CLIMATE CHANGE IN THE BARENTS REGION – AN INFRASTRUCTURE AND DRINKING WATER CHALLENGE

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LULEÅ KOMMUN

DRINKING WATER RESOURCES IN THE BARENTS REGION

Drinking water source

- >> 50% Surface water
- Abundance of water (m^3/person use < 1% of source)
- Pure water

Water quality and environment

- Colour and taste problems (FTU + humic acid)
- Microorganisms (survival in cold waters)
- Harsh Climate conditions (plant operation)
- Focus on organisms, specific minerals and organics, aesthetics (turbidity/colour), taste and temperature

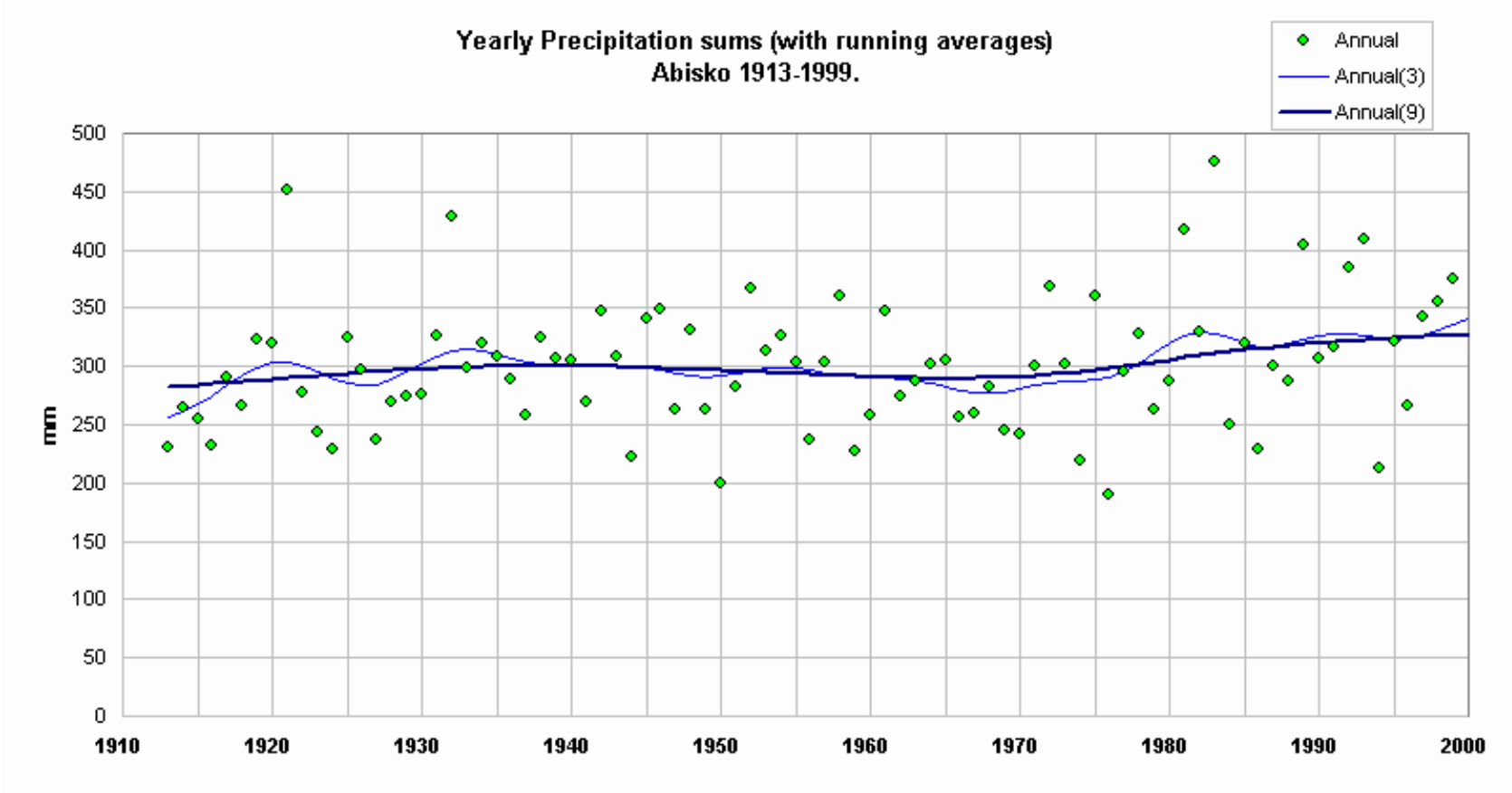
Population and water distribution

- Few in numbers and spread over a vast area
- Long distribution systems
- Seasonal frozen ground or permafrost

