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Water Challenges for the Town of Okotoks: The quest for supply security

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Overview

- Background
- Review of Okotoks setting and water challenges
- Examples of conjunctive water management
- Sheep River Alluvial System & other GW sources
- Water supply outlook for 2010
- Challenges and risks going forward

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State of the environment

- http://www.okotoks.ca/data/1/rec_docs/469_SOWTFH_decision.pdf

- Town of Okotoks growth cap – 30,000 unless Sheep & Highwood Rivers can accommodate further growth….or we come up with a different strategy (i.e., conjunctive use strategy)

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State of the environment

- SSRB – Highwood/Sheep: WCO set at 45% of natural flow or 10% above current in-stream flow objective *(whichever is greater)*
- Sheep occasionally has flows less than the WCO *(same for Highwood)*
- Less quantity and poor quality ground water in deeper formations *(but still exists as a supply source)*
- Water restrictions becoming the rule vs. the exception
- Need for water management strategy to get through water-year

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Water Act

"Water *allocation* in Alberta remains very much the domain of the provincial government, which retains ownership of the resource and has ultimate accountability for water allocation decision-making and implementation. For instance, decisions regarding the allocation of water are made by provincial officials, who also have the authority to decide on water allocation transfers. It is the responsibility of these provincial officials to ensure that water allocation decisions do not harm aquatic ecosystems and existing water users."

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What we know…

- Do not need a diversion for storage
- Alluvial systems governed by SSRB Water Conservation Objectives
- Aquatic Ecosystems and WCO under the protection and enforcement of AENV
- Sheep & Highwood – low and high flows *(nothing to do with averages)*
- Return flows not currently licensed
- Allocation Review – has implications, yet can be influenced by water license holders

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Situation for Okotoks (and others in the basin)

"Okotoks intends to investigate small license transfers and small, local groundwater resources to supply the Town's needs, and not to proceed with a regional water supply pipeline from Calgary.

If, in the future, growth in Okotoks exceeds the capacity of the available water resources, a pipeline from Calgary will be required."

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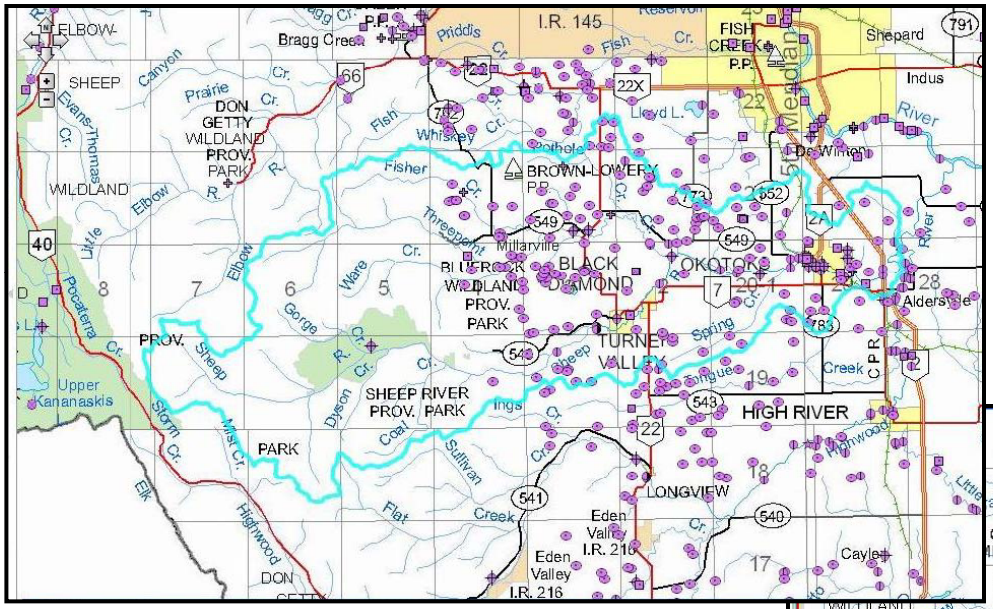
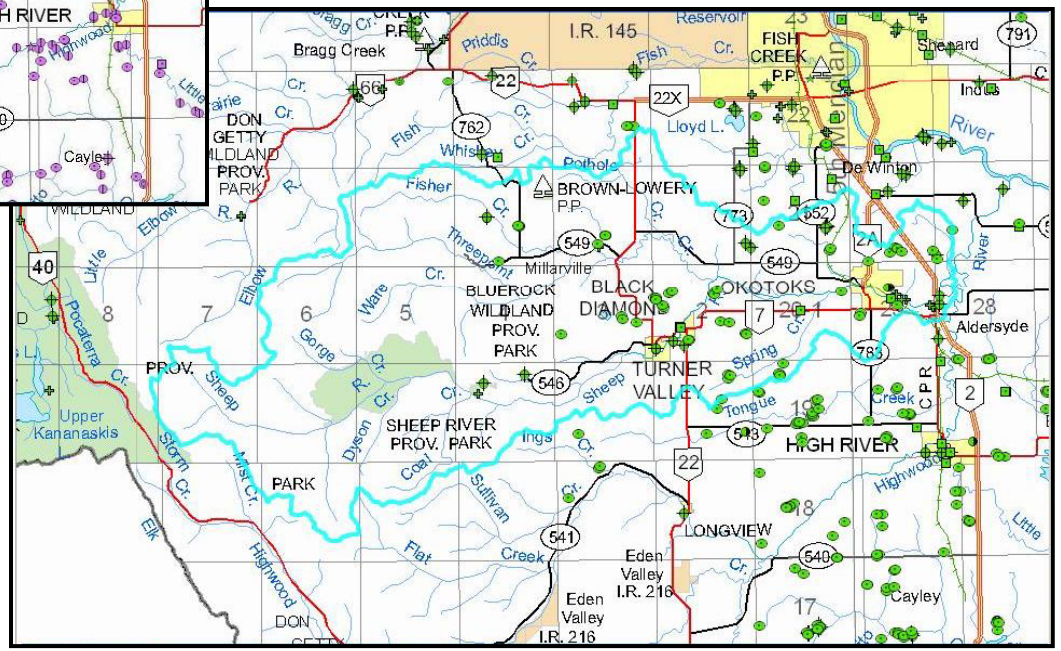
Allot of straws in the glass

Licensed Surface Water Diversions



Licensed Groundwater Diversions



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Traditional methods
(some examples)

Low water fixtures

Metering

Watering restrictions

Large-scale storage (on and off-stream)

Xeriscape landscaping

Rainwater capture

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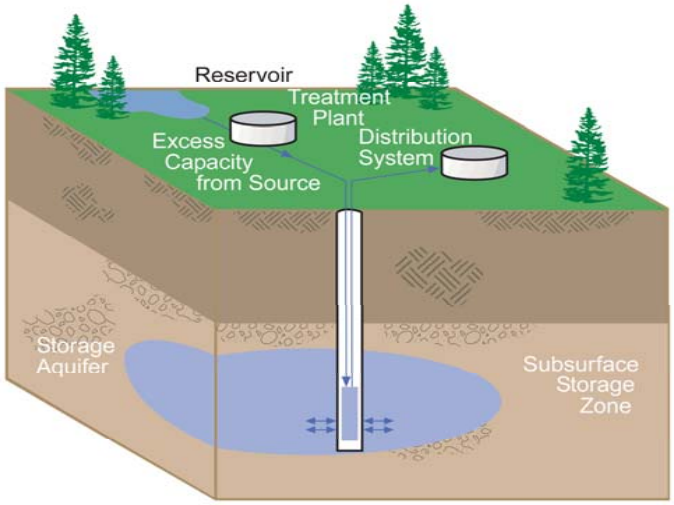
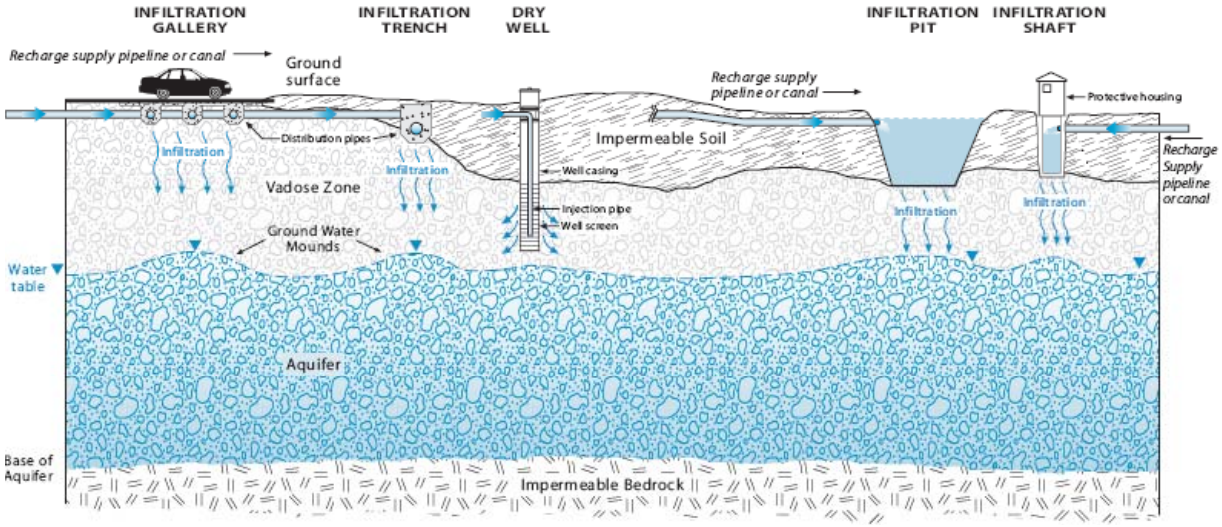
Less traditional options



Aquifer storage & recovery (ASR)

Managed Aquifer Recharge (MAR)



There's always groundwater

- Sheep River Alluvial aquifer
  - Fluvial sand and gravel; shallow & interacting with river; high yield ($K = 10^{-3}$ m/s or so)
  - Good quality water (low TDS)
- Aquifer system outside river valley
  - Sands & gravel overtop bedrock; suspected high yield
  - Reasonable quality water (low to moderate TDS)
- Tertiary Bedrock
  - Paskapoo-Porcupine Hills / Willow Creek Formations; interbedded sandstone and mudstone (fluvial)
  - Heterogeneous; fracture permeability; low yield ($K = 10^{-6}$ m/s or so)
  - Reasonable quality water (low to moderate TDS)

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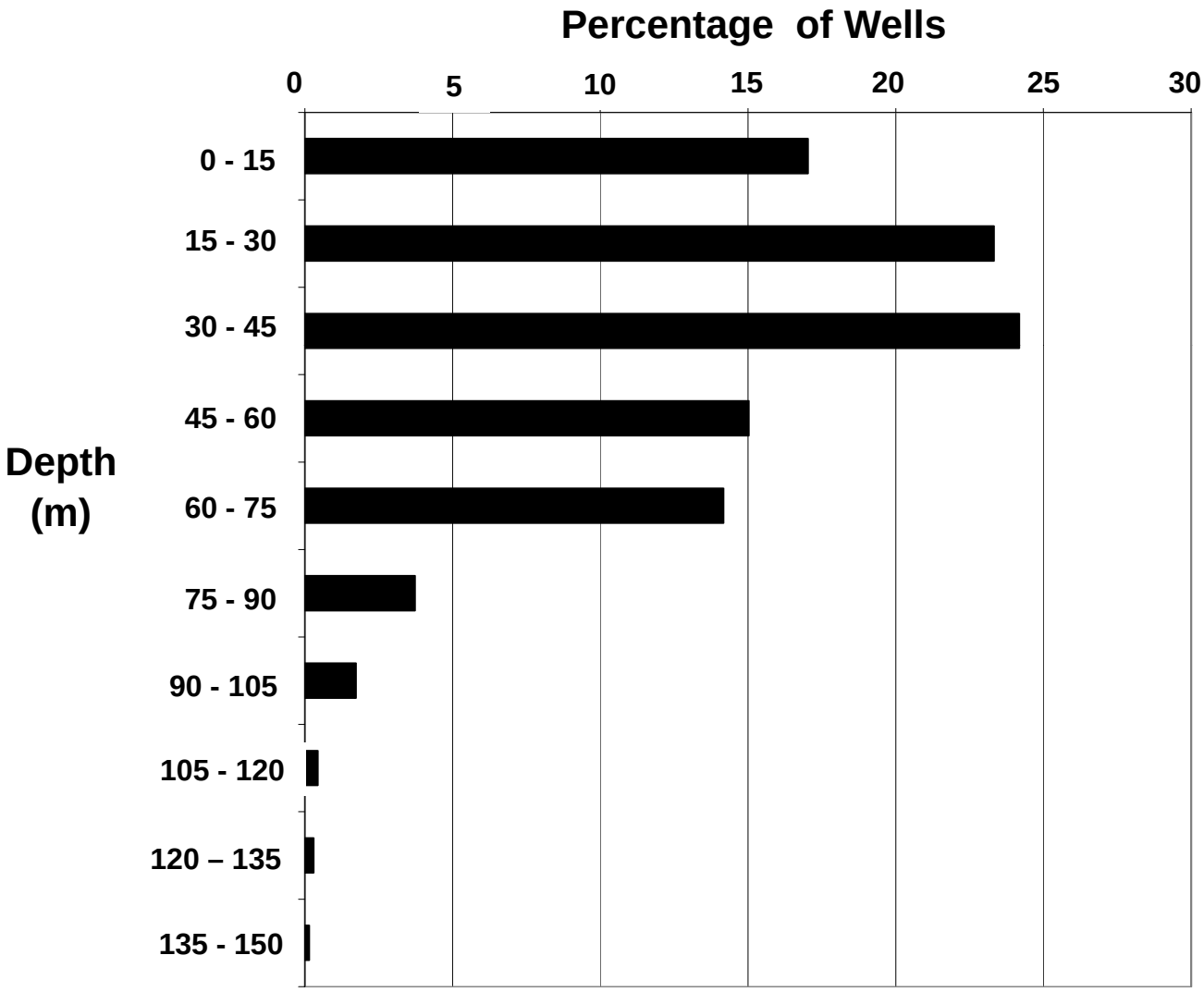
Increasing groundwater pressures



- Majority of GW users taking from shallow intervals
- Potential for effects to Sheep River flows

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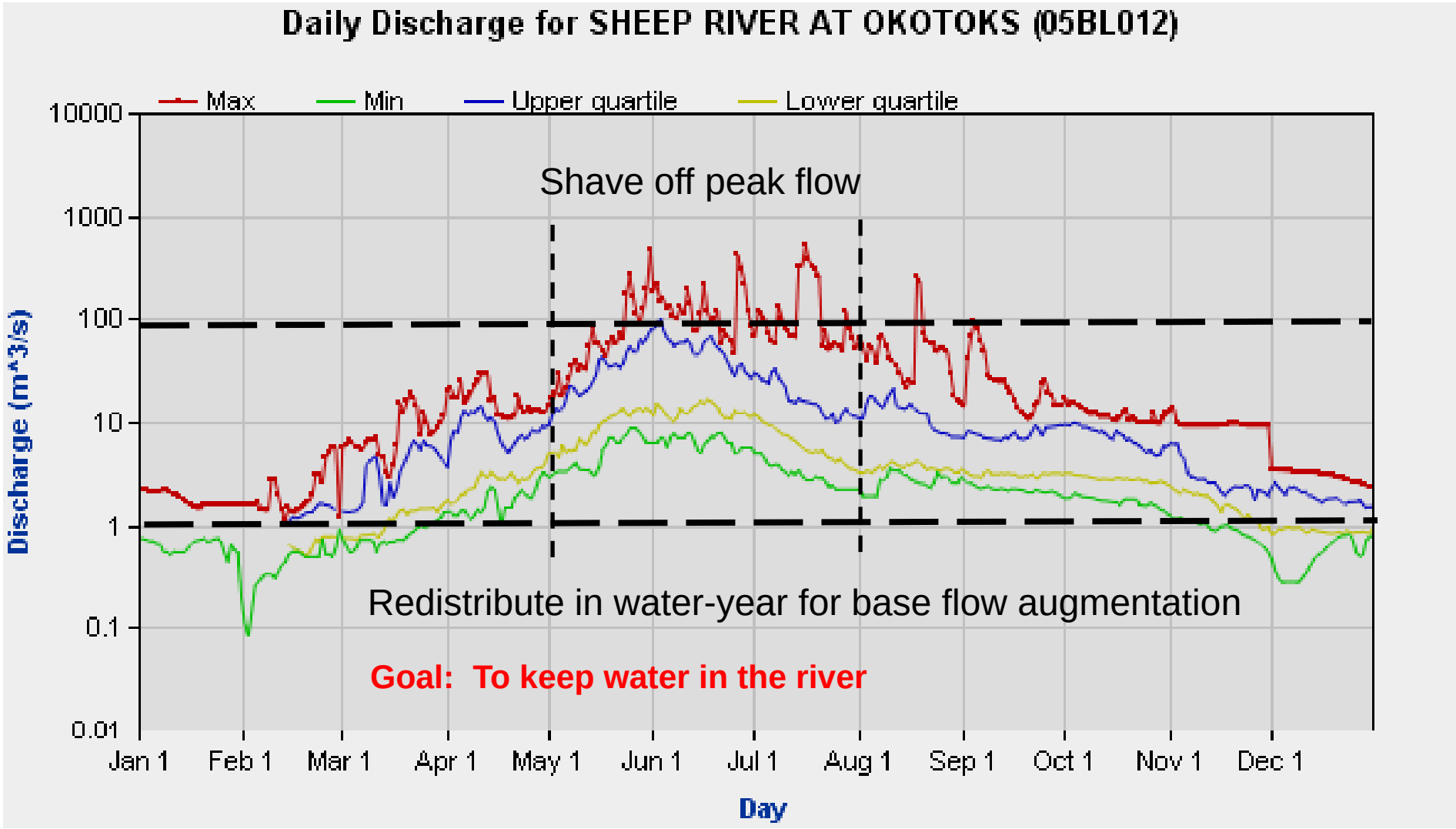
Conjunctive use strategy



