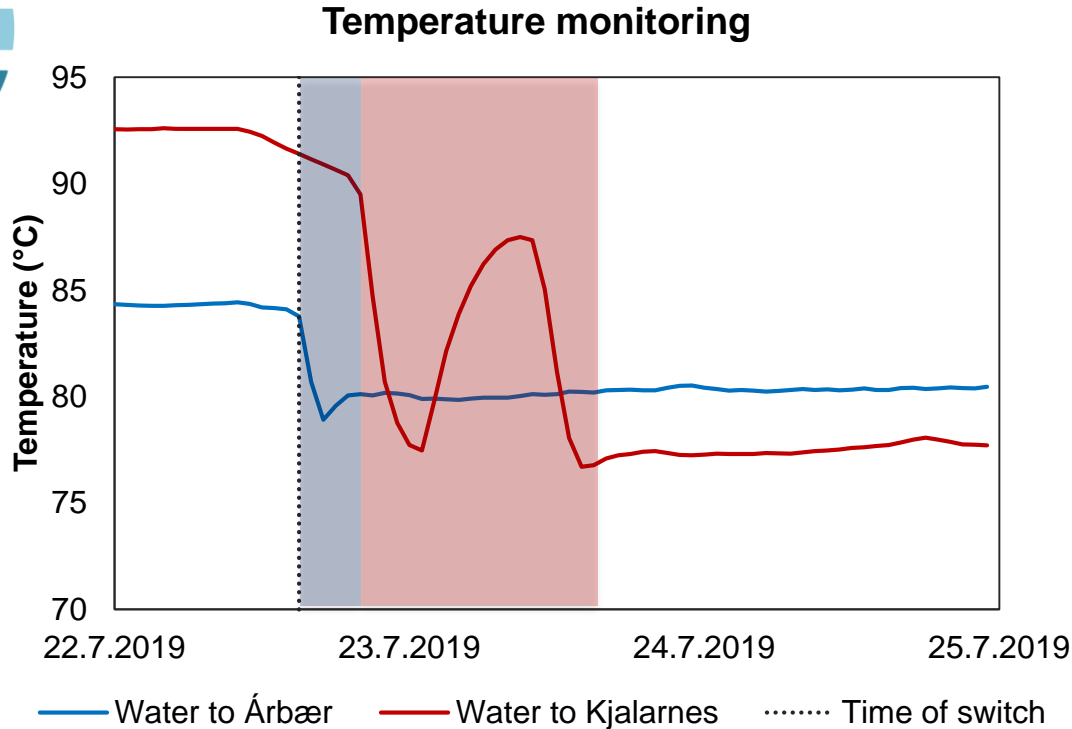
- Performed a pilot of the operational changes this summer

# Data gathering and monitoring

- Temperature in main distribution pipes
- Ionic strength of main components
  - Na, Mg, Ca, SiO<sub>2</sub>, SO<sub>4</sub>, Cl
  - pH
  - Conductivity
- Dissolved gas content
  - O<sub>2</sub>, H<sub>2</sub>S