SWEDISH SUBARCTIC CLIMATE CHANGE RECORD

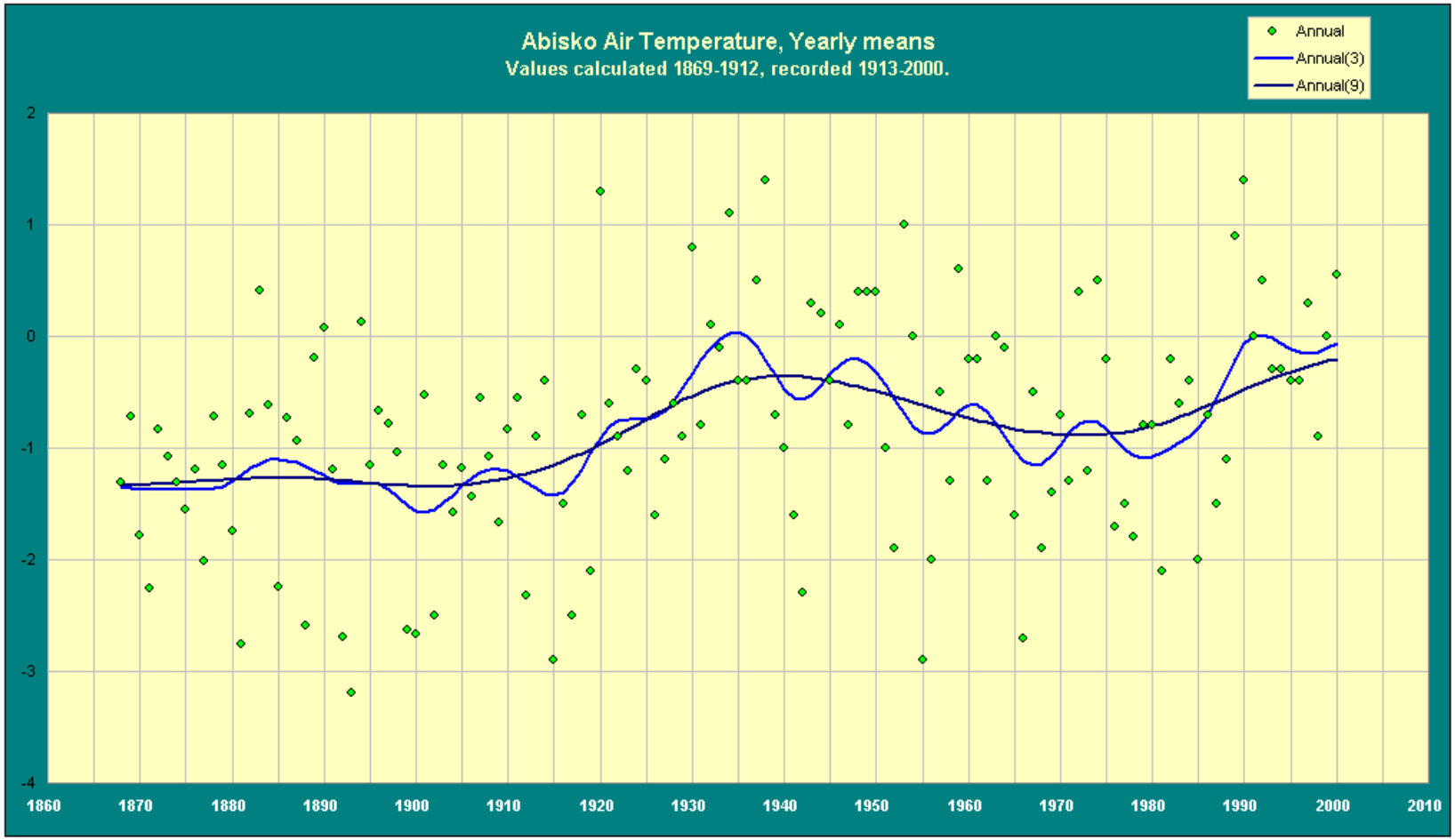
- Abisko National Park precipitation
- Abisko National Park temperature
- Torne Lake ice cover
- Torne River ice break up
- Lule River mean flow