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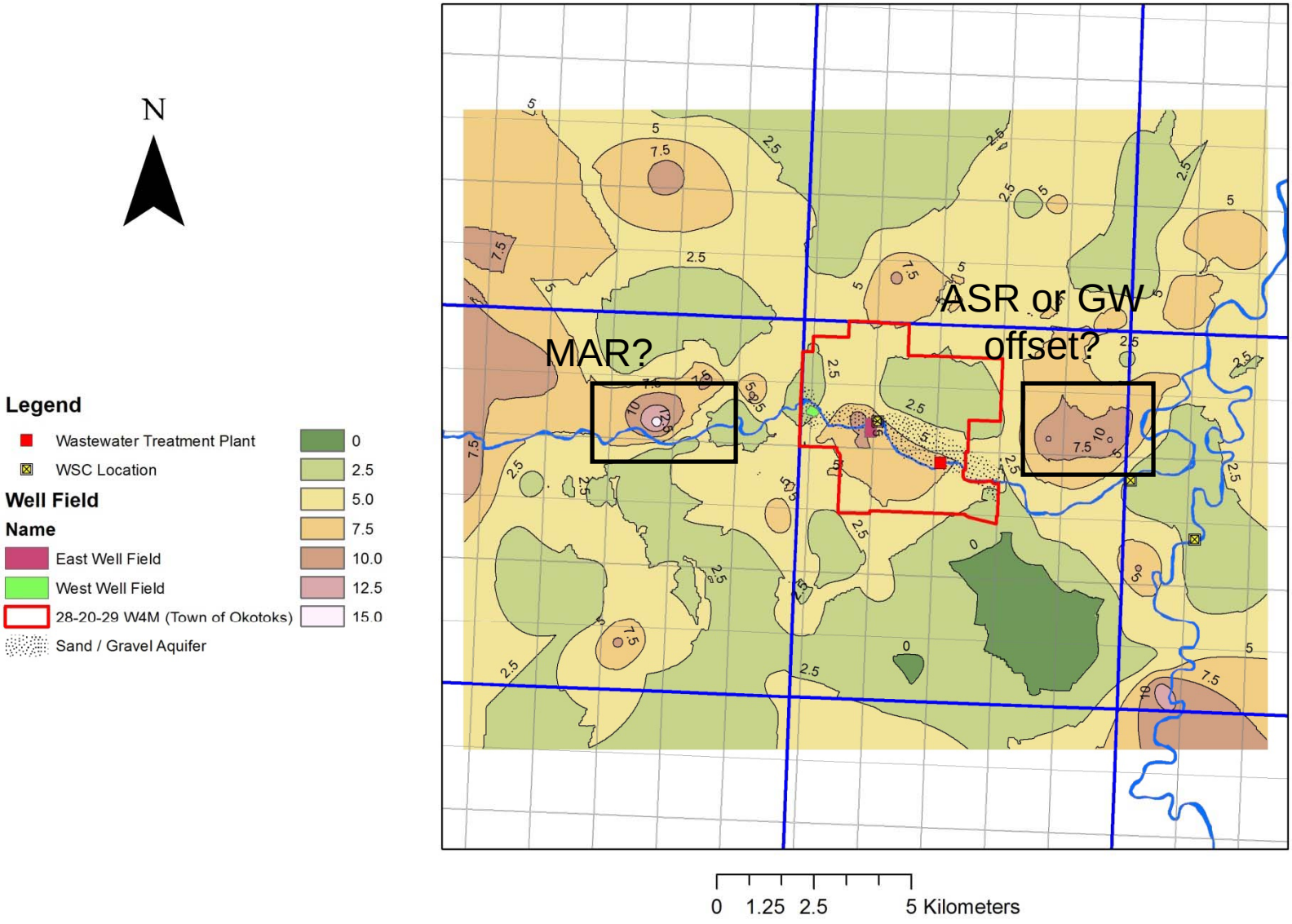
Shallow sand & gravel thickness



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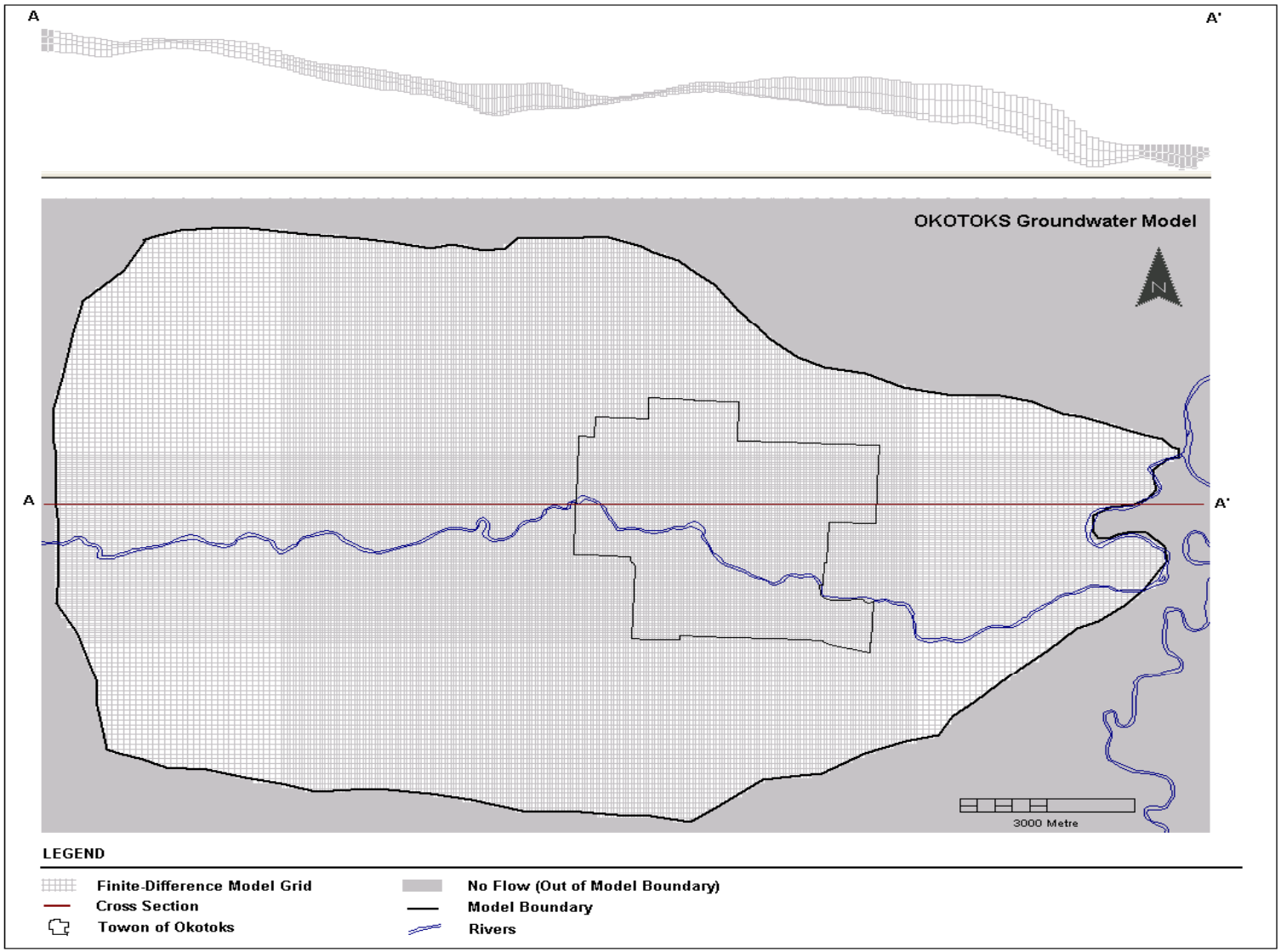
GW model domain



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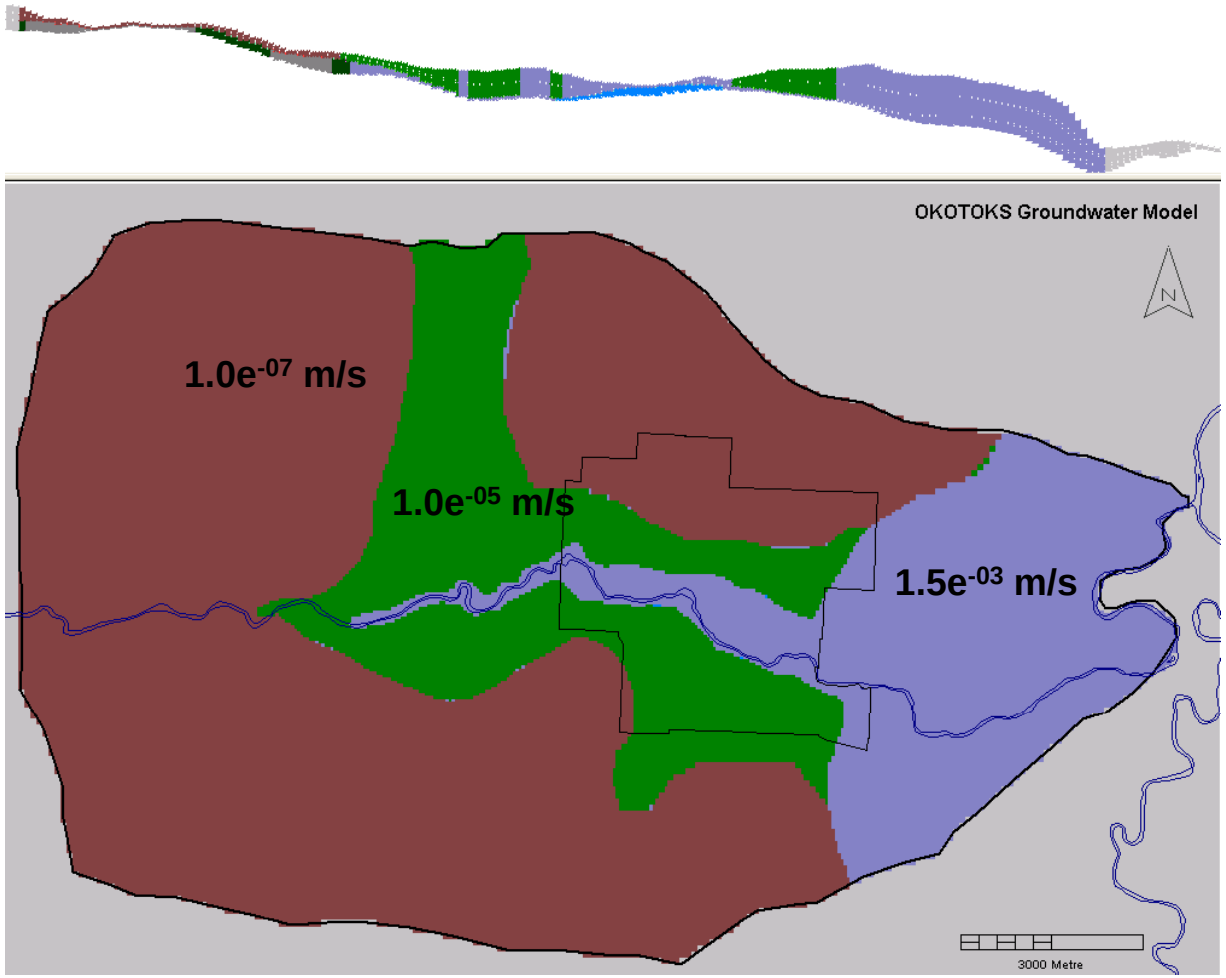
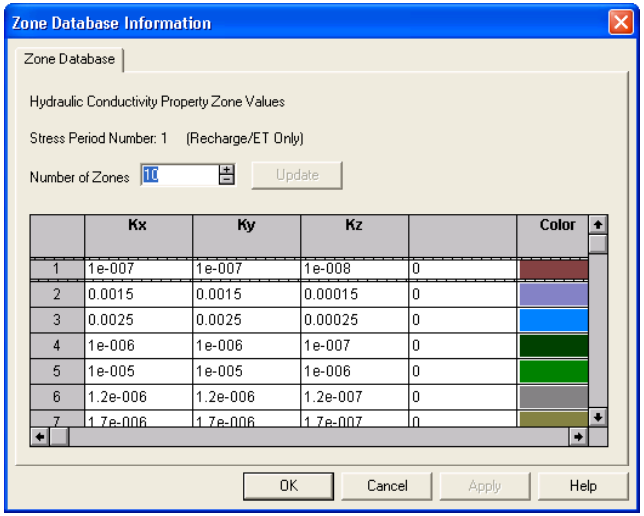
Hydraulic conductivity (K)
Layer 1 and 2





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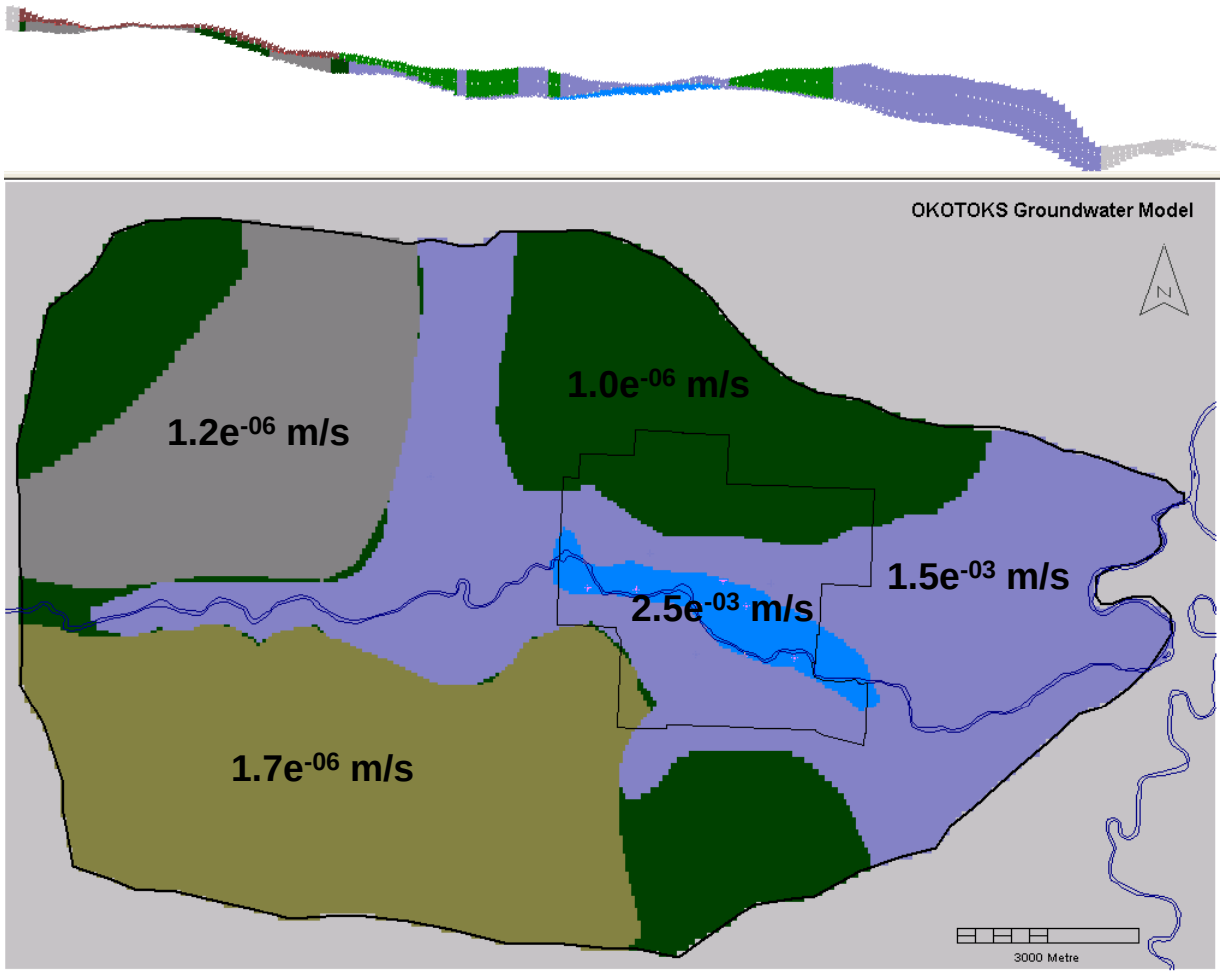
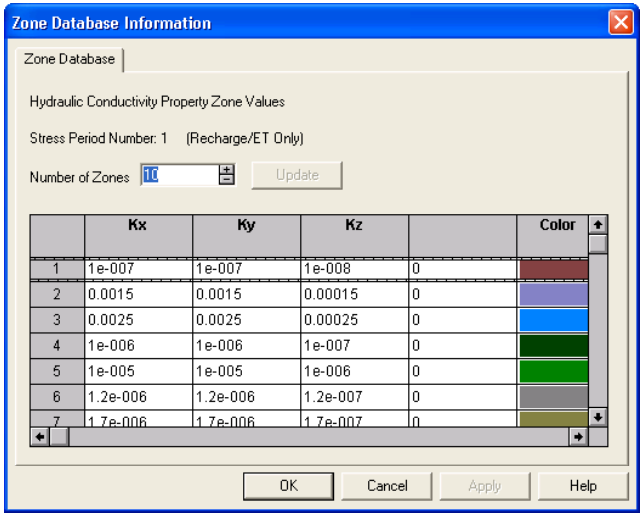
Hydraulic conductivity (K)
Layer 3