# Temperature Development

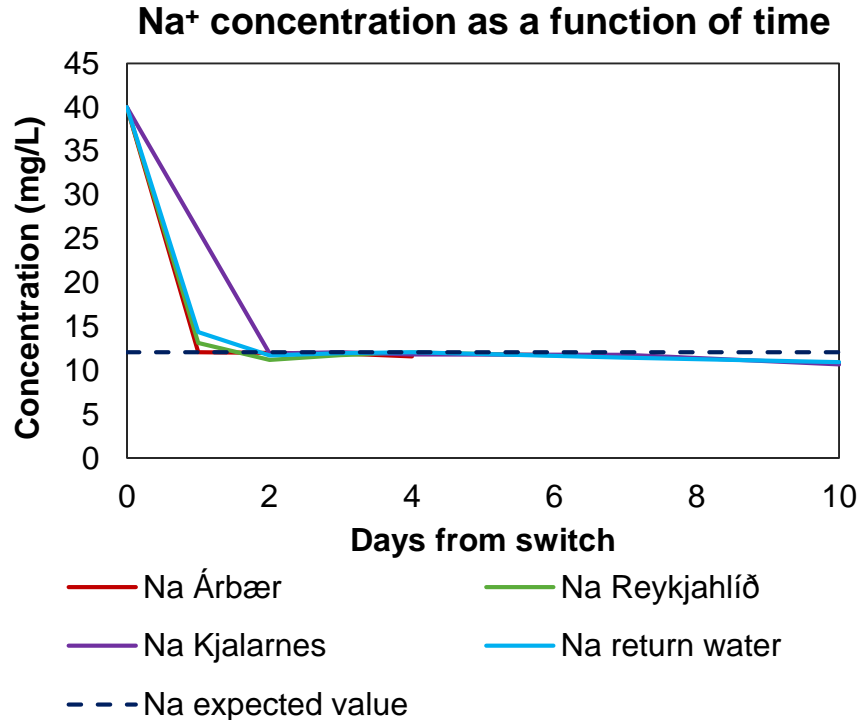


**Geothermal water and groundwater have different temperatures**

Temperature adjustment:  
Árbær: 4 hours  
Kjalarnes: 26 hours



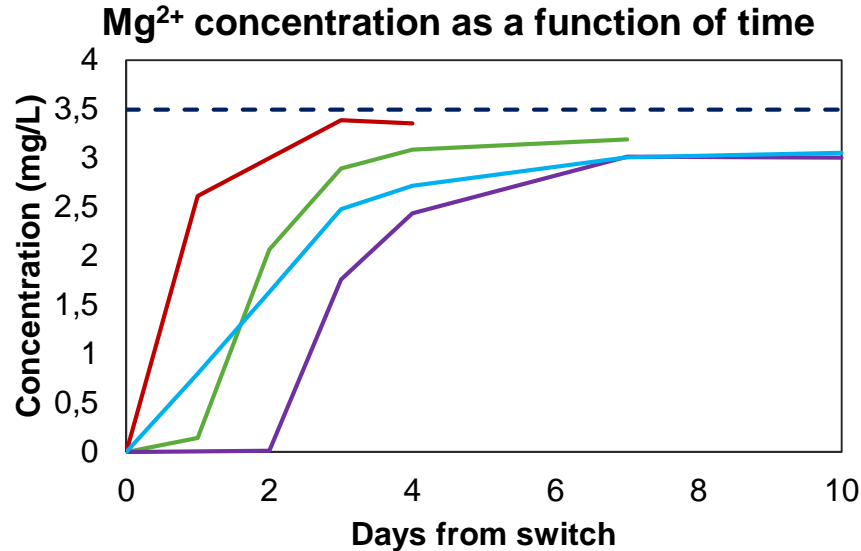
# Monitoring – Na Concentration



Heated groundwater: ~12 mg/L Na<sup>+</sup>

Geothermal water: ~40 mg/L Na<sup>+</sup>

# Monitoring – Mg Concentration

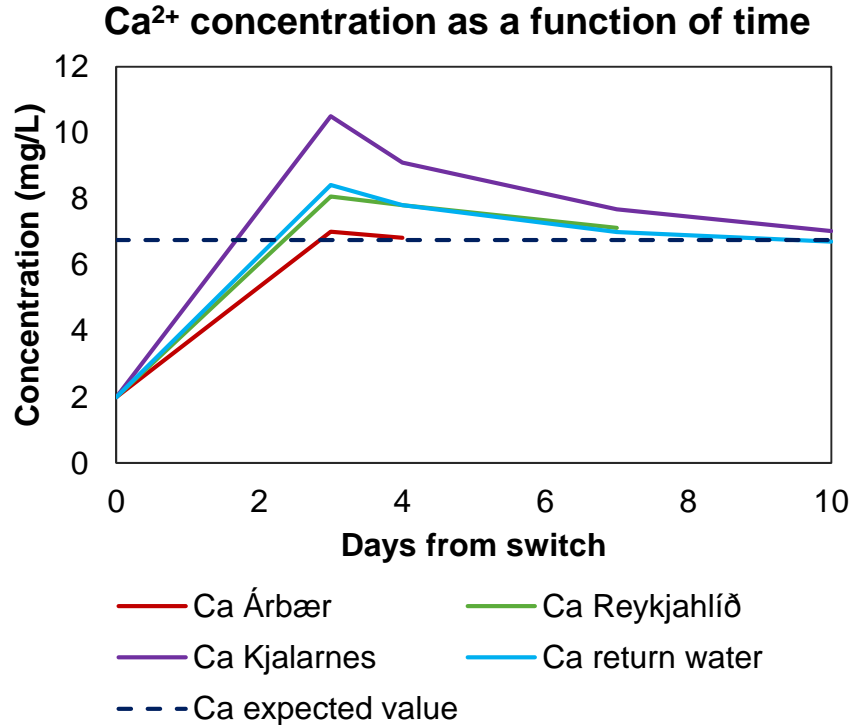


Heated groundwater: ~3.5 mg/L Mg<sup>2+</sup>

Geothermal water: ~0 mg/L Mg<sup>2+</sup>

- Mg Árbær
- Mg Reykjahlíð
- Mg Kjalarnes
- Mg return water
- - - Mg expected value

# Monitoring – Ca Concentration



Heated groundwater: ~7.7 mg/L Ca<sup>2+</sup>

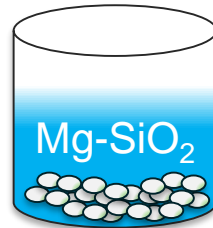
Geothermal water: ~2 mg/L Ca<sup>2+</sup>

# Summary

Successfully piloted a method to optimize our resource utilization for the future

Some precipitation can be assumed

→ Insert metal plates for scale collection next year



A high-speed photograph of a water droplet falling into a pool of water, creating a series of concentric ripples. The background is a light blue gradient. On the left side, there is a partial circular logo with horizontal stripes in red, green, and blue.