ABISKO NATIONAL PARK PRECIPITATION 1910-2000

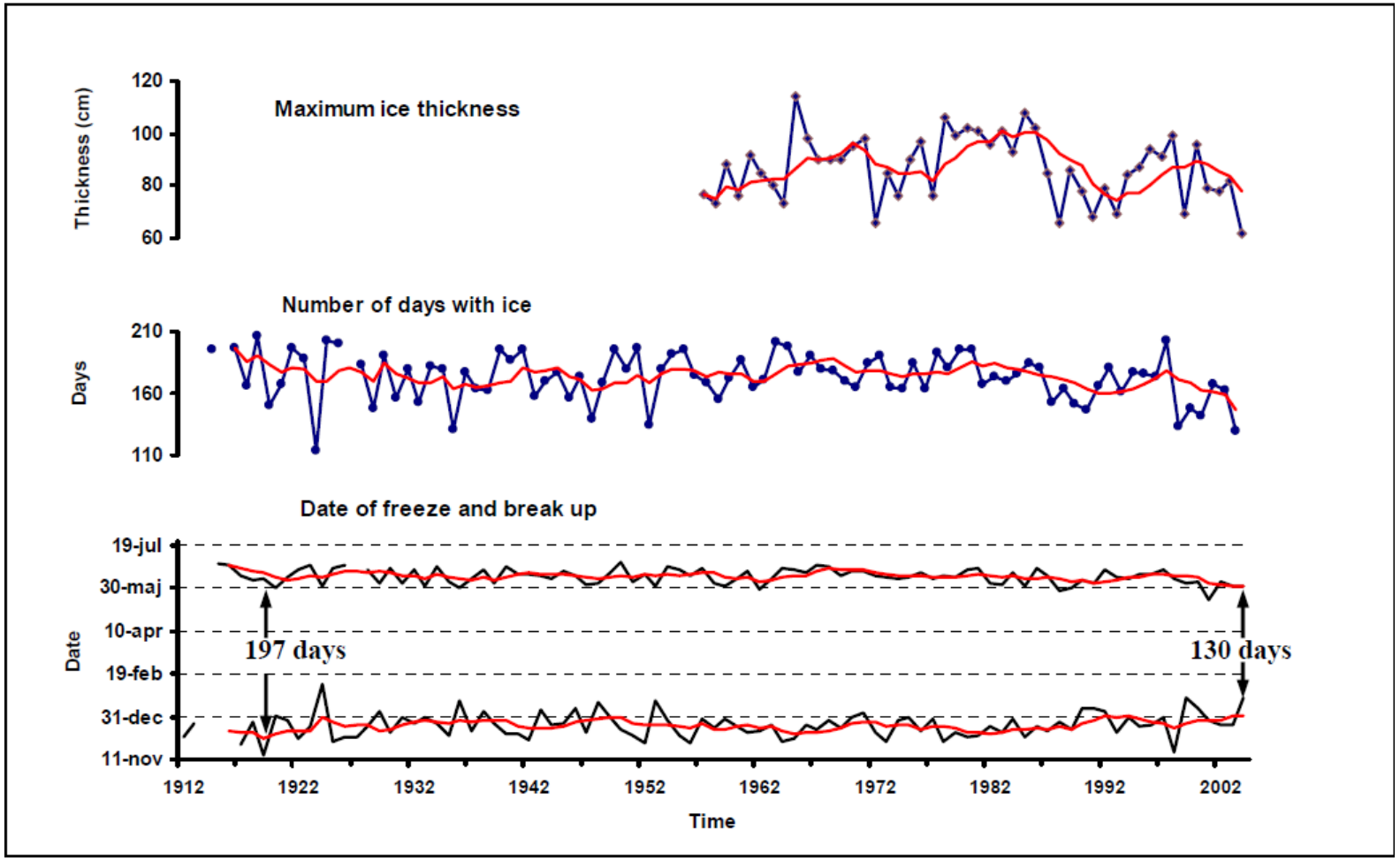


ABISKO NATIONAL PARK TEMPERATURE

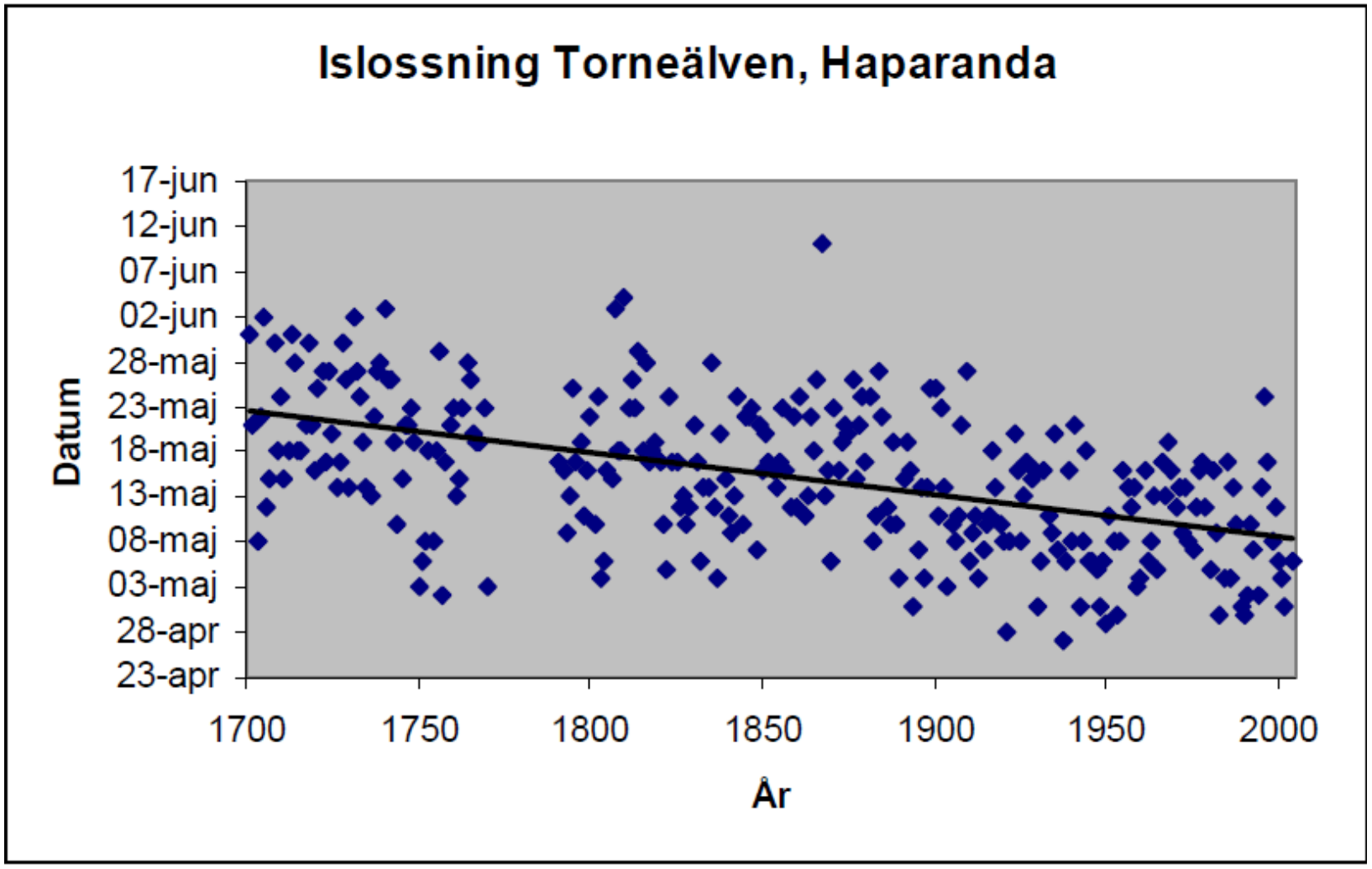
1868-2000



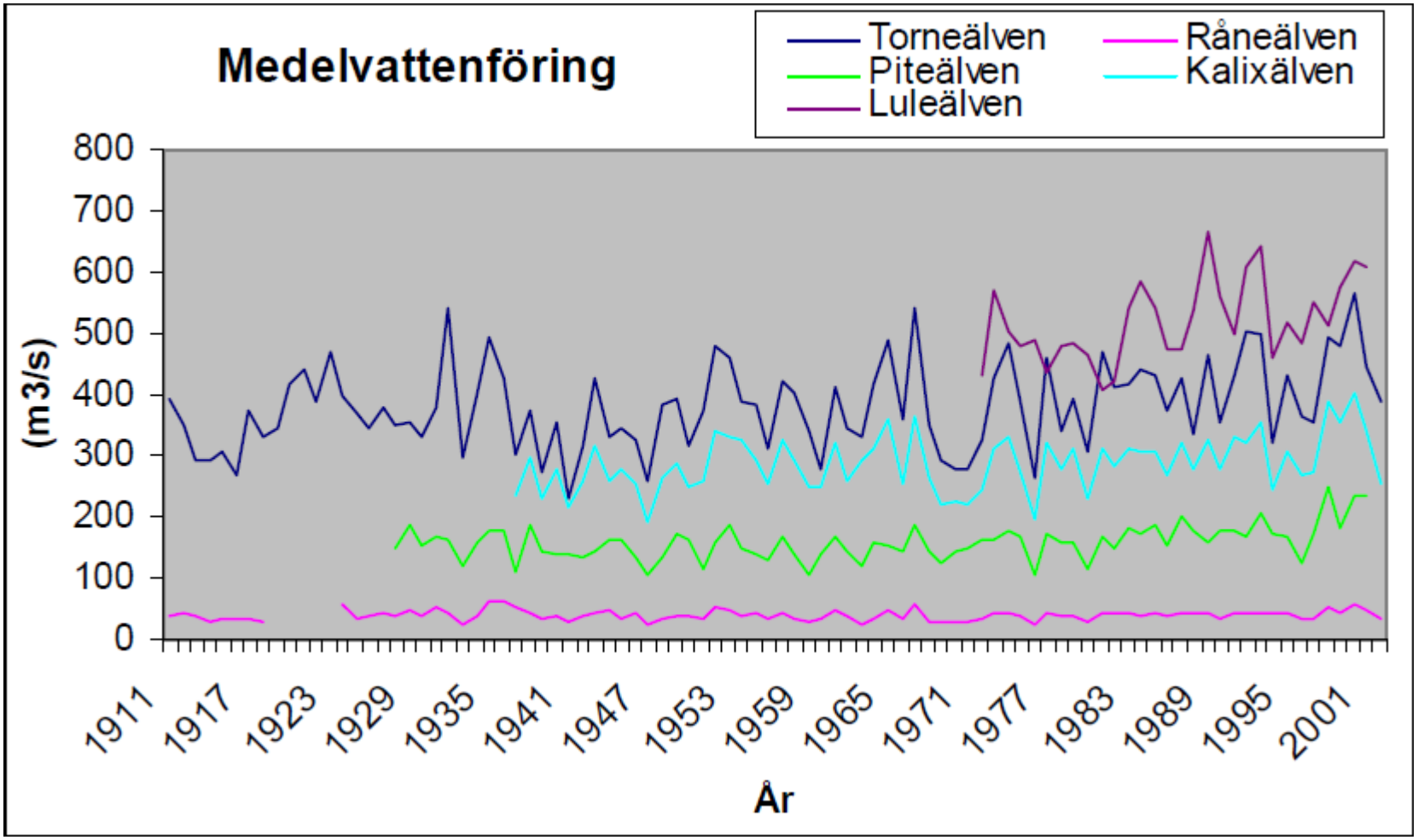
TORNE LAKE ICE COVER 1912-2005