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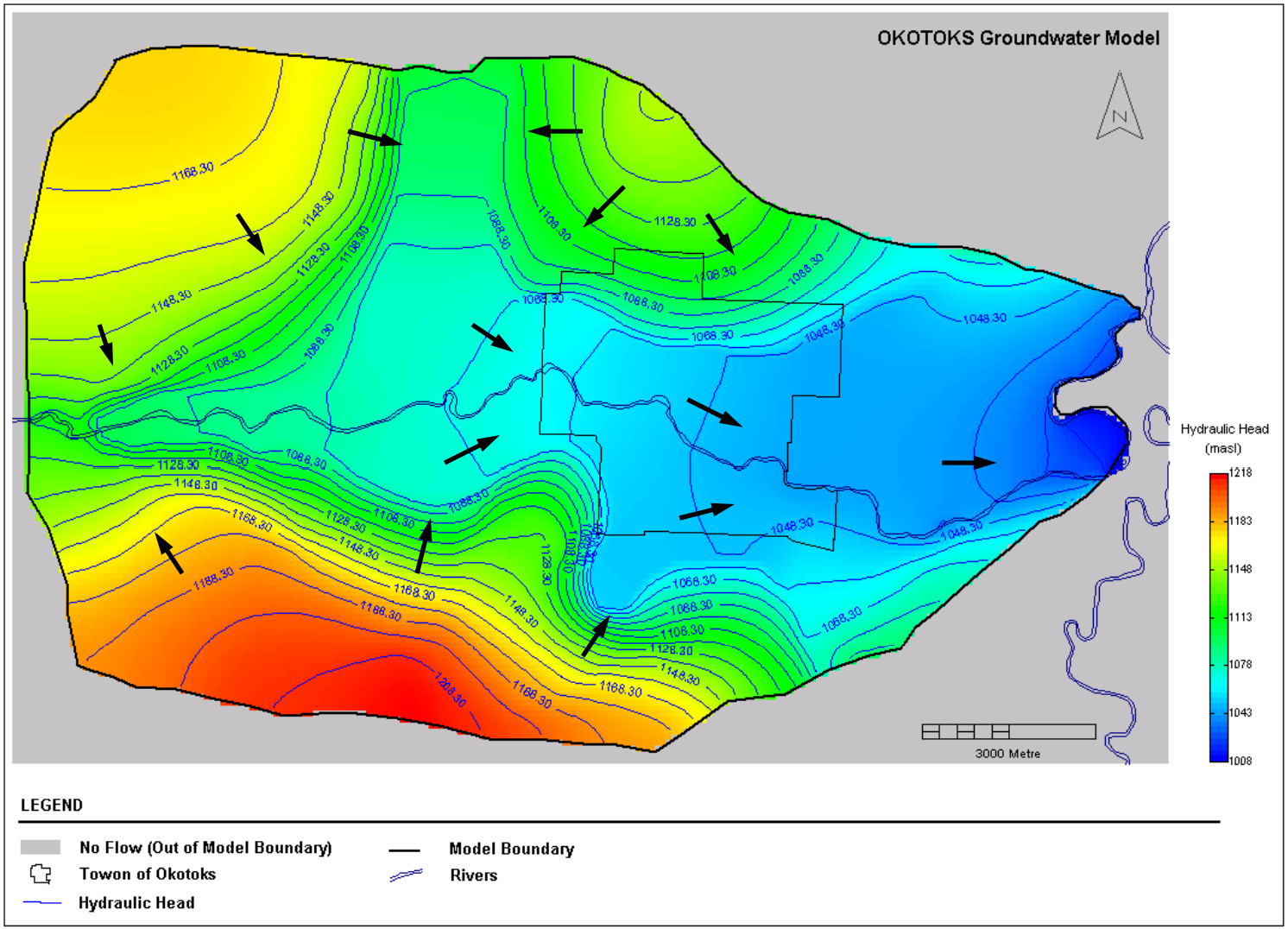
Modeled groundwater elevations
(steady state)



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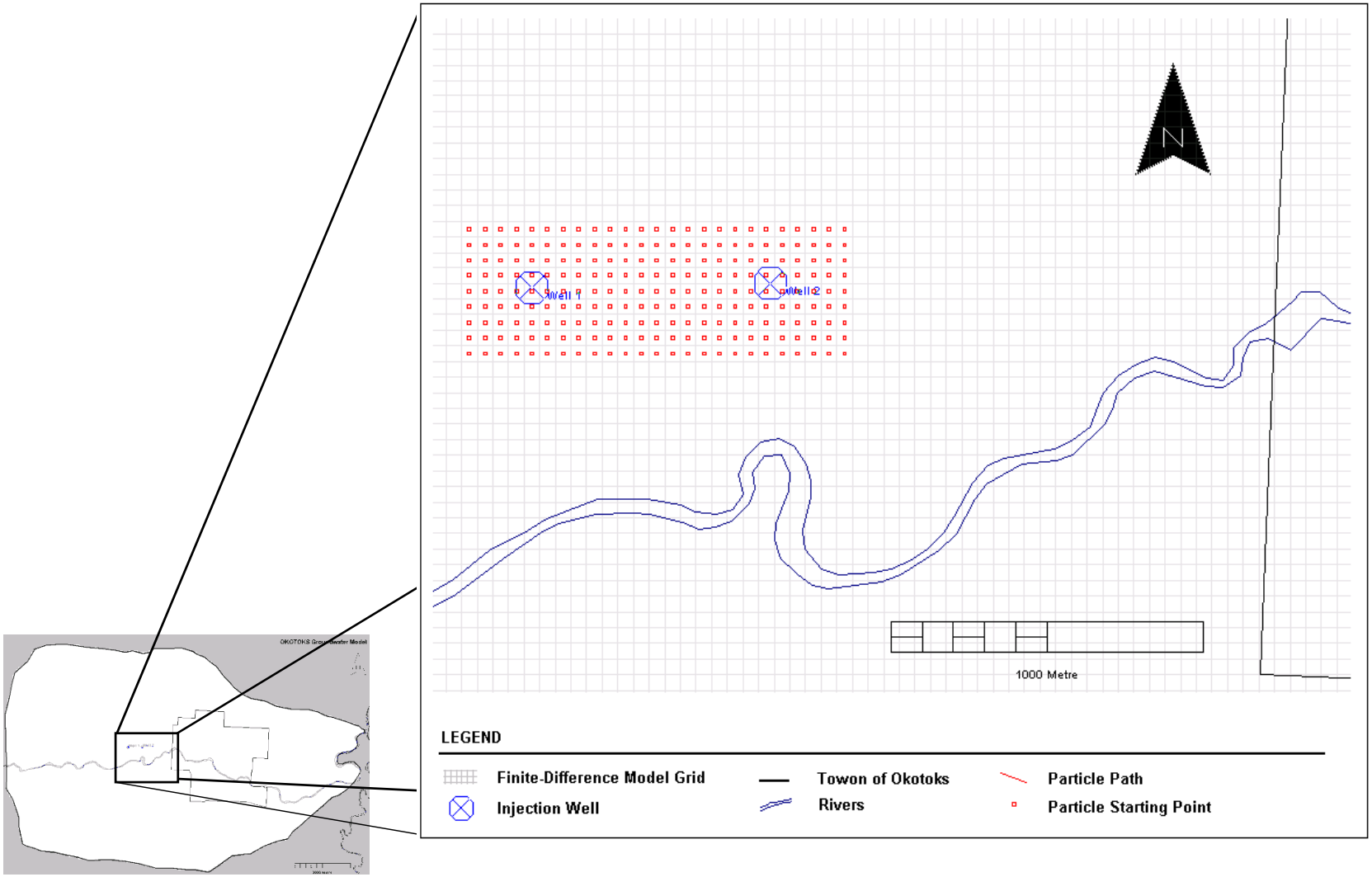
Particle Tracking
(particle locations)



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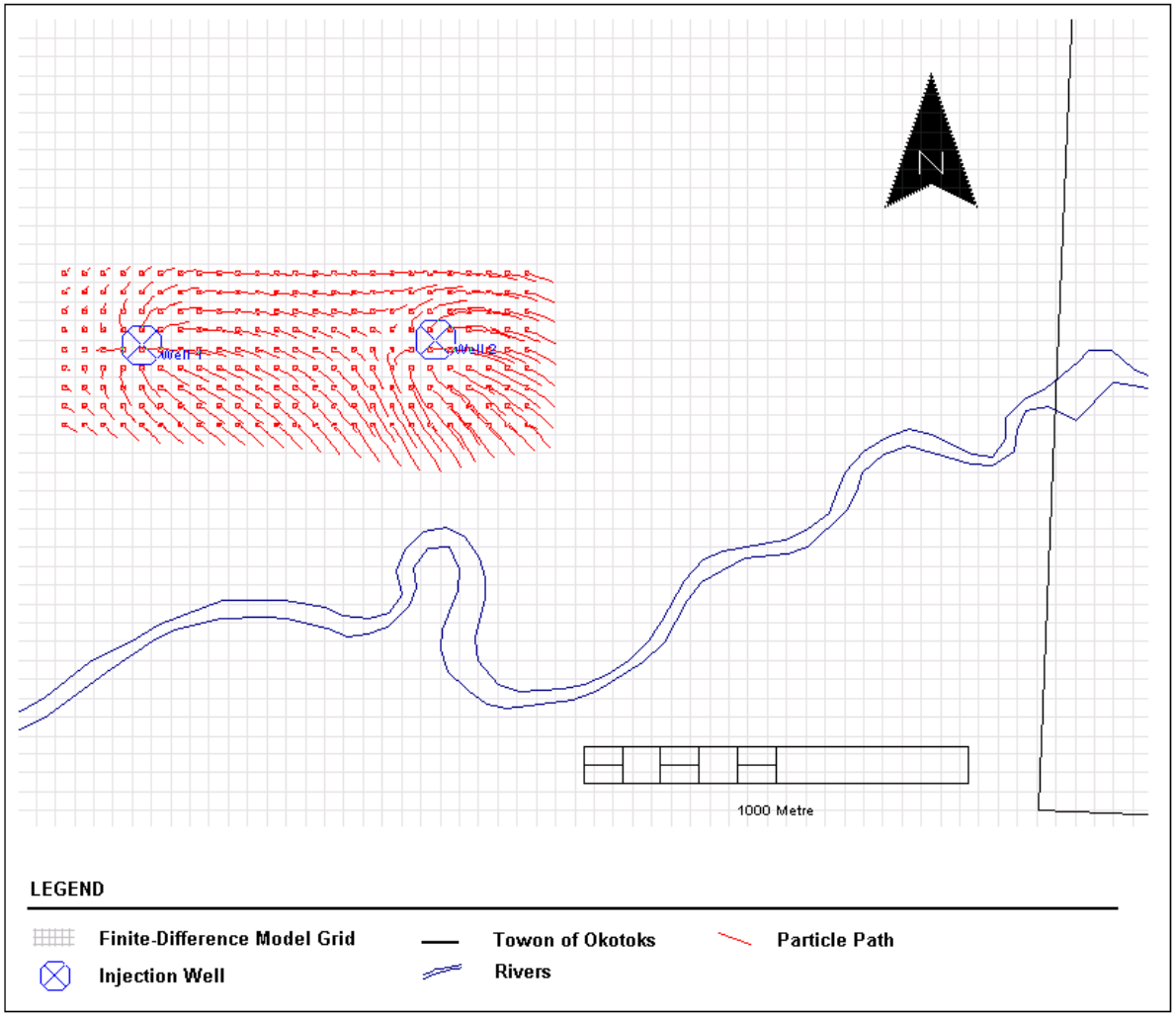
Particle Tracking
(after 1 month)



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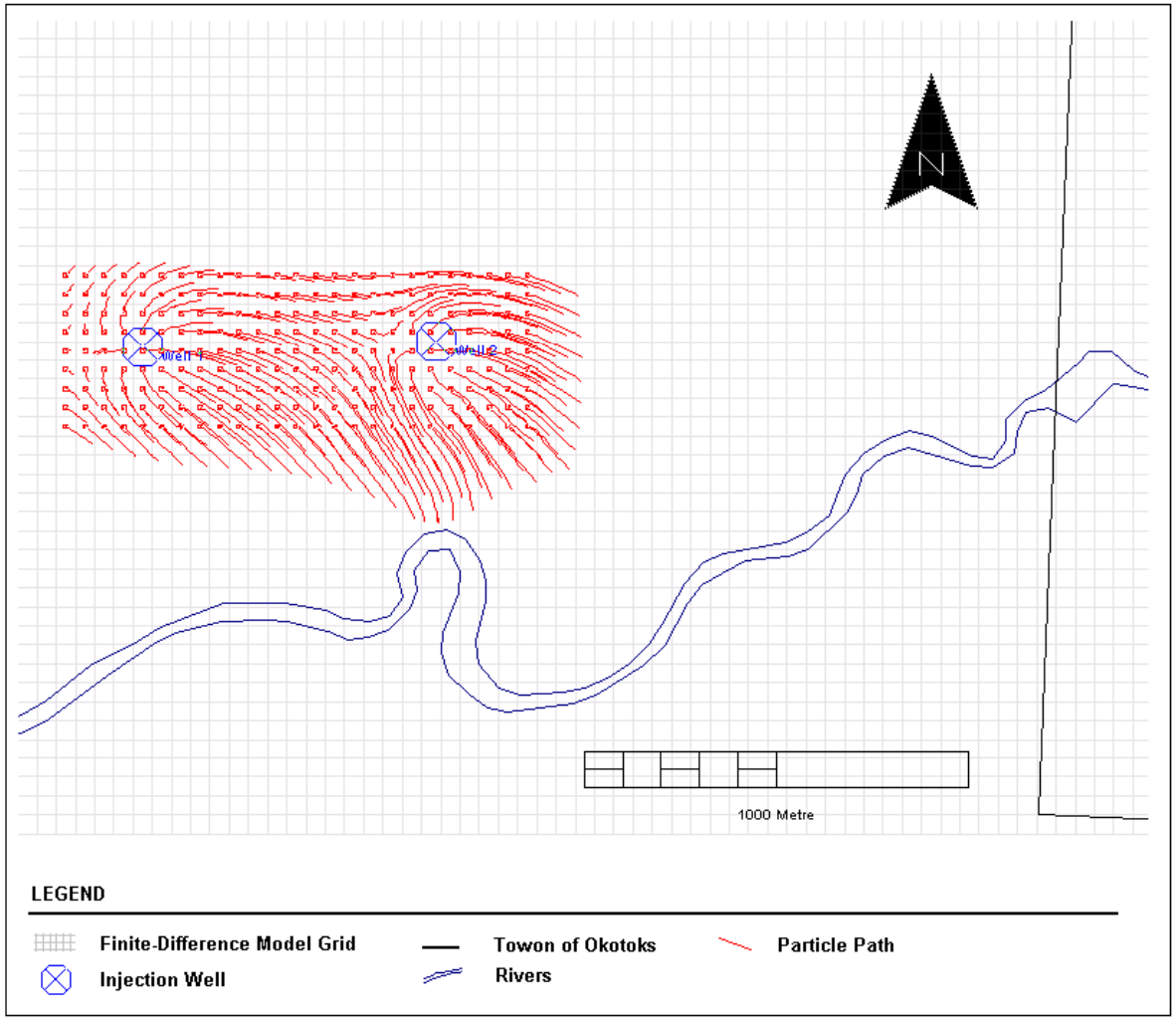
Particle Tracking
(after 2 months)