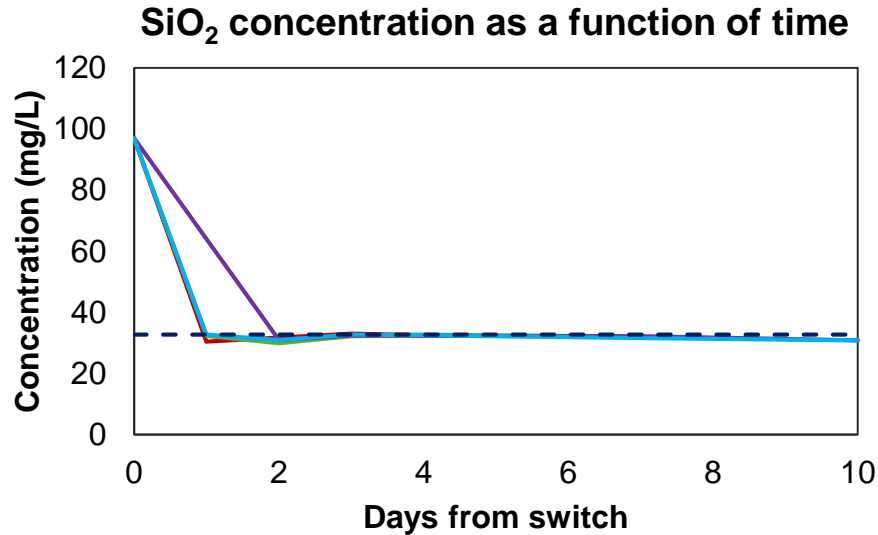
**Thank you!**

Arna.Palsdottir@or.is

# Additional slides

# Ionic concentration monitoring

# Monitoring – Silica concentration



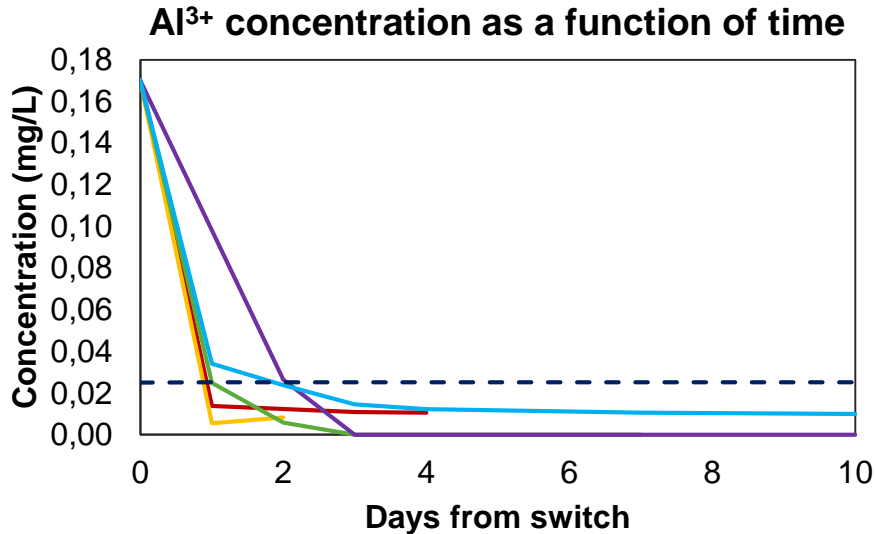
Heated groundwater: ~30 mg/L SiO<sub>2</sub>

Geothermal water: ~100 mg/L SiO<sub>2</sub>

- SiO<sub>2</sub> Árbær
- SiO<sub>2</sub> Reykjahlíð
- SiO<sub>2</sub> Kjalarnes
- SiO<sub>2</sub> return water
- - - SiO<sub>2</sub> expected value