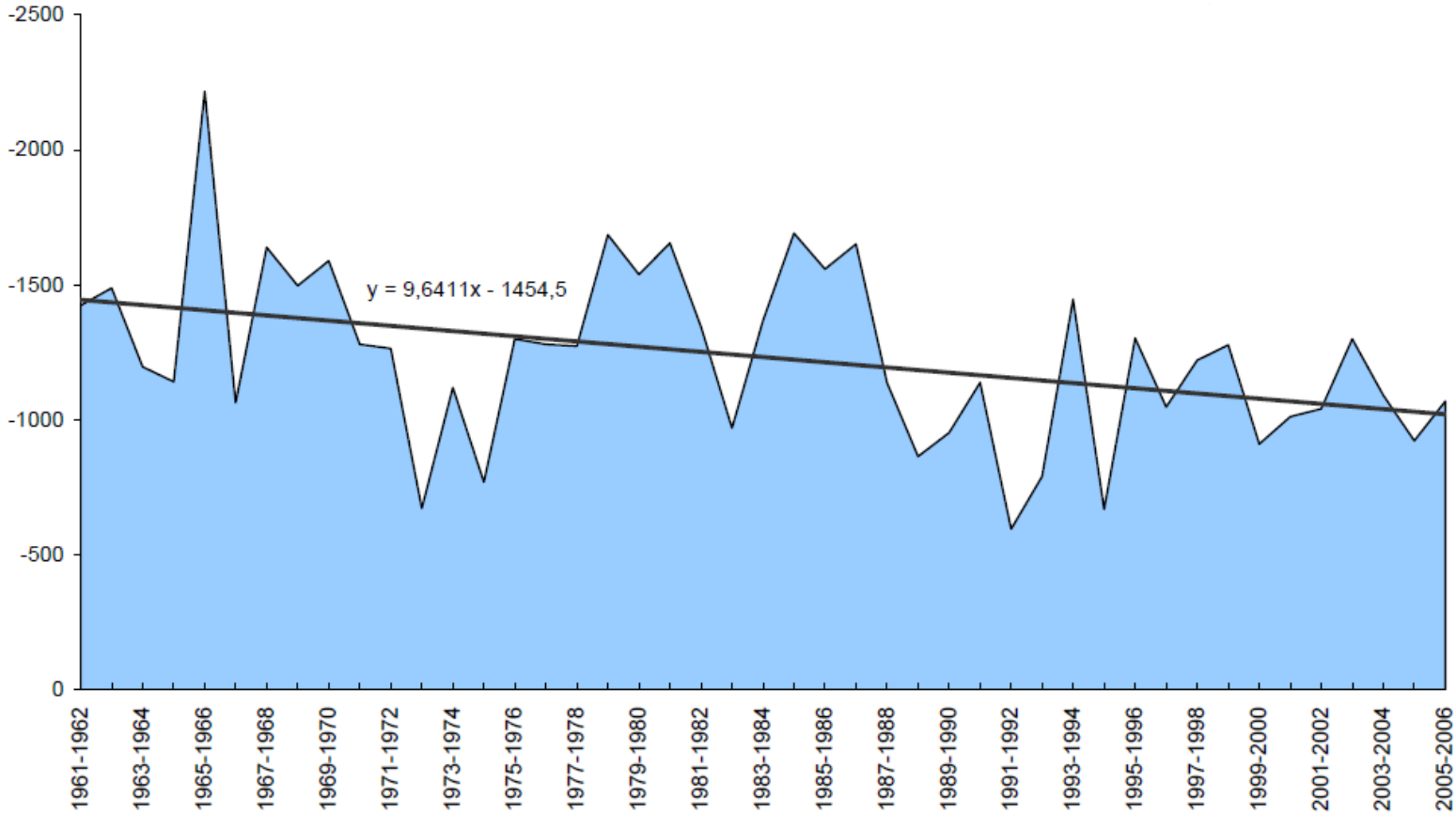
TORNE RIVER ICE BREAK UP DATE 1700-2000



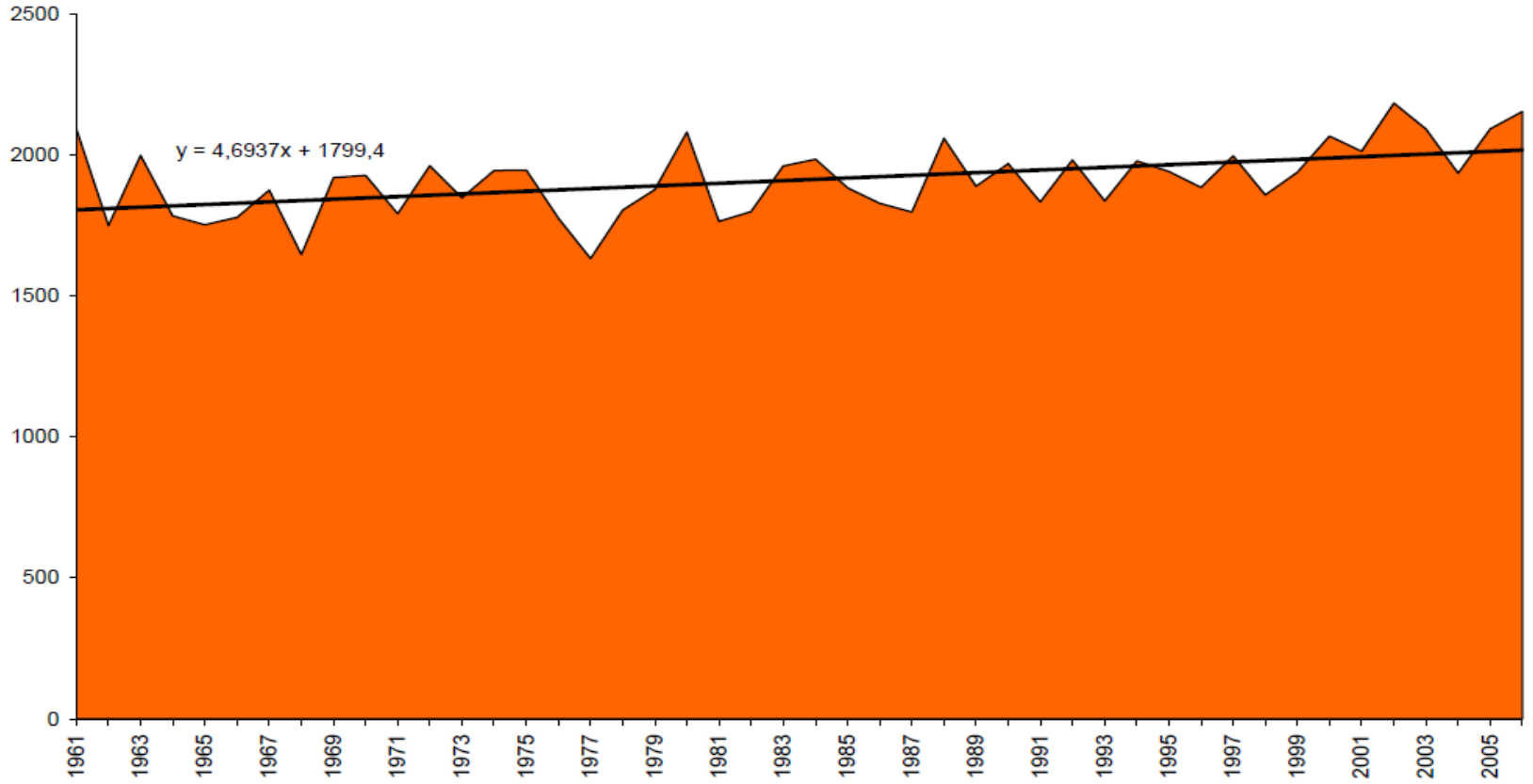
LULE RIVER 10-YEARS MEAN FLOW 1971-2000



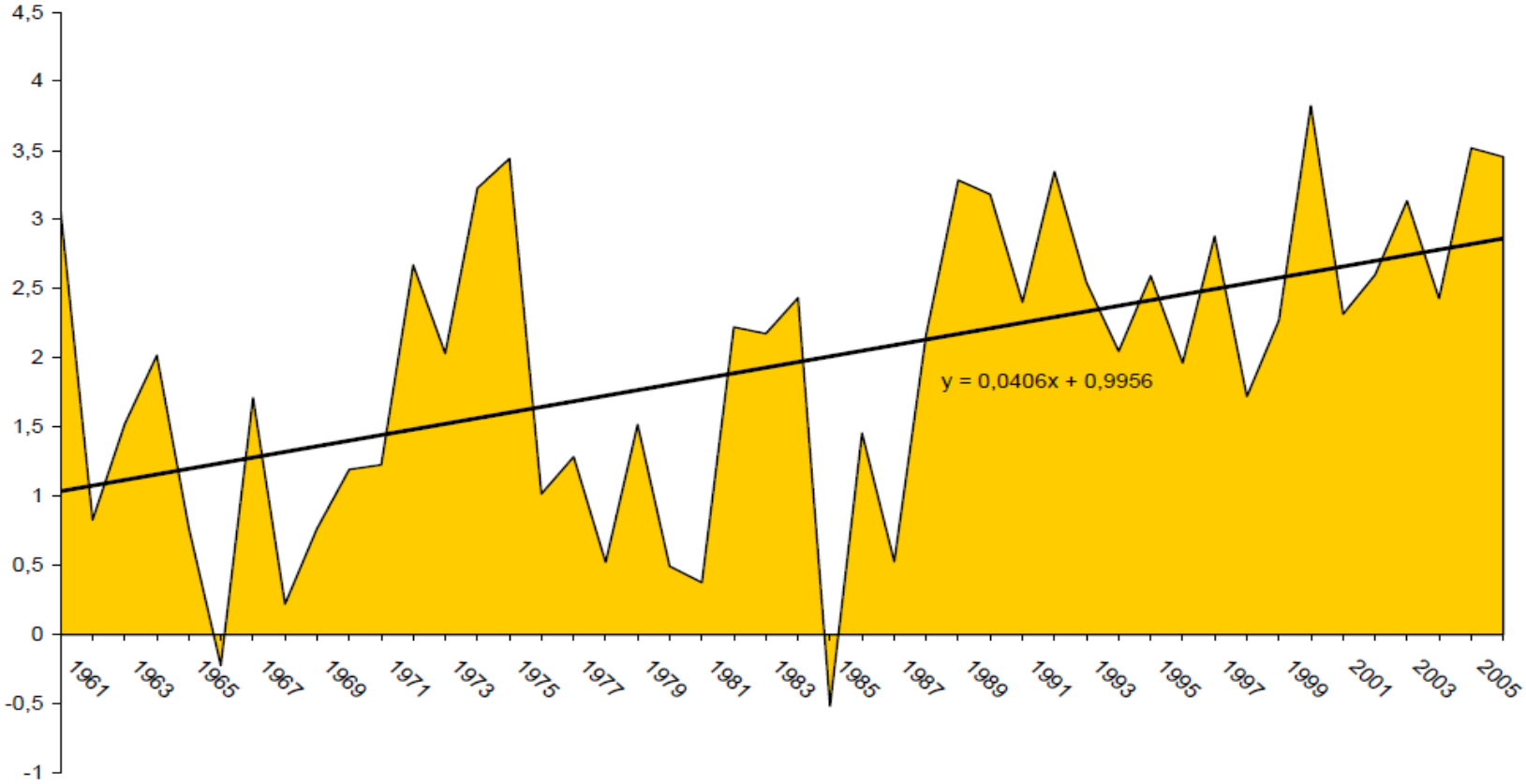
ACCUMULATED NEGATIVE DEGREE DAYS AT KALLAX AIRPORT, FROM NOVEMBER 1 TO APRIL 15