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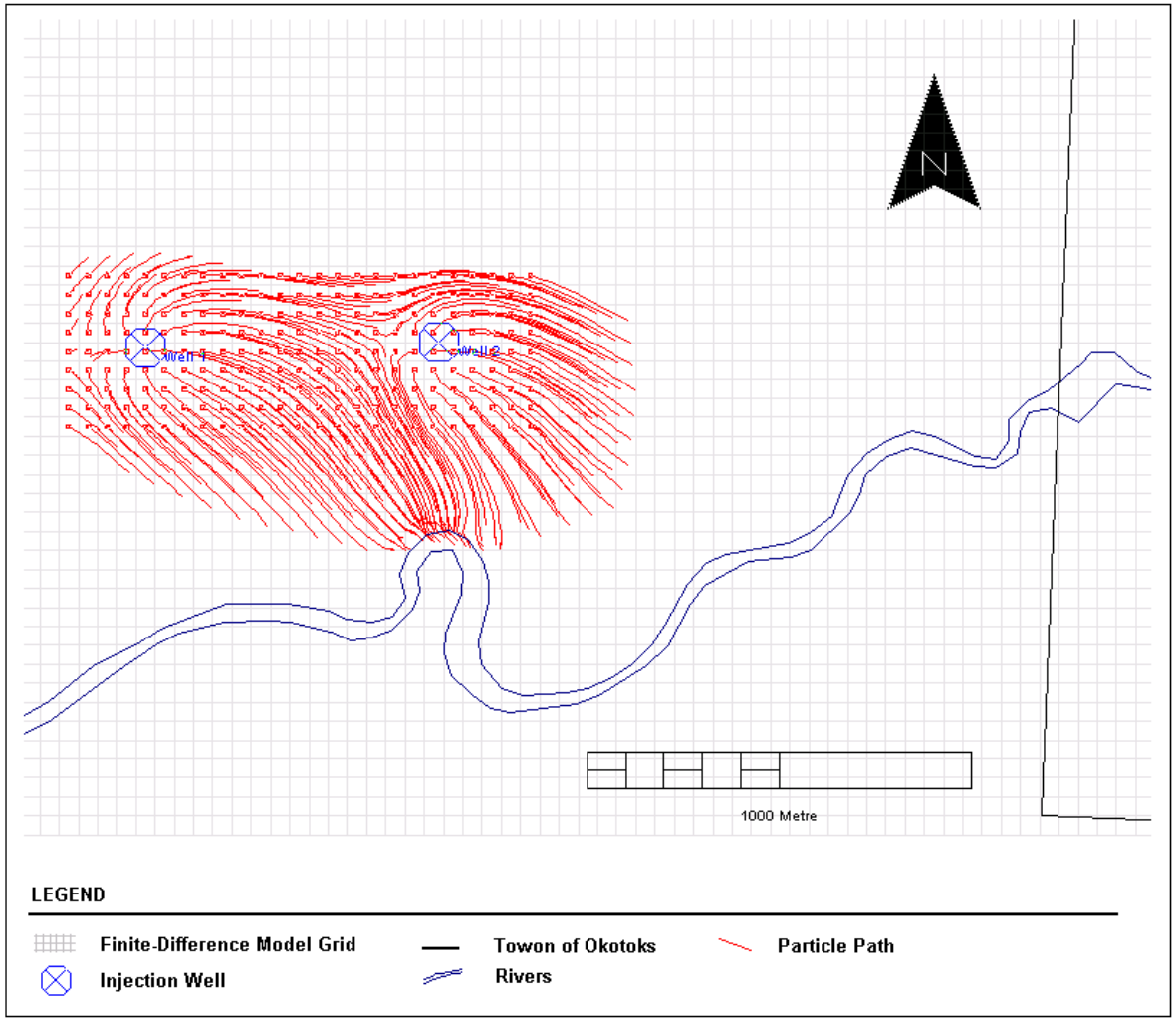
Particle Tracking
(after 4 months)



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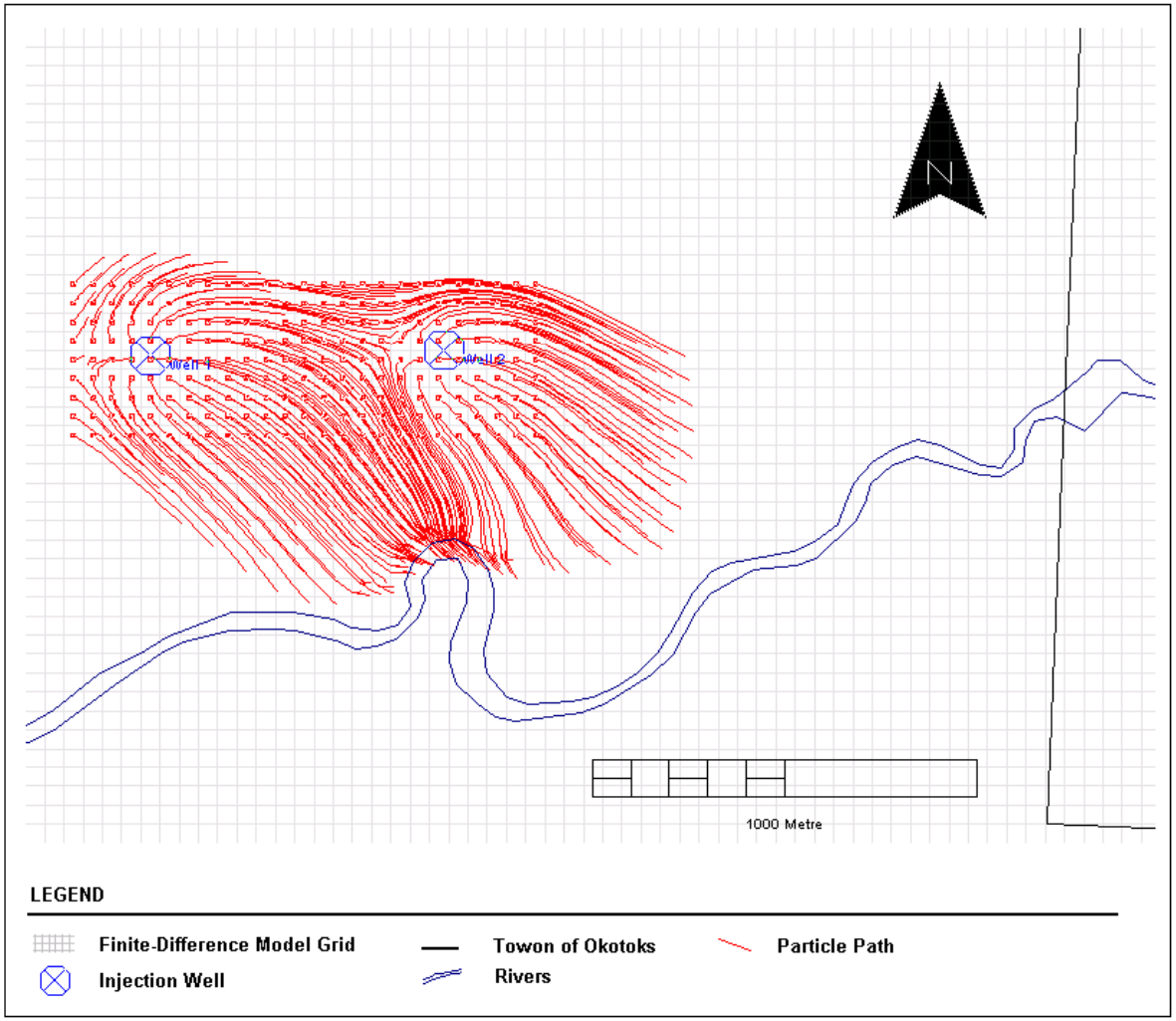
Particle Tracking
(after 6 months)



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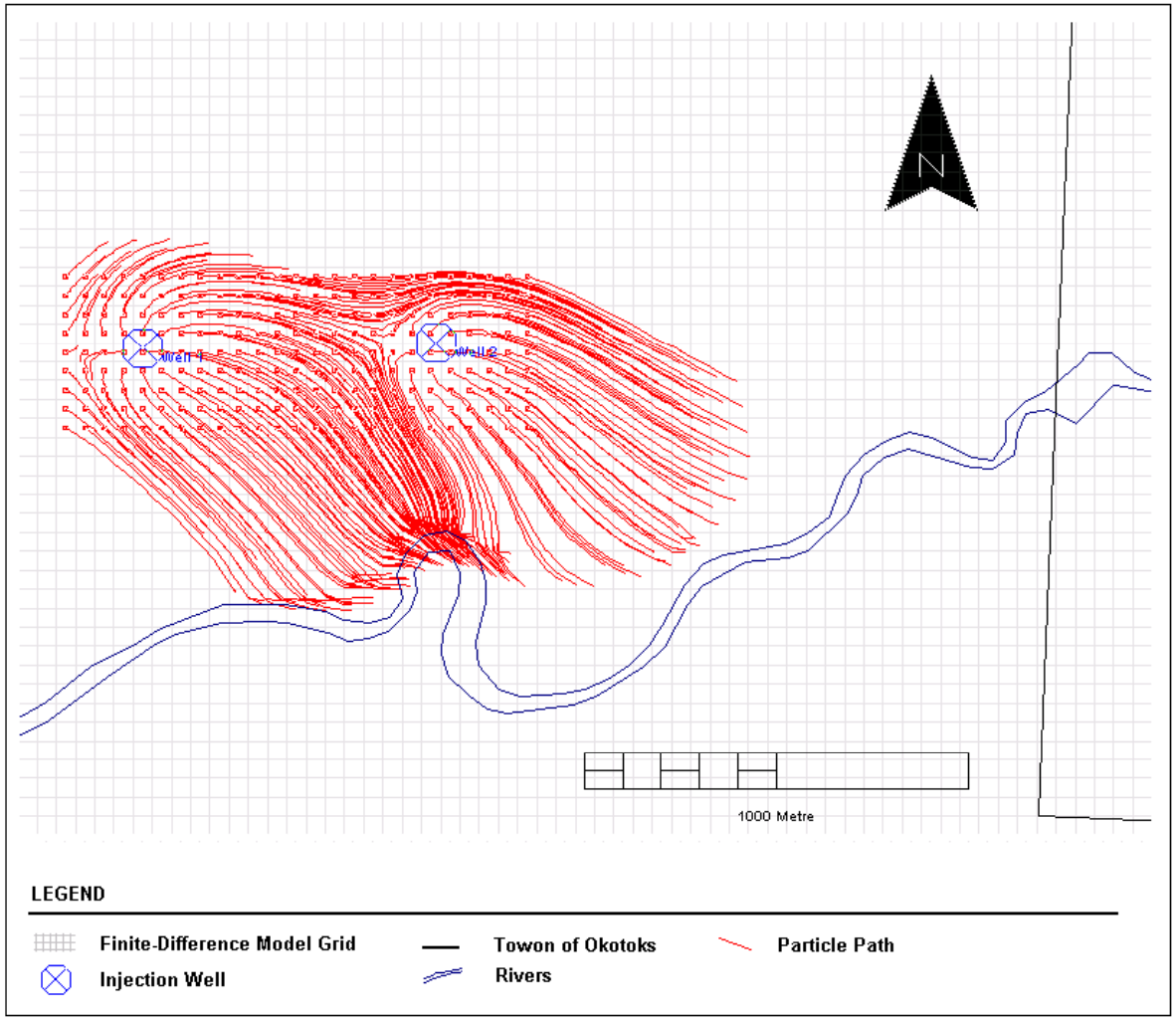
Particle Tracking
(after 8 months)



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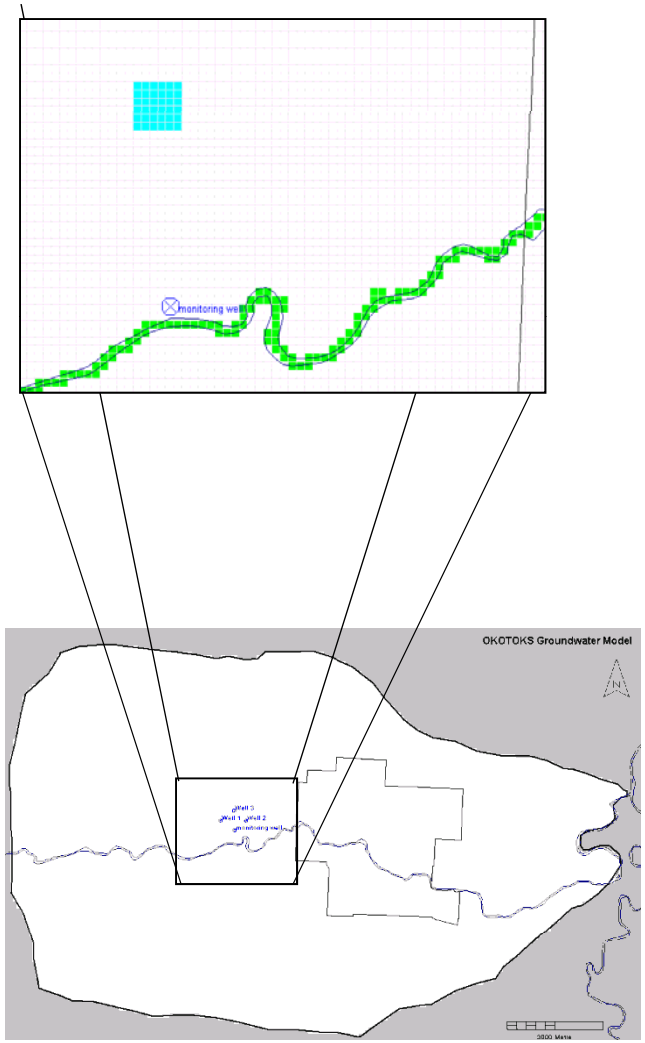
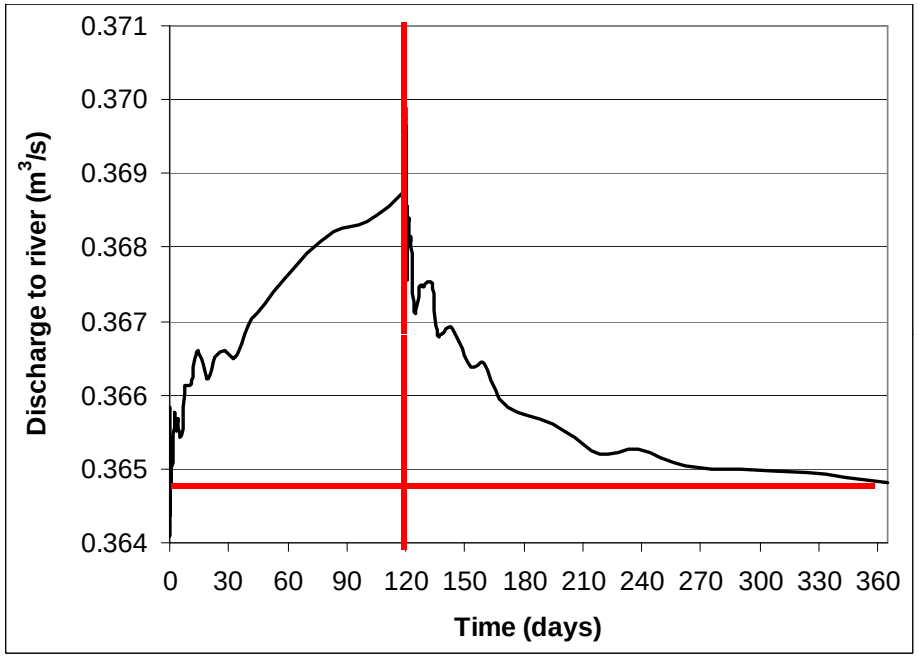
Modeled discharge profile





- Prolific system
  - results very sensitive to permeability of alluvial system
- Other options exist (including surface storage, ASR or groundwater offset)

So why are we looking at this?