# Monitoring – Al concentration

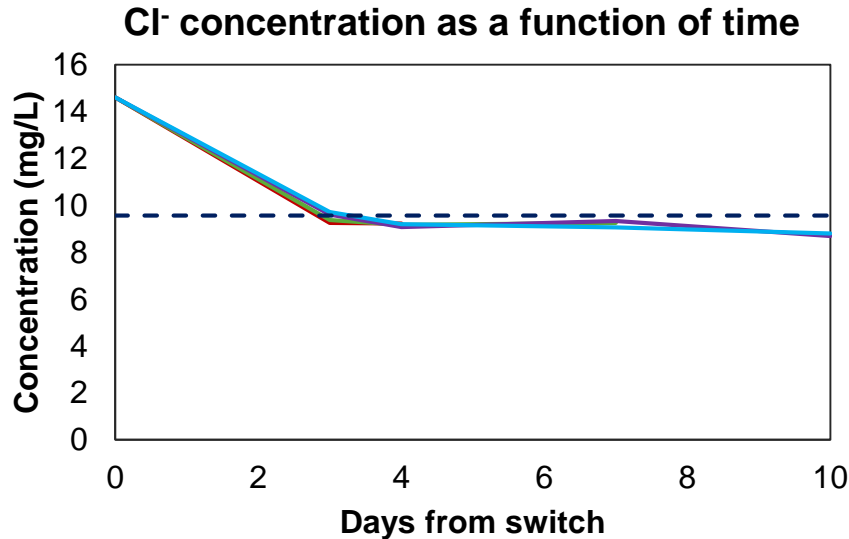


Heated groundwater: ~0.025 mg/L Al<sup>3+</sup>

Geothermal water: ~0.17 mg/L Al<sup>3+</sup>

- Al framvatn Árbær
- Al Reykjavíð
- Al bakvatn Árbær
- Al Reykir
- Al Kjalarnes
- - - Al í virkjanavatni

# Monitoring – Cl concentration



Heated groundwater: ~9.6 mg/L Cl<sup>-</sup>

Geothermal water: ~15 mg/L Cl<sup>-</sup>

— Cl framvatn Árbær

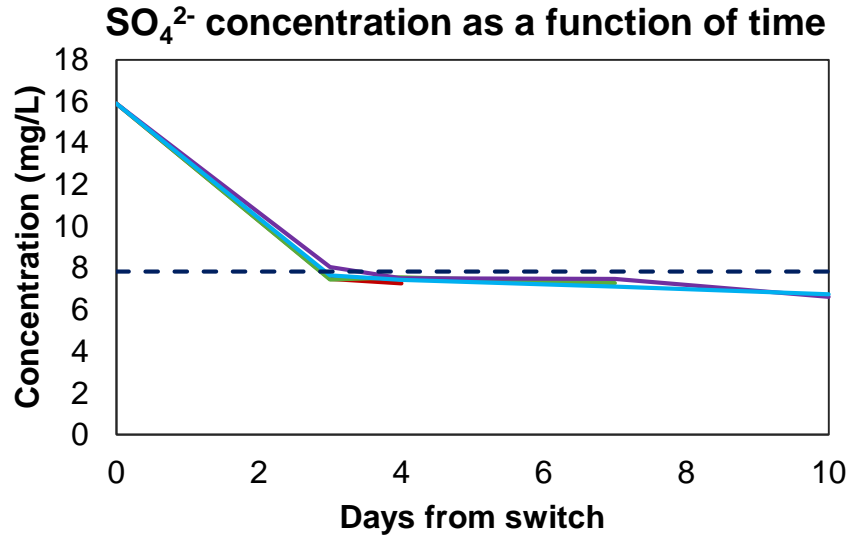
— Cl Reykjahlíð

— Cl Kjalarnes

— Cl bakvatn Árbær

- - - Cl í virkjanavatni

# Monitoring – SO<sub>4</sub> concentration

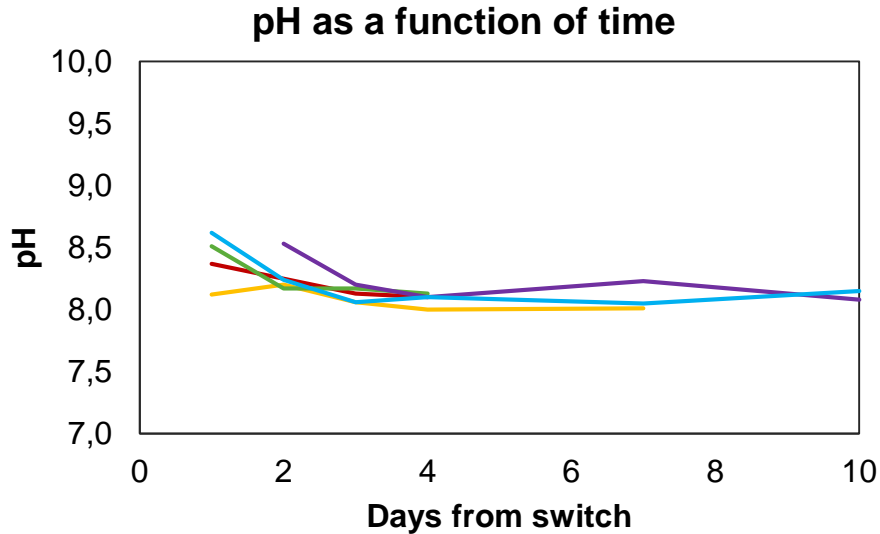


Heated groundwater: ~7.8 mg/L SO<sub>4</sub><sup>2-</sup>

Geothermal water: ~16 mg/L SO<sub>4</sub><sup>2-</sup>

- SO<sub>4</sub> framvatn Árbær
- SO<sub>4</sub> Reykjahlíð
- SO<sub>4</sub> Kjalarnes
- SO<sub>4</sub> bakvatn Árbær
- - - SO<sub>4</sub> í virkjanavatni