ACCUMULATED POSITIVE DEGREE DAYS AT KALLAX AIRPORT, FROM APRIL 16 TO OCTOBER 31



MEAN ANNUAL TEMPERATURE AT KALLAX AIRPORT



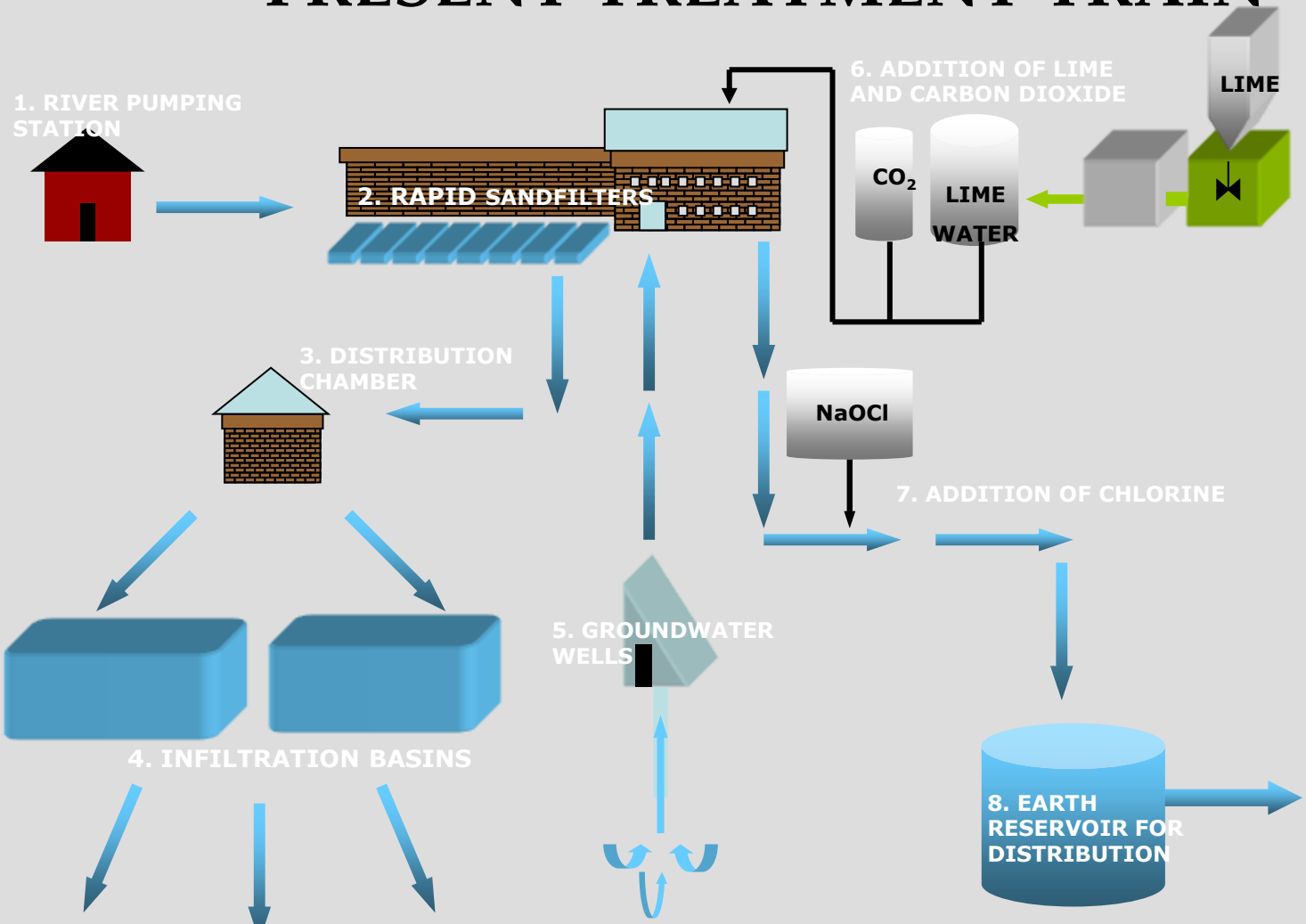
STRATEGIES FOR FUTURE WATER PRODUCTION IN LULEÅ

Identified threats

- Extreme high-flow river periods
- Need for increased water treatment
- Environmental disaster
- Sourva hydropower dam disaster

LULEÅ WATER TREATMENT PLANT

LULEÅ WATER TREATMENT PLANT – PRESENT TREATMENT TRAIN



PROCESS LAYOUT GROUNDWATER GÄDDVIK 2009

WHAT HAS BEEN DONE SO FAR?