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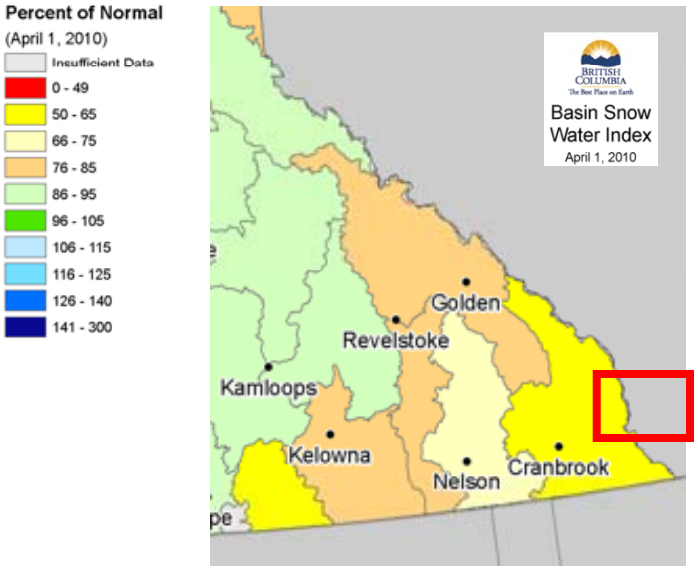
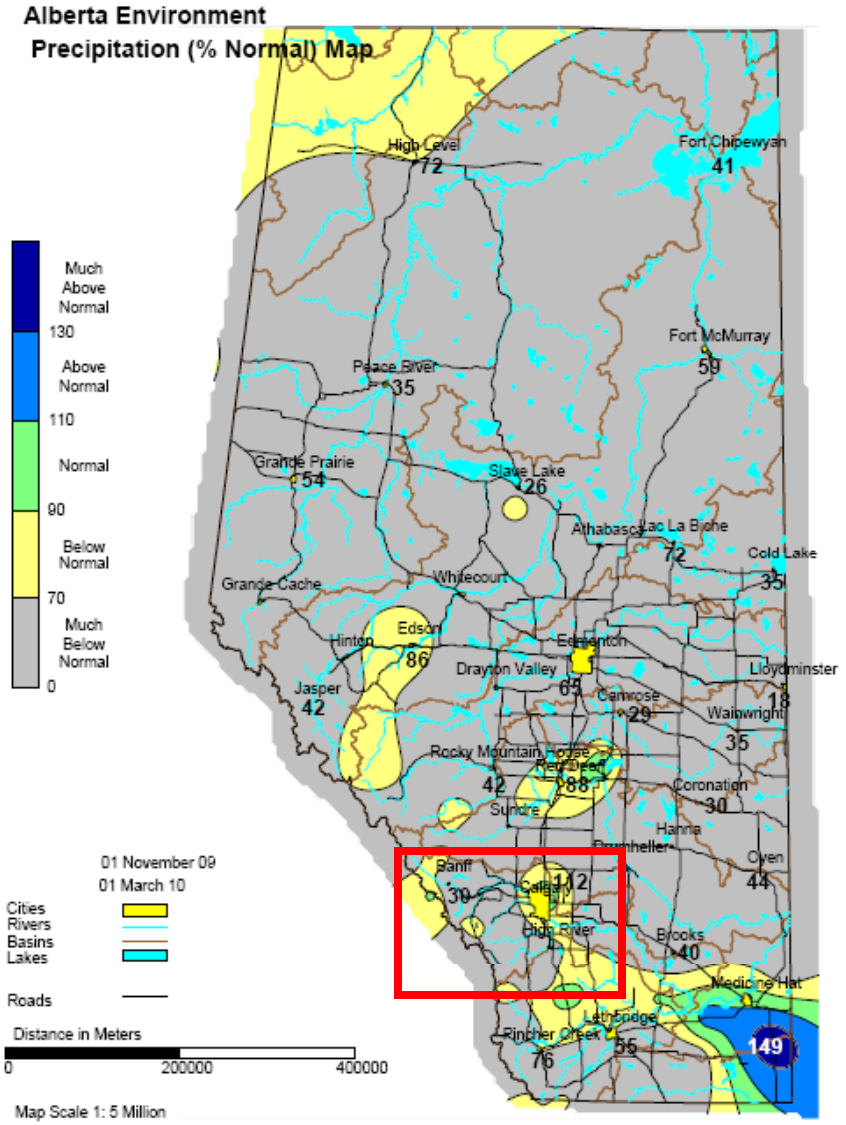
Water-year is not looking good





- Below average snowpack

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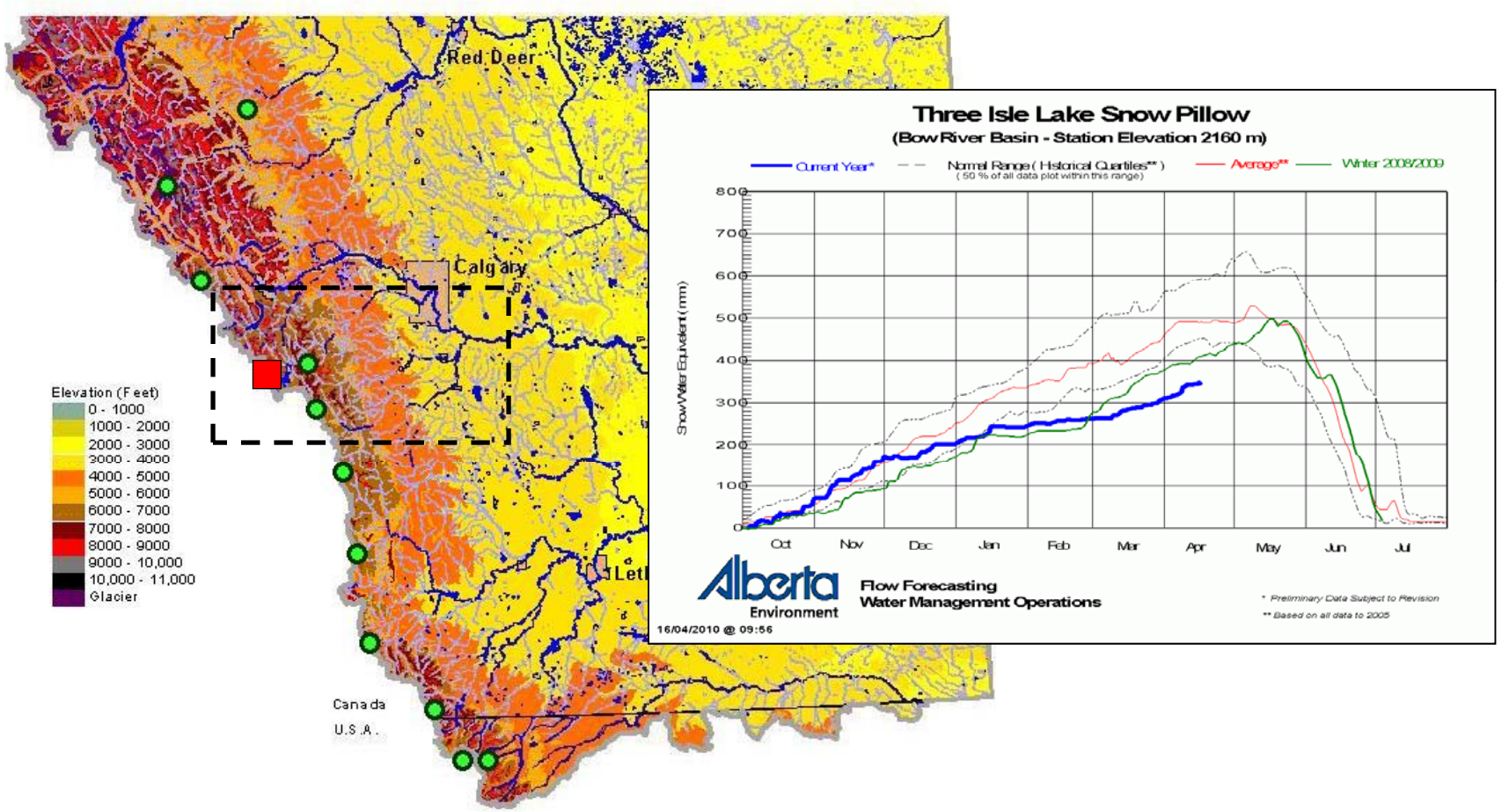
Snow pack



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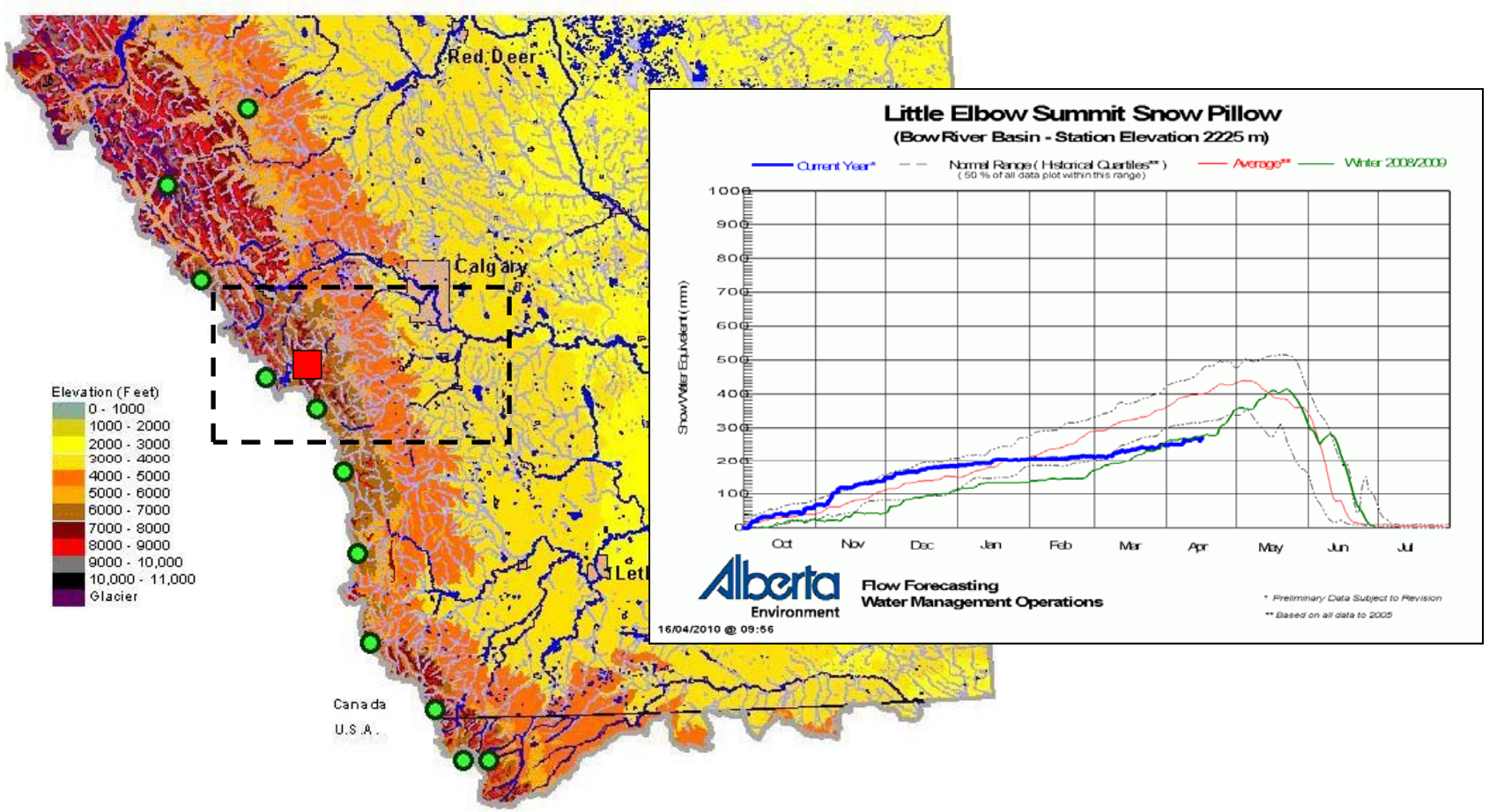
Snow pack



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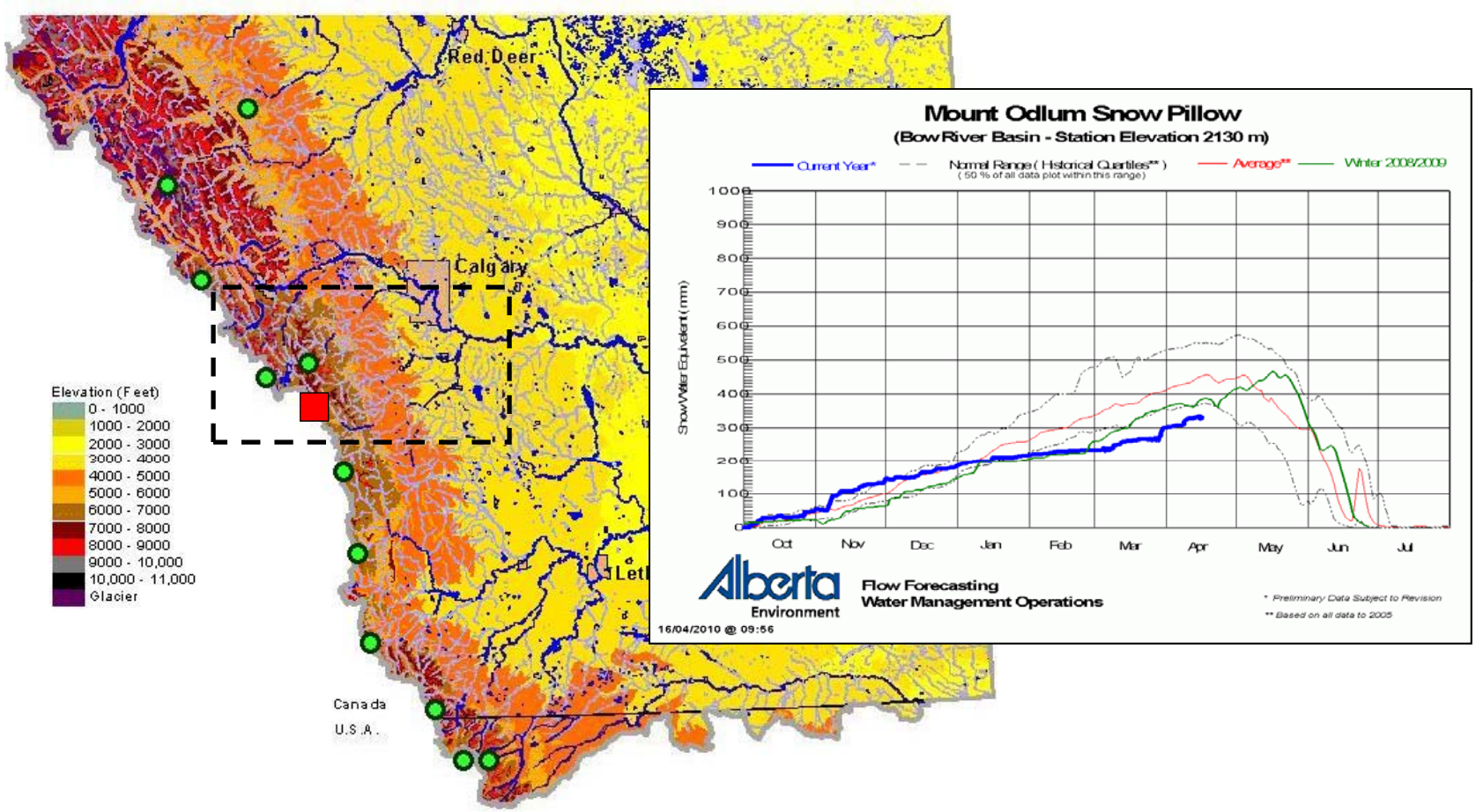
Snow pack



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Water shortfalls likely

March 2010

Water Supply Forecast as of March 1, 2010 - Bow River Basin (Natural Flows)

	Volume Forecast for March 1 to September 30, 2010					
Locations	**Volume in dam^3**	**Volume as a % of Average**	**Probable Range as a % of Average**	**Potential Minimum as % of Average**	**Forecast Ranking (lowest to highest)**	**Recorded March-September 2009 Volume as a % of Average**
Bow River at Banff	907,000	85	72-91	66	13/91	72
Lake Minnewanka Inflow	153,000	82	69-93	61	23/91	84
Spray River near Banff	324,000	89	74-102	69	29/91	84
Kananaskis River	371,000	91	83-102	72	33/91	83
Bow River at Calgary	2,039,000	84	72-94	65	21/91	80
Elbow River	186,000	85	69-97	58	38/91	86
Highwood River	472,000	75	51-102	45	31/91	67

Average is calculated for the March 1 to September 30 period from 1912 to 2001

NOTE: There is: a 50% chance that the actual natural flow will fall within the probable range given; a 25% chance that the actual flow will be less than the lower bound of the probable range given; and a 10% chance that the actual natural flow will be less than the potential minimum. Actual day to day streamflow conditions may vary throughout the season as a result of the effects of streamflow diversion and reservoir storage.