# Monitoring – pH



Heated groundwater: ~ 8.0 – 8.5

Geothermal water: ~ 9.5 – 9.7

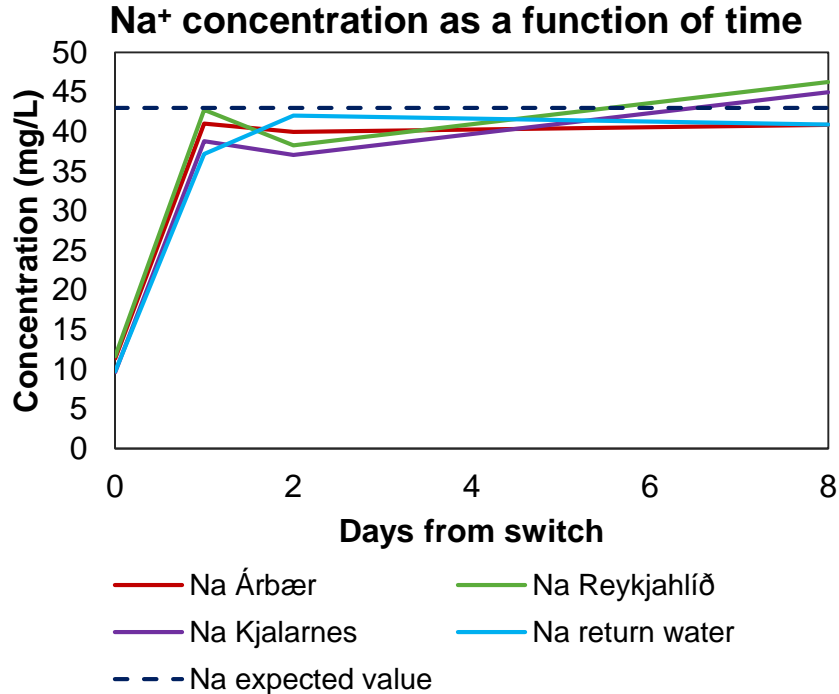
- pH framvatn Árbær
- pH Reykir
- pH Reykjahlíð
- pH Kjalarnes
- pH bakvatn Árbær



# Ionic concentration monitoring

## The switch back

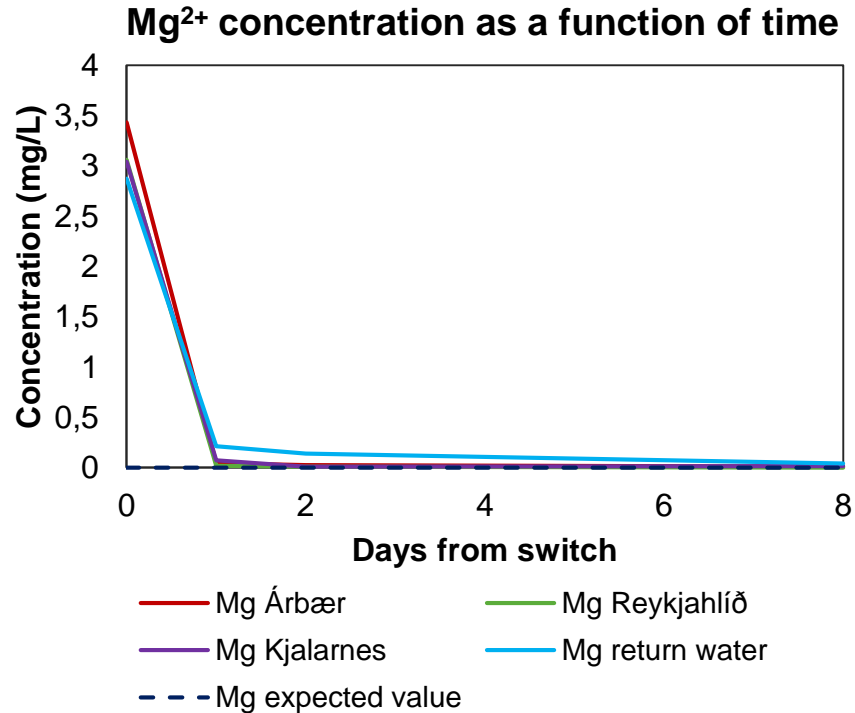
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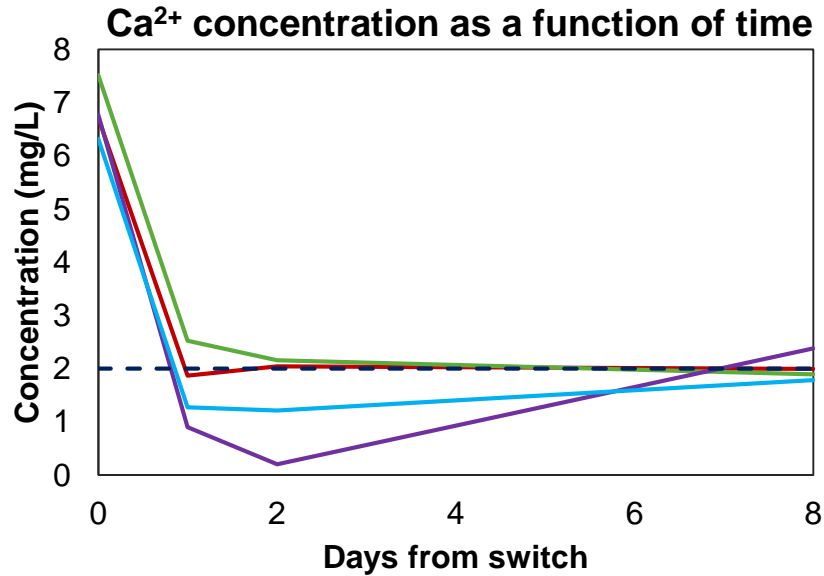
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Heated groundwater: ~3.5 mg/L Mg<sup>2+</sup>