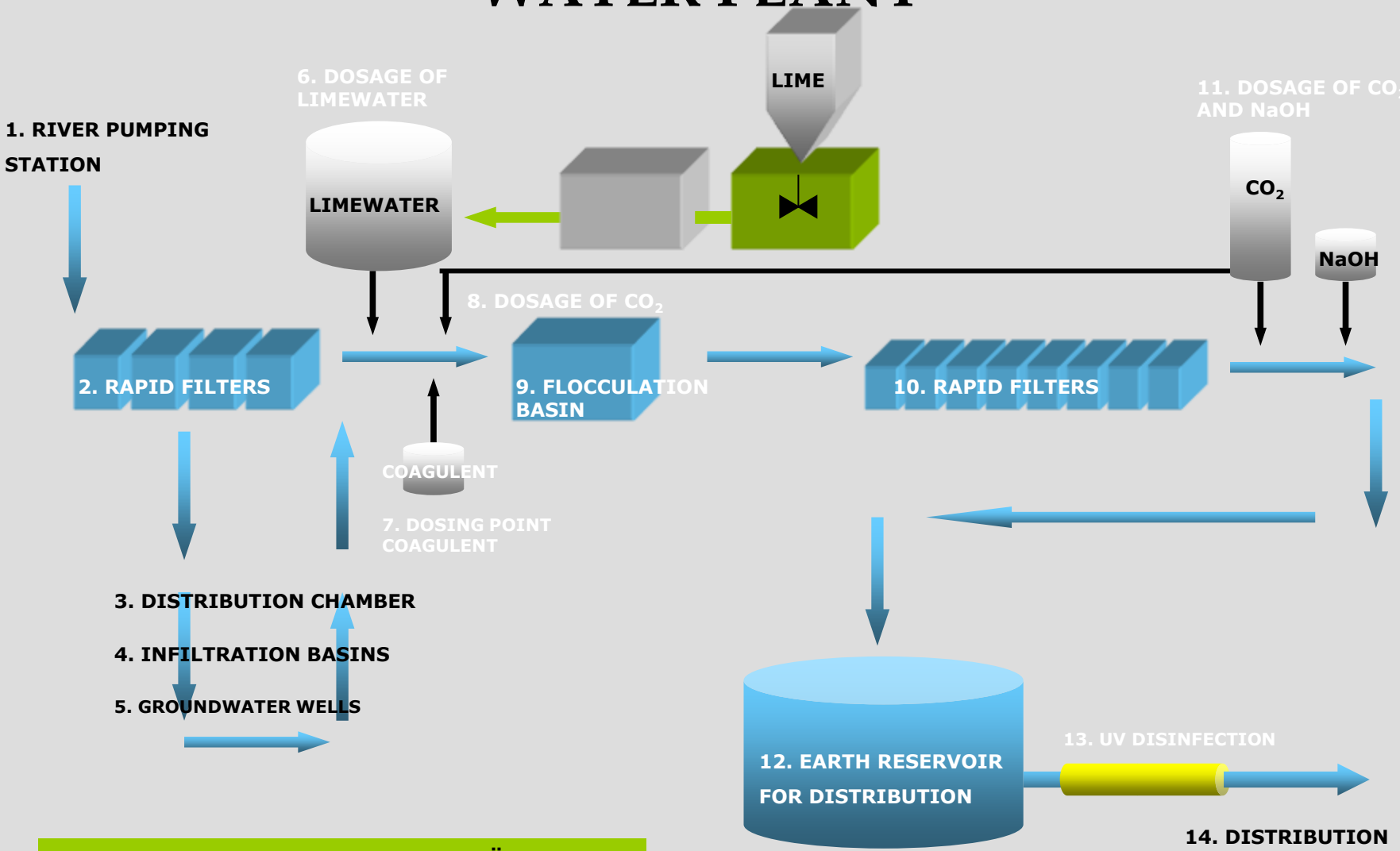
- Diesel-engine stand-by power
- Water treatment area groundwater flow patterns identified
- New water protection areas ready for ratification
- Treatment steps pilot studies performed
  - Ultra membrane filtration
  - Chemical precipitation on 2-media down stream filter
- Elevated intake works
- Preliminary design – new central block and back-up treatment train