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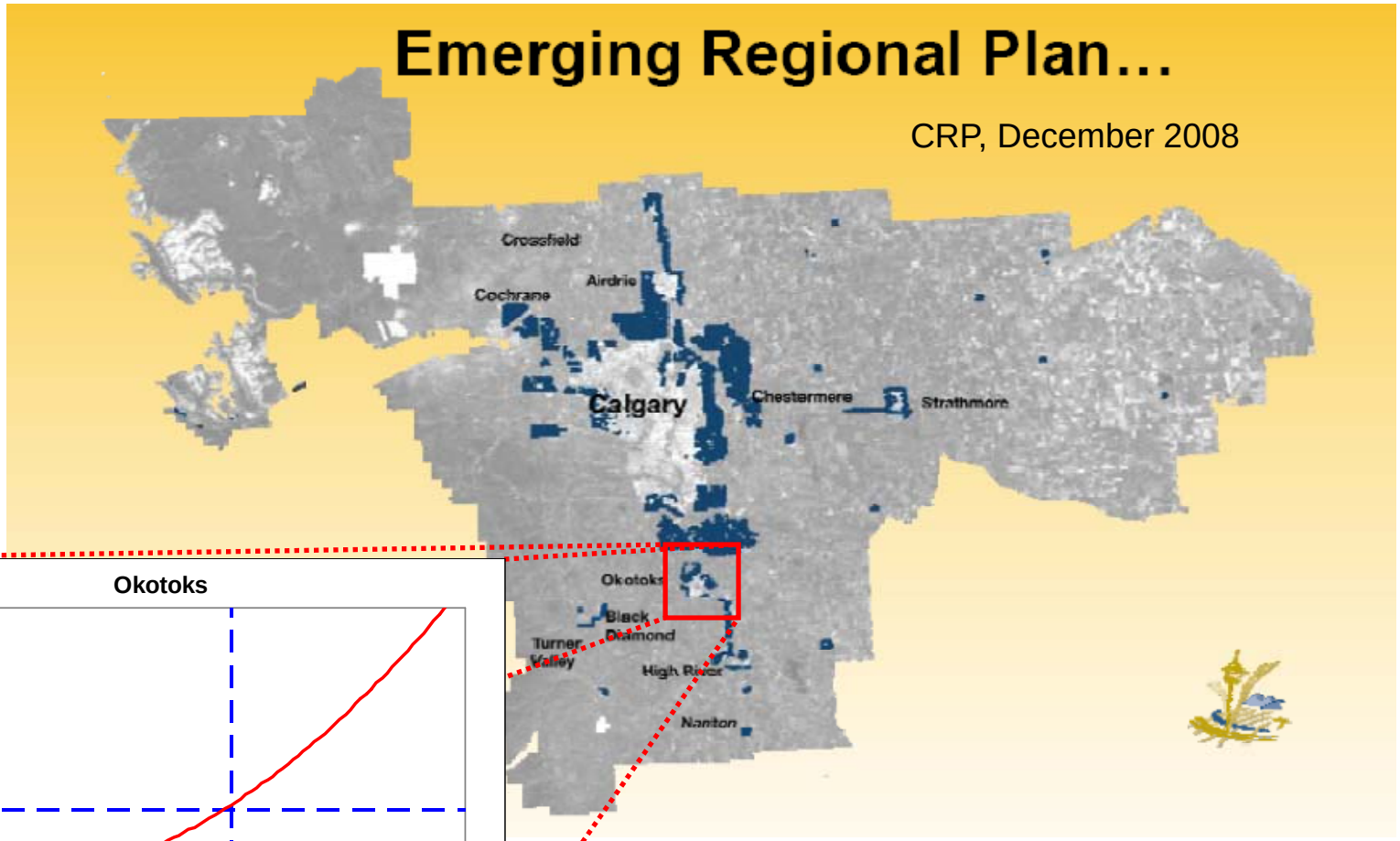
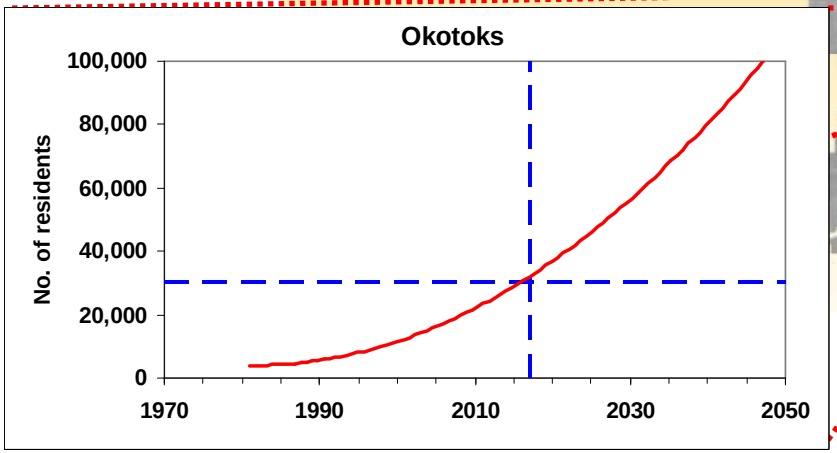
Longer-term risks
(growing population)





30,000 projected around 2017

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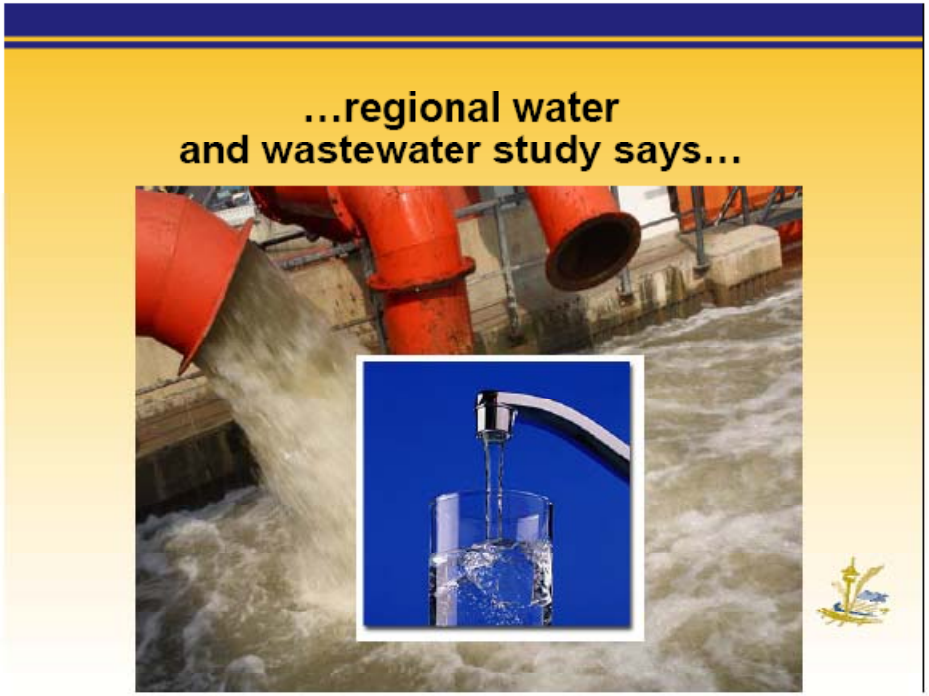
Longer-term risks
(thirsty population)



THE STUDY TOLD US THAT WE LIKELY HAVE ENOUGH WATER TO ACCOMMODATE THE NEXT 2 MILLION RESIDENTS...

BUT IT WILL TAKE SIGNIFICANT COLLABORATION, CONSERVATION AND REGIONAL PLANNING SOLUTIONS...

CRP, December 2008

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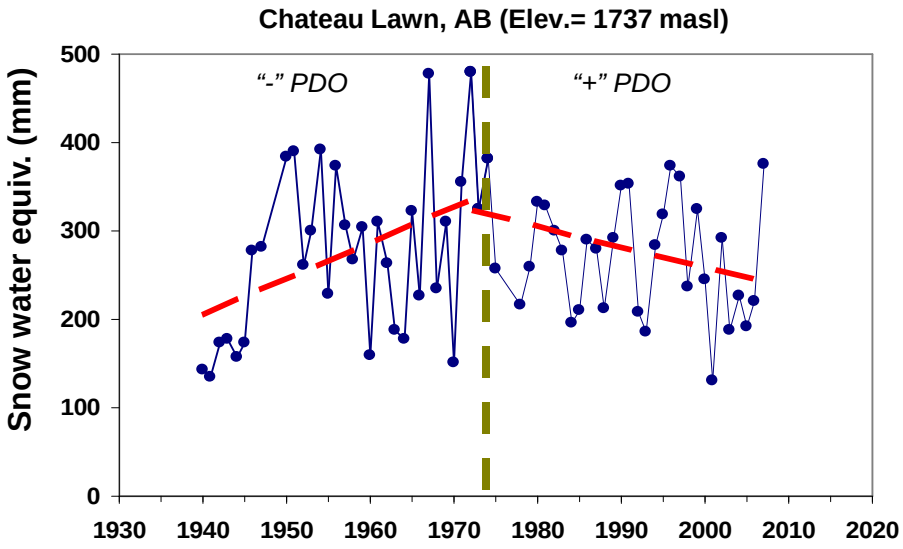
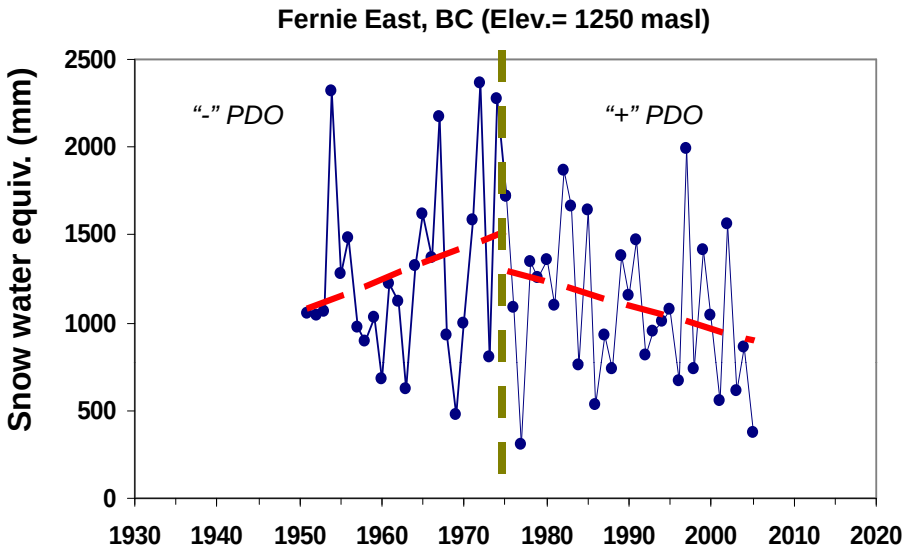
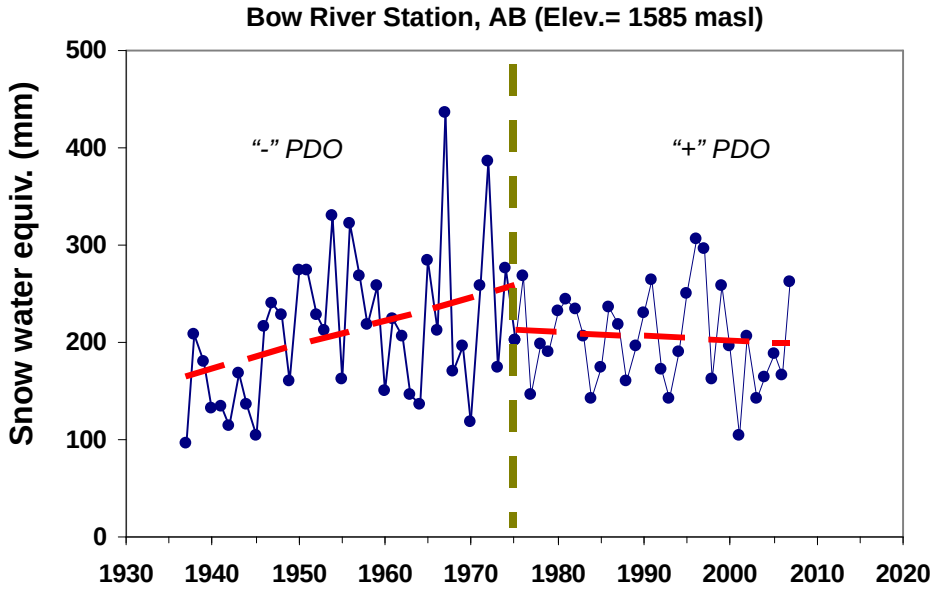
Longer-term risks
(changing water balance)







Declining snow pack

(serious issue for communities like Okotoks)

Less supply of melt-water

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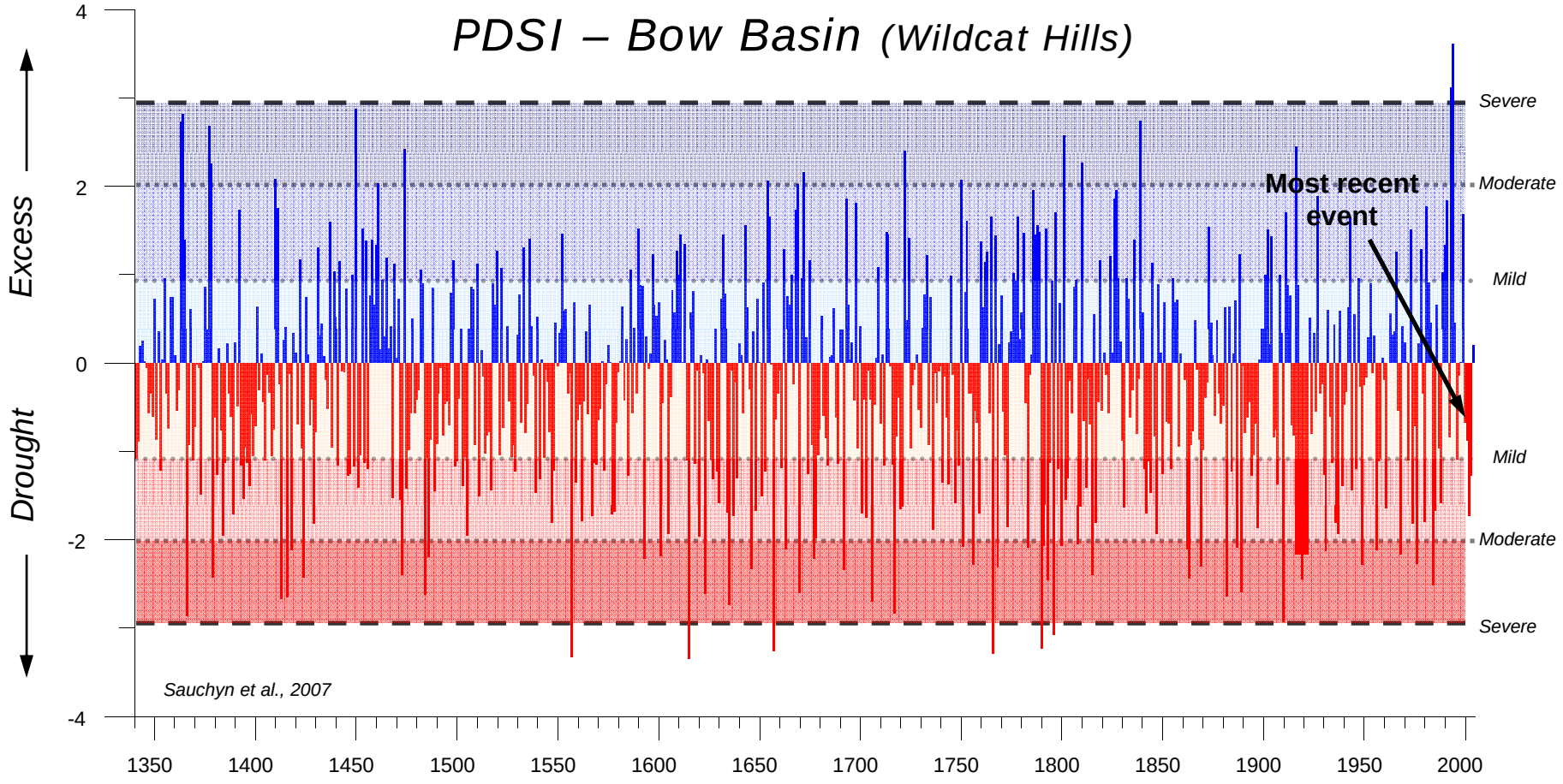
Longer-term risks
(chance of drought)