Geothermal water: ~0 mg/L Mg<sup>2+</sup>

# Monitoring – Ca Concentration



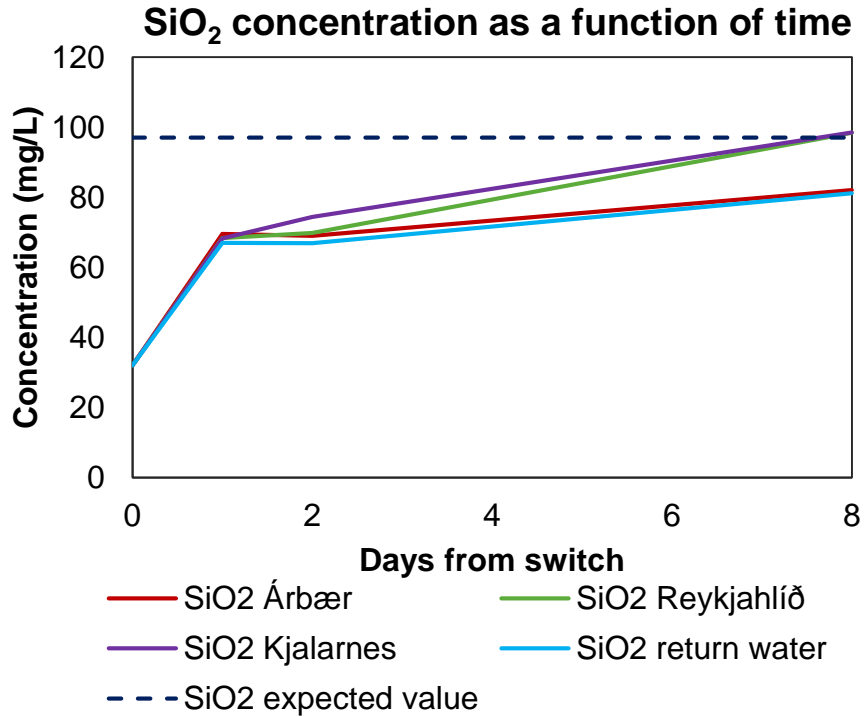
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- - - Ca expected value