PILOT ULTRA FILTRATION TREATMENT UNIT

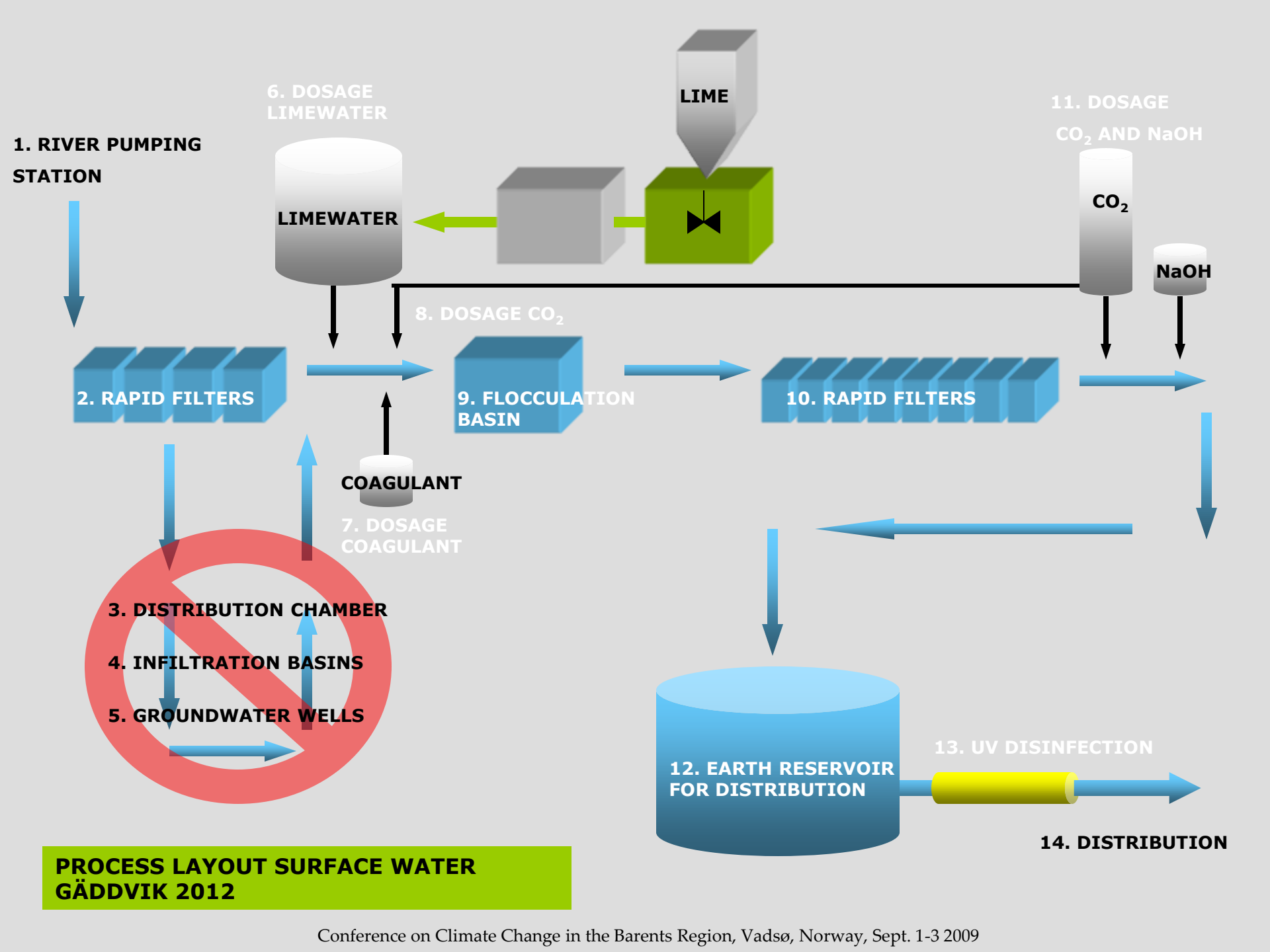
CHEMICAL PILOT PRECIPITATION ON 2-MEDIA FILTERS

ELEVATED INTAKE WORKS

NEW CENTRAL BLOCK AND STAND-BY WATER PLANT



PROCESS LAYOUT GROUNDWATER GÄDDVIK 2012


1. RIVER PUMPING STATION
2. RAPID FILTERS
3. DISTRIBUTION CHAMBER
4. INFILTRATION BASINS
5. GROUNDWATER WELLS
6. DOSAGE LIMEWATER
LIMEWATER
LIME
7. DOSAGE COAGULANT
COAGULANT
8. DOSAGE CO_2
9. FLOCCULATION BASIN
10. RAPID FILTERS
11. DOSAGE CO_2 AND NaOH
CO_2
NaOH
12. EARTH RESERVOIR FOR DISTRIBUTION
13. UV DISINFECTION
14. DISTRIBUTION
PROCESS LAYOUT SURFACE WATER GÄDDVIK 2012

WHAT IS LEFT TO DO?

- Erection of central treatment block (2010-2013) including
  - 10-fold increased reduction of water turbidity
  - Increased microorganism reduction
  - Two-step stabilization of Ph and alcalinity
  - Built-in stand-by surface water treatment plant

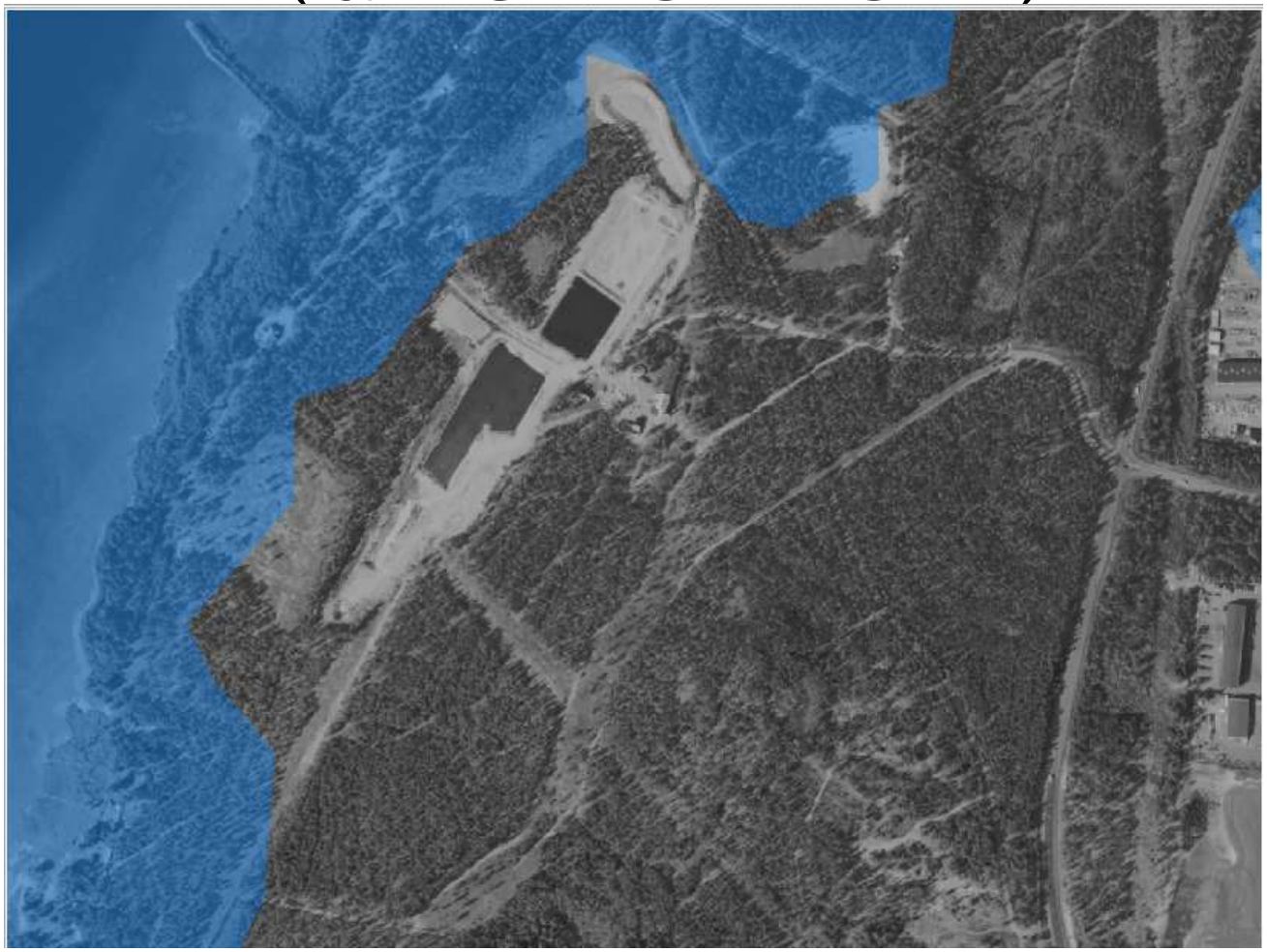
- County Administrative Board acceptance of plant safety regulations

- 3rd main water pipe connecting water plant and central Luleå

WHAT IS FINALLY ACHIEVED?

- Total project cost: ca 30 million US $
- Ability to handle increased and new micro-organisms, and other impurity
- Ability to handle extreme river flows
  (2000-5000 m^3/s)
- Ability to produce or fast regain potable water production during dam disaster
  (> 10 000 m^3/s)
- Ability to produce or fast regain potable water production with on-going near-by environmental accident

ESTIMATED MAXIMUM PLANT SITE FLOODING IN CASE OF SUORVA HYDROPOWER DAM FAILURE (ca 7 Gm^3 CAPACITY)



CONCLUSIONS

- Think globally – act locally
- Plant siting and environment conditions must be examined
- Plant process train must be fully understood
- Produce plant safety regulations, including physical environment
- Evaluate process and environment, and add supplementary technology and security regulations
- Plan for catastrophe and accident
- Practise operator safety programs and skills needed for catastrophe events