Notable periods of drought

⇒ *not uncommon & can last long periods of time*

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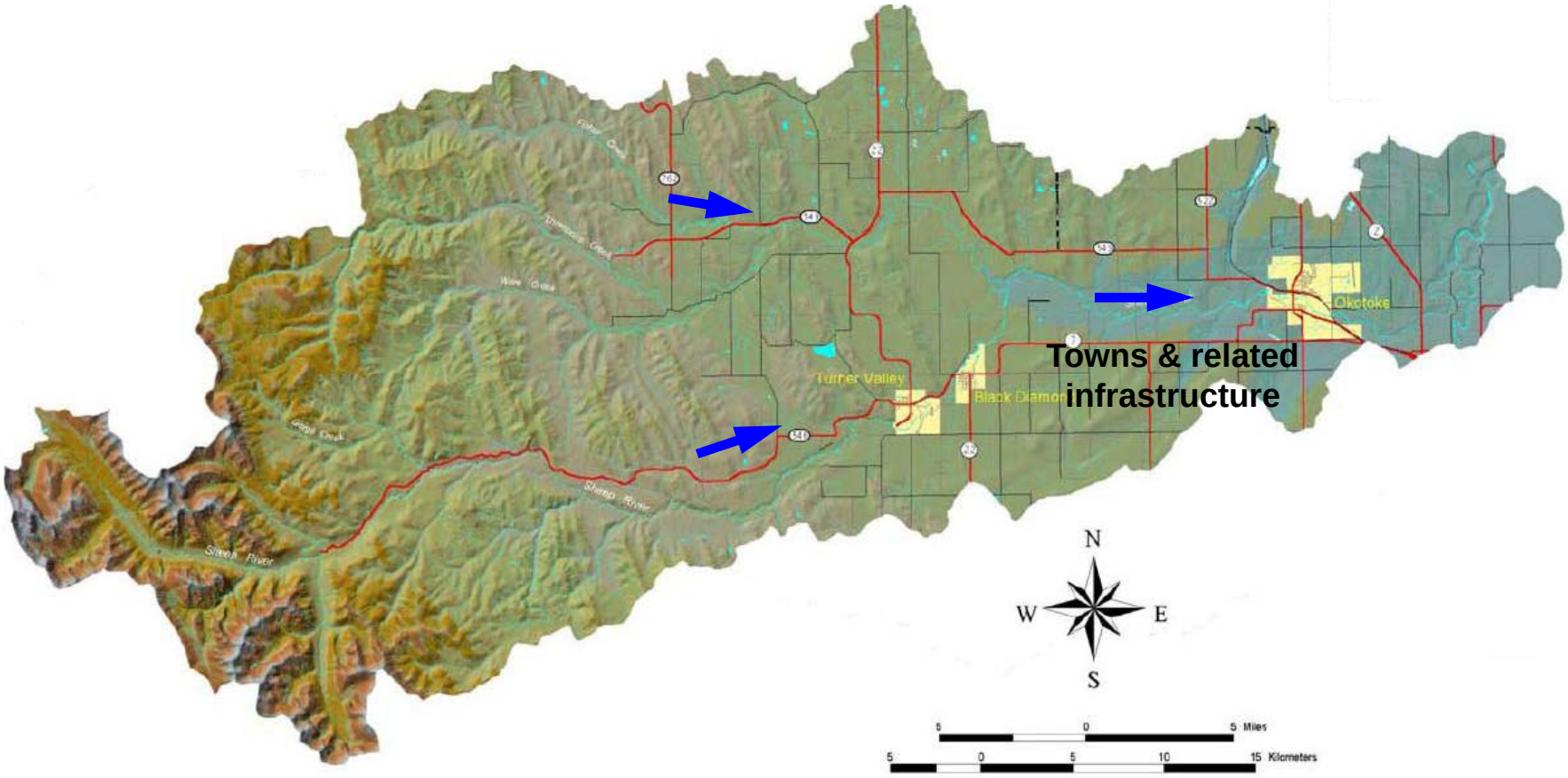
Increasingly vulnerable basin



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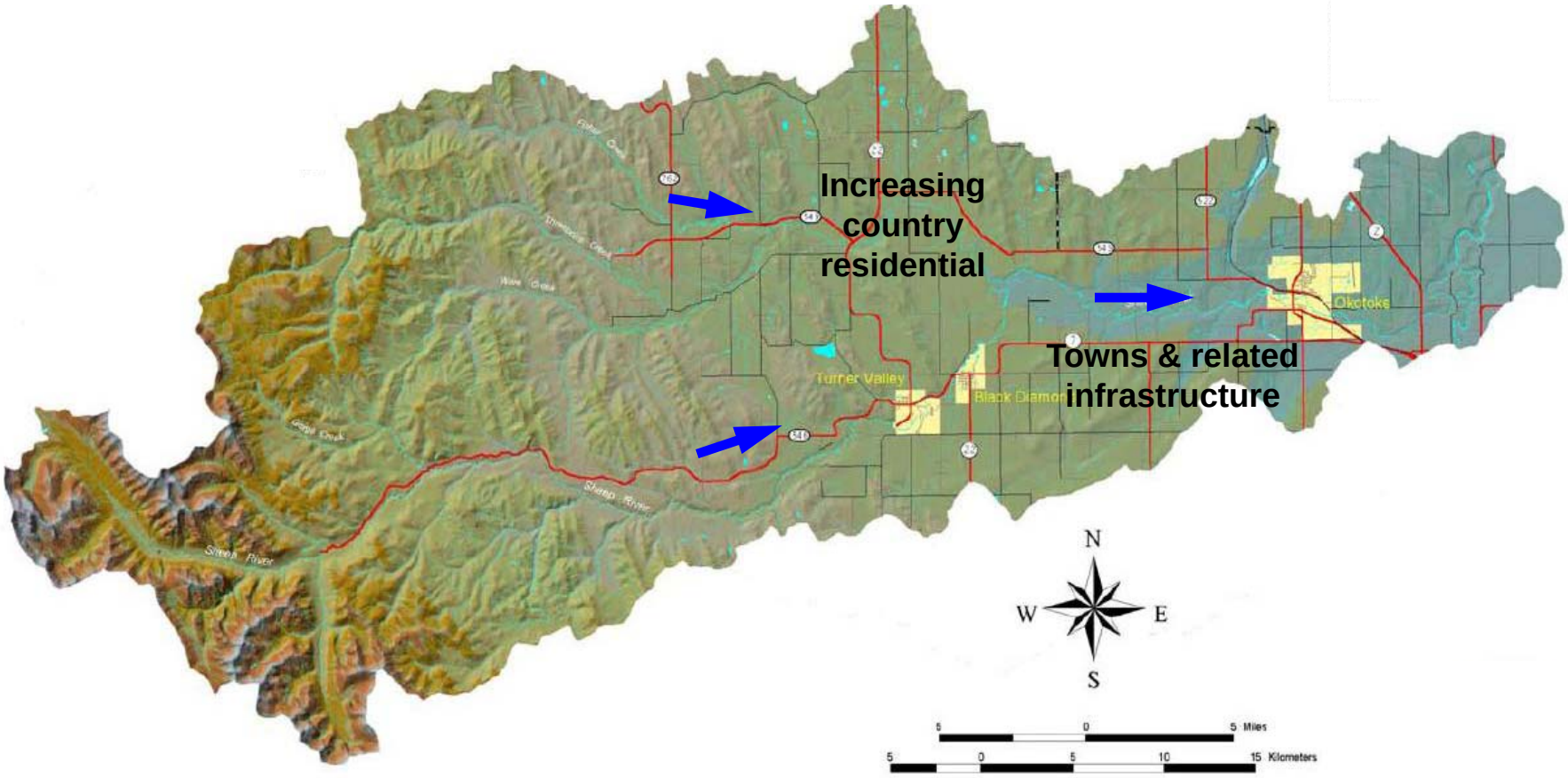
Increasingly vulnerable basin



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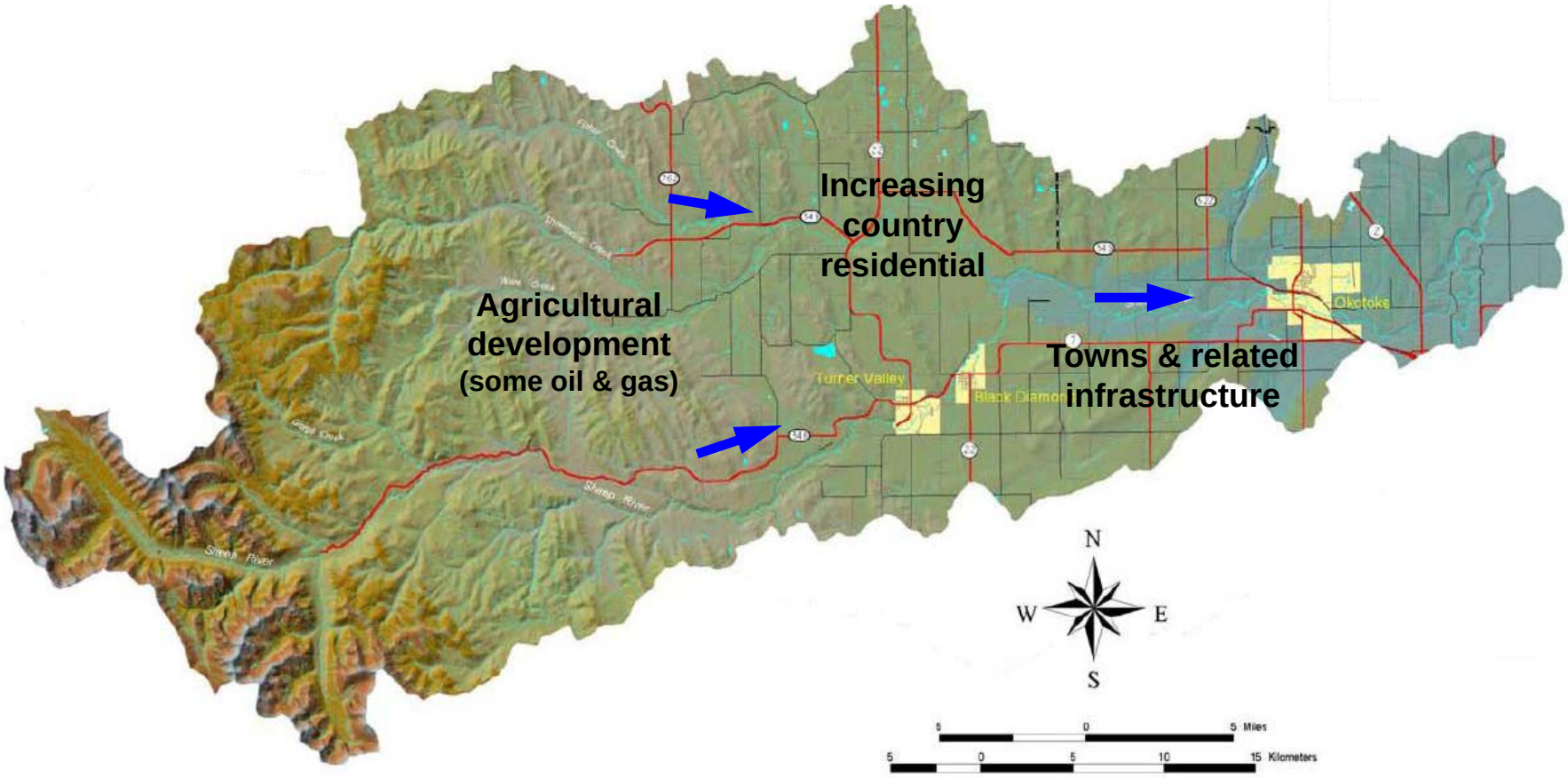
Increasingly vulnerable basin



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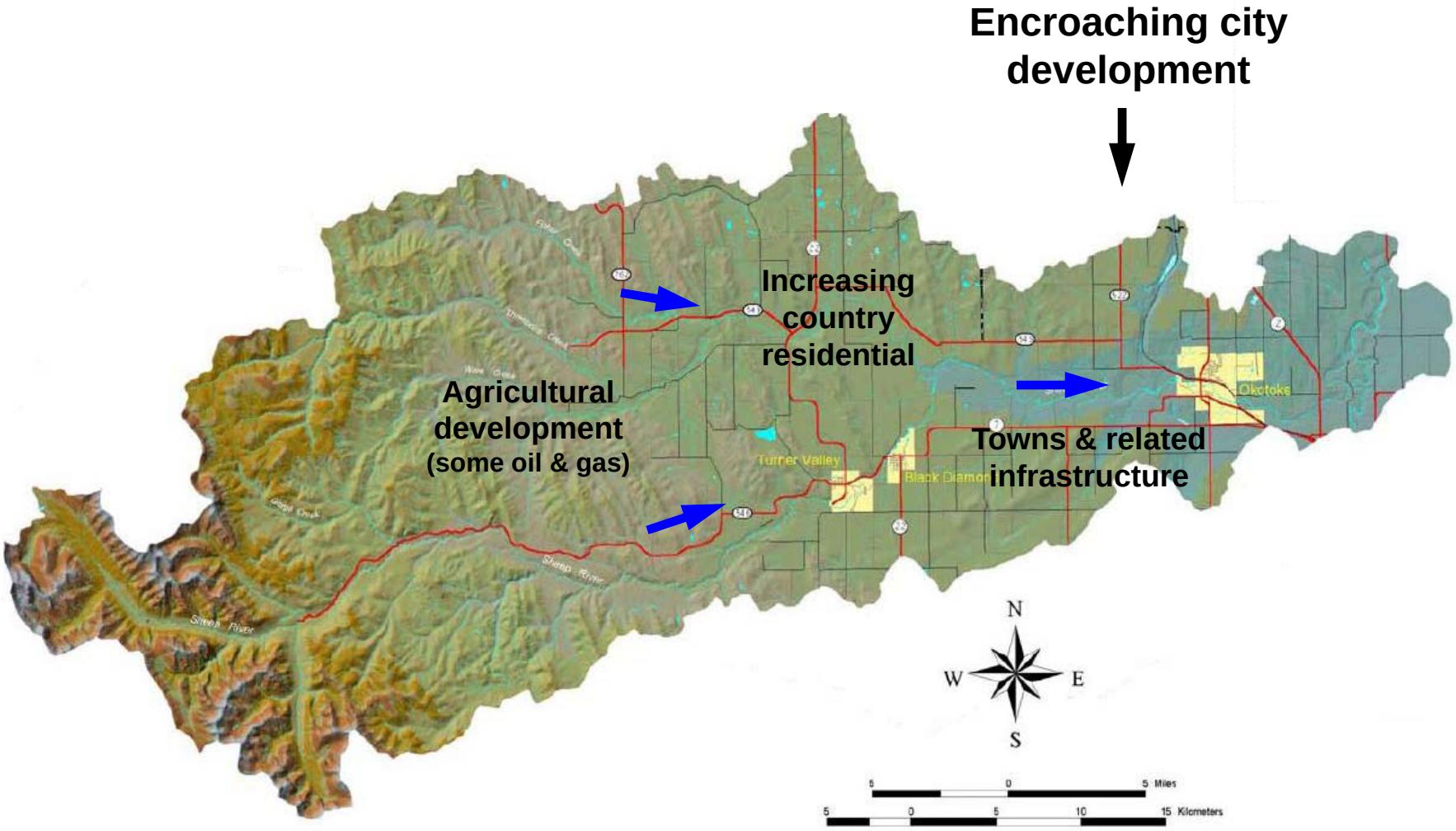
Increasingly vulnerable basin