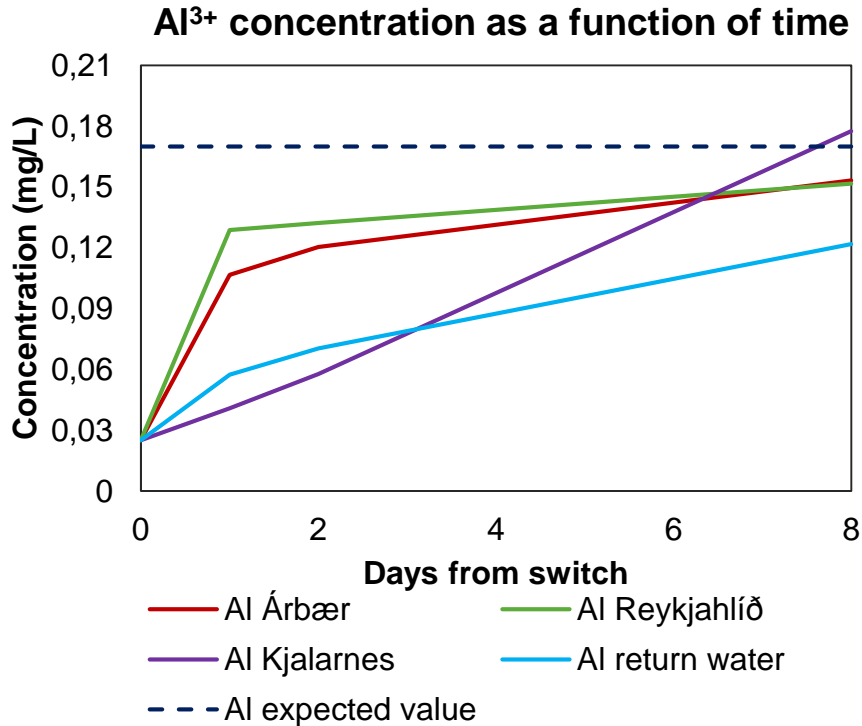
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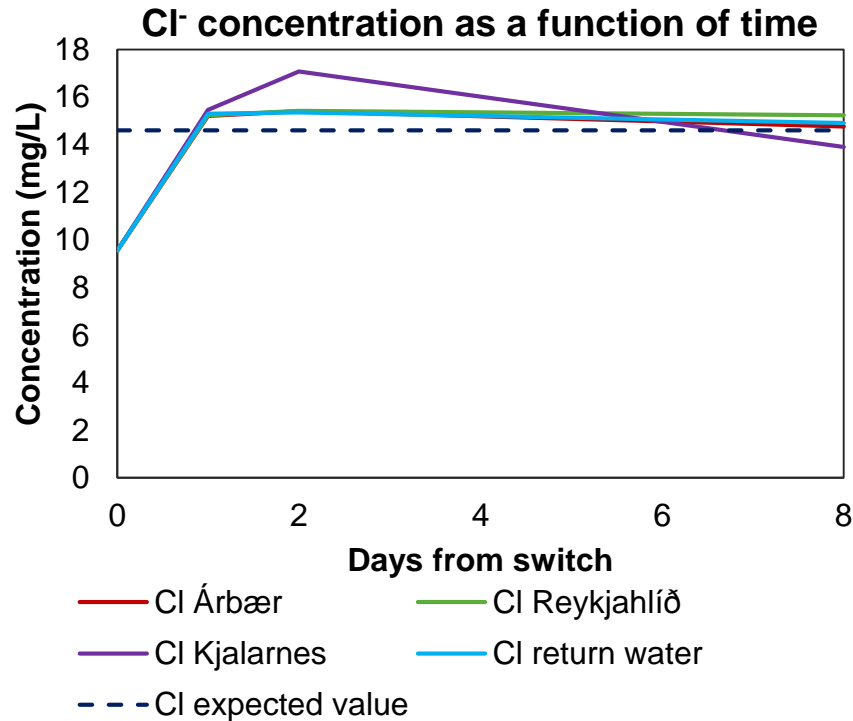
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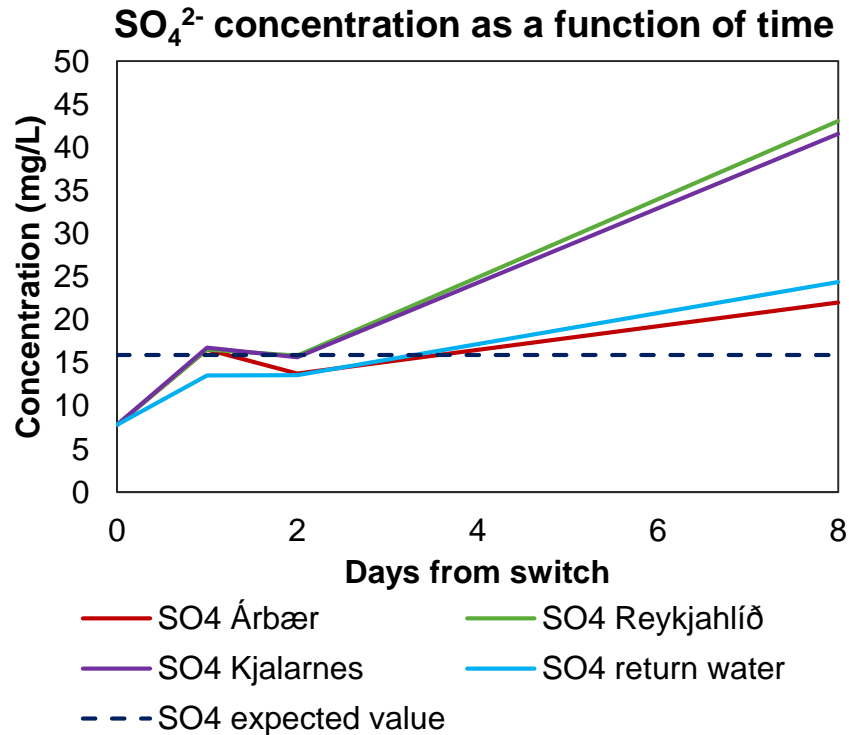
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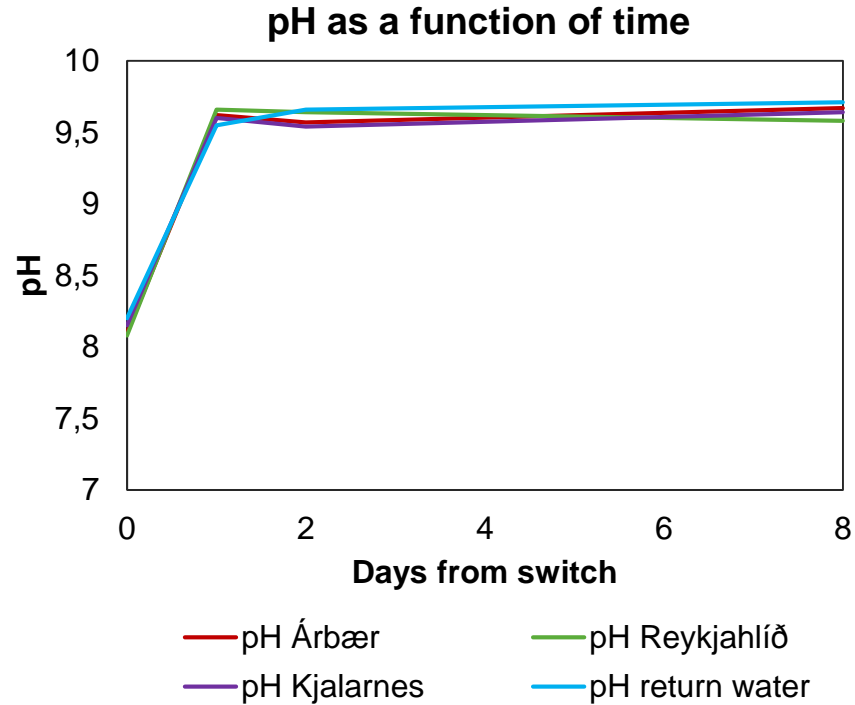
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Heated groundwater: ~7.8 mg/L SO<sub>4</sub><sup>2-</sup>

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# Monitoring – pH



Heated groundwater: ~ 8.0 – 8.5

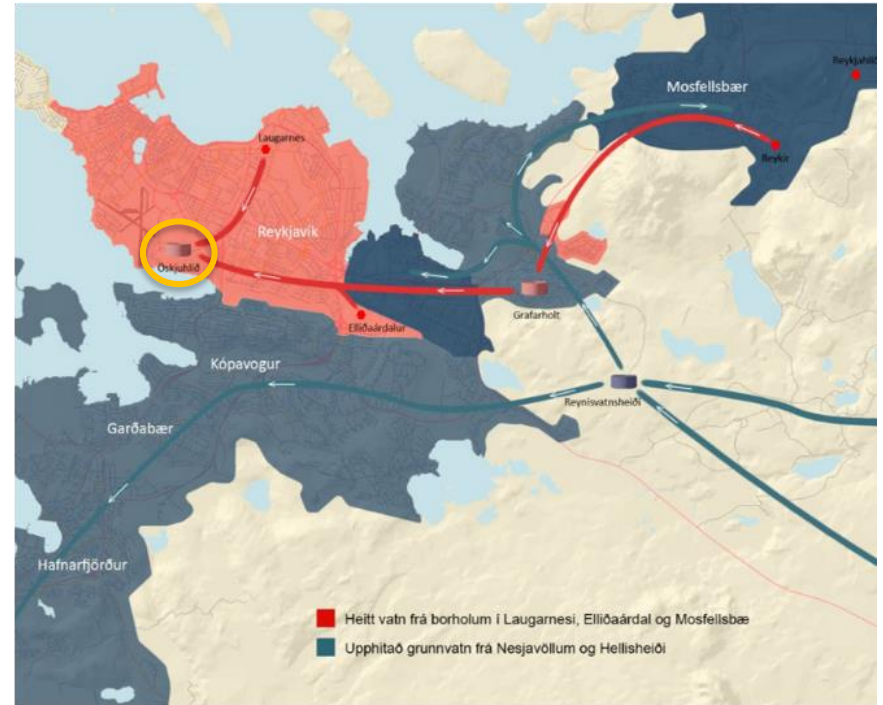
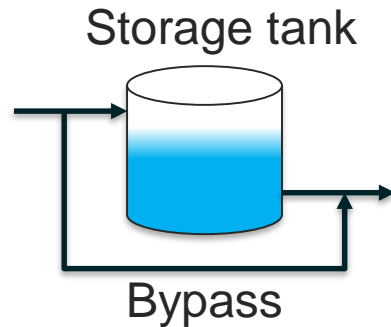
Geothermal water: ~ 9.5 – 9.7

A high-speed photograph of a water droplet falling into a pool of water, creating concentric ripples. The background is a light blue gradient.

**Other**

# Dissolved Gas Monitoring

- Dissolved oxygen detected  
→ Resolved by taking storage tanks out of service



# Temperature Monitoring

## Temperature development The switch back