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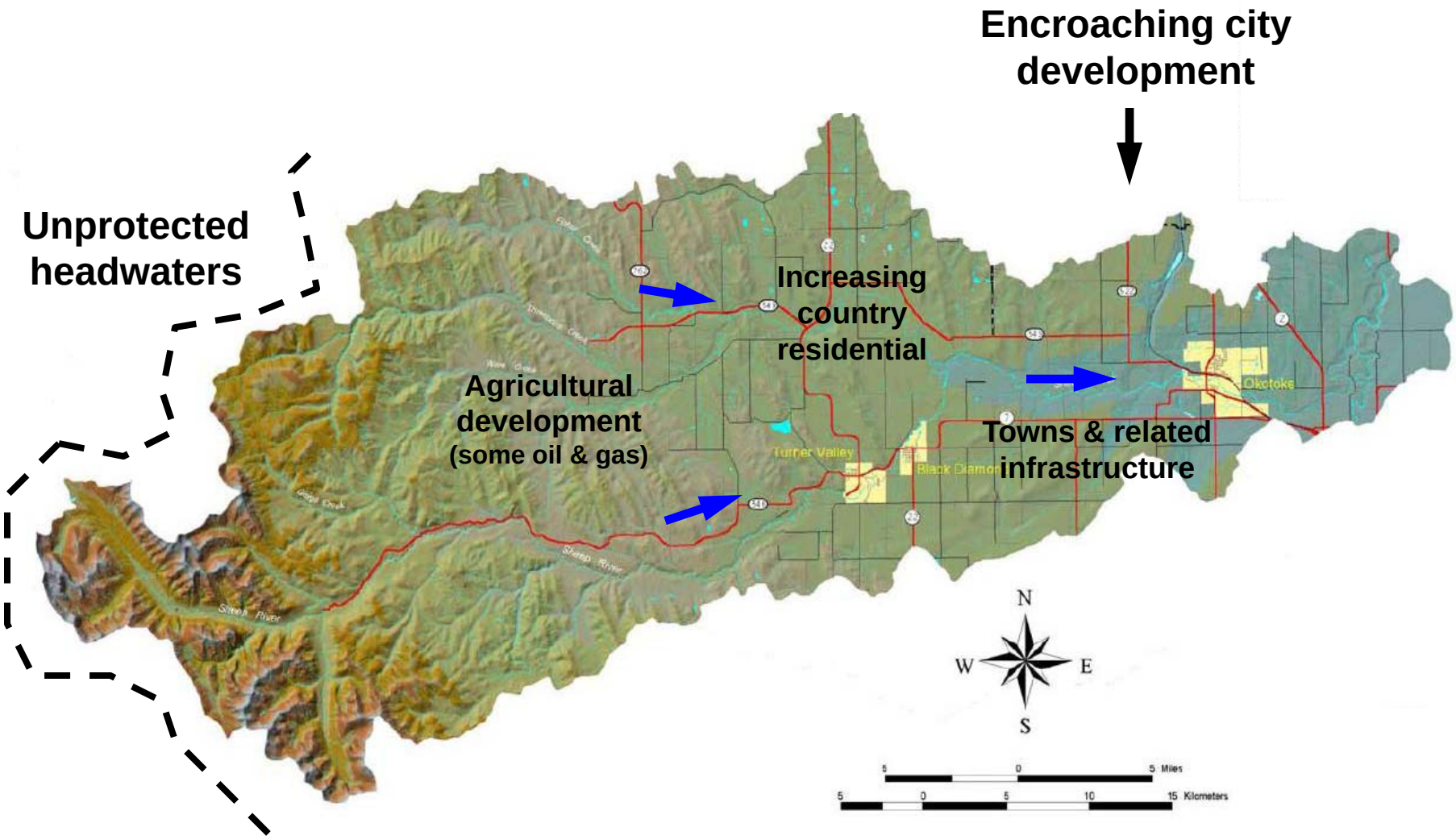
Increasingly vulnerable basin



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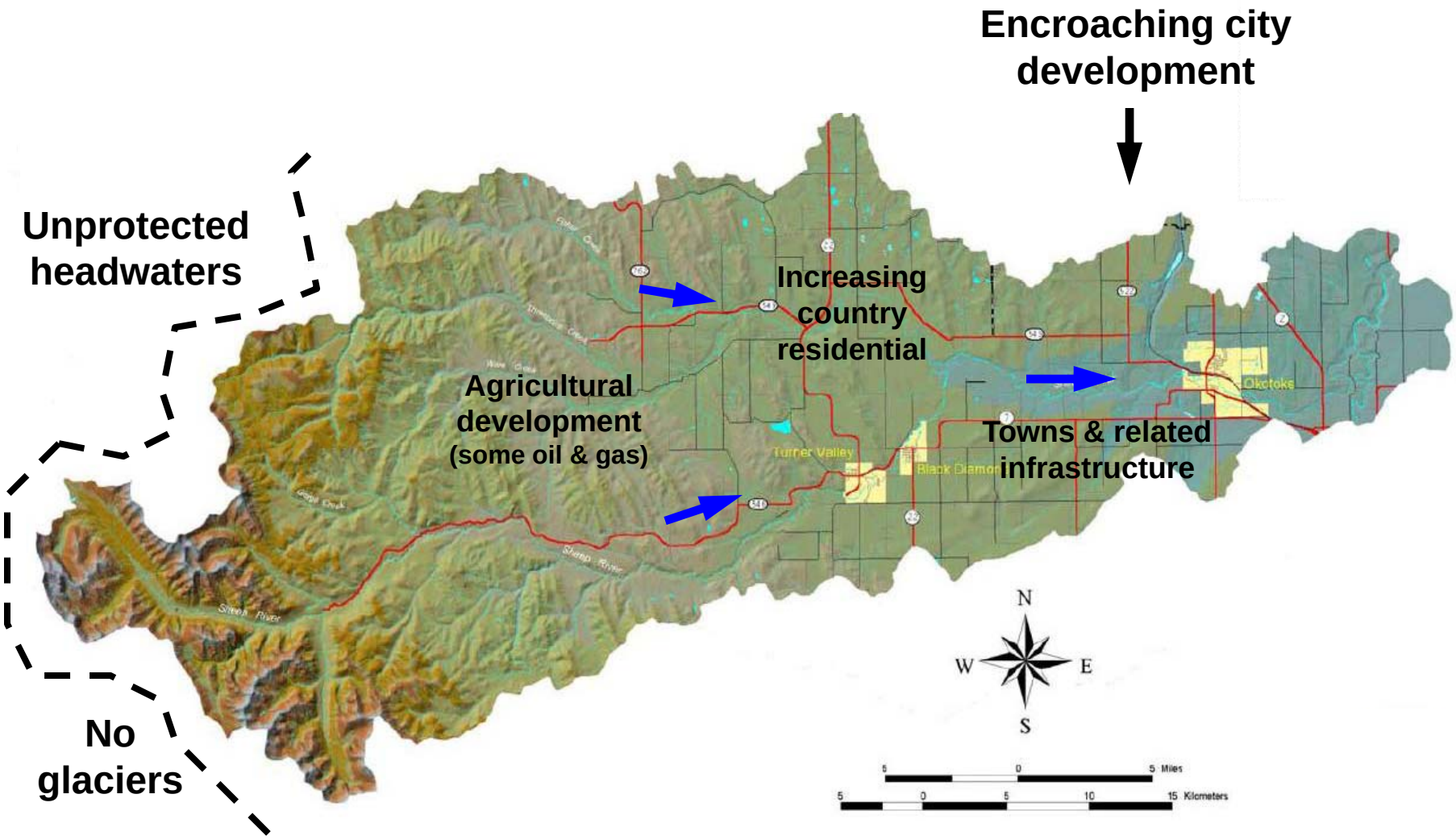
Increasingly vulnerable basin



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A possible result from increasing rural development...

(…and GW use in a closed basin)

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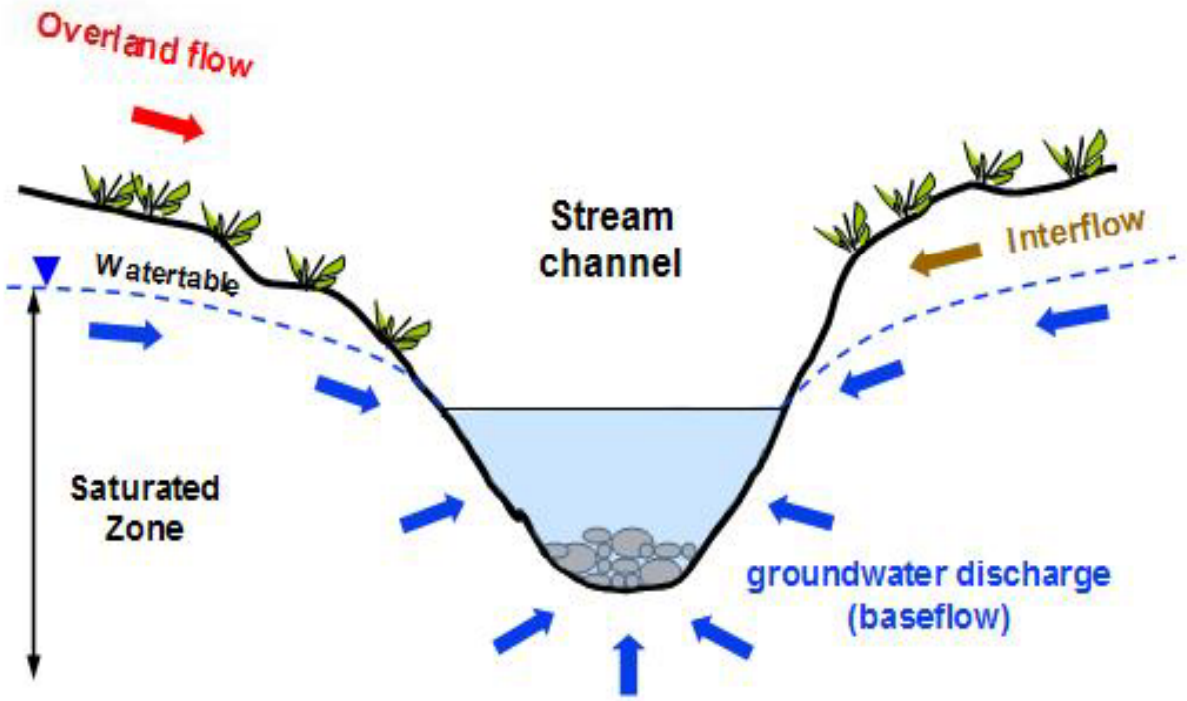
A system in balance
(GW-SW interaction)



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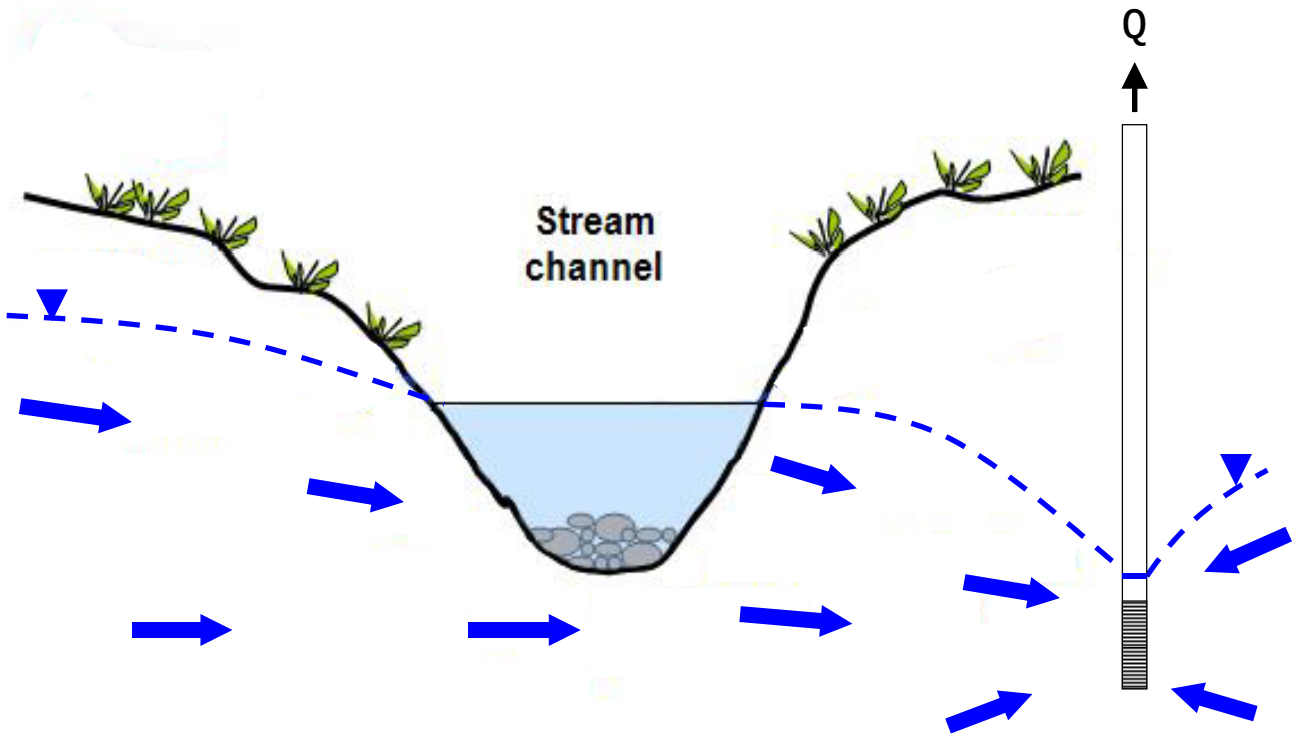
Stream interception



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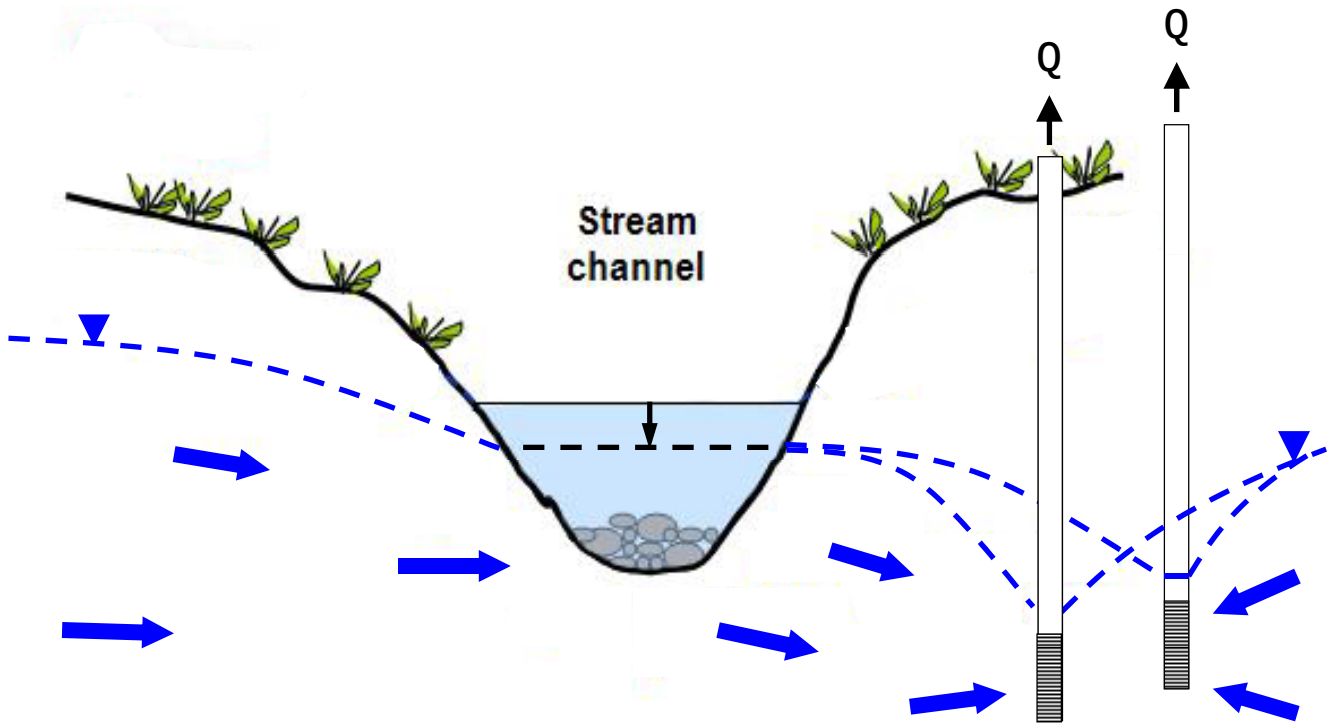
Cumulative lowering of water levels



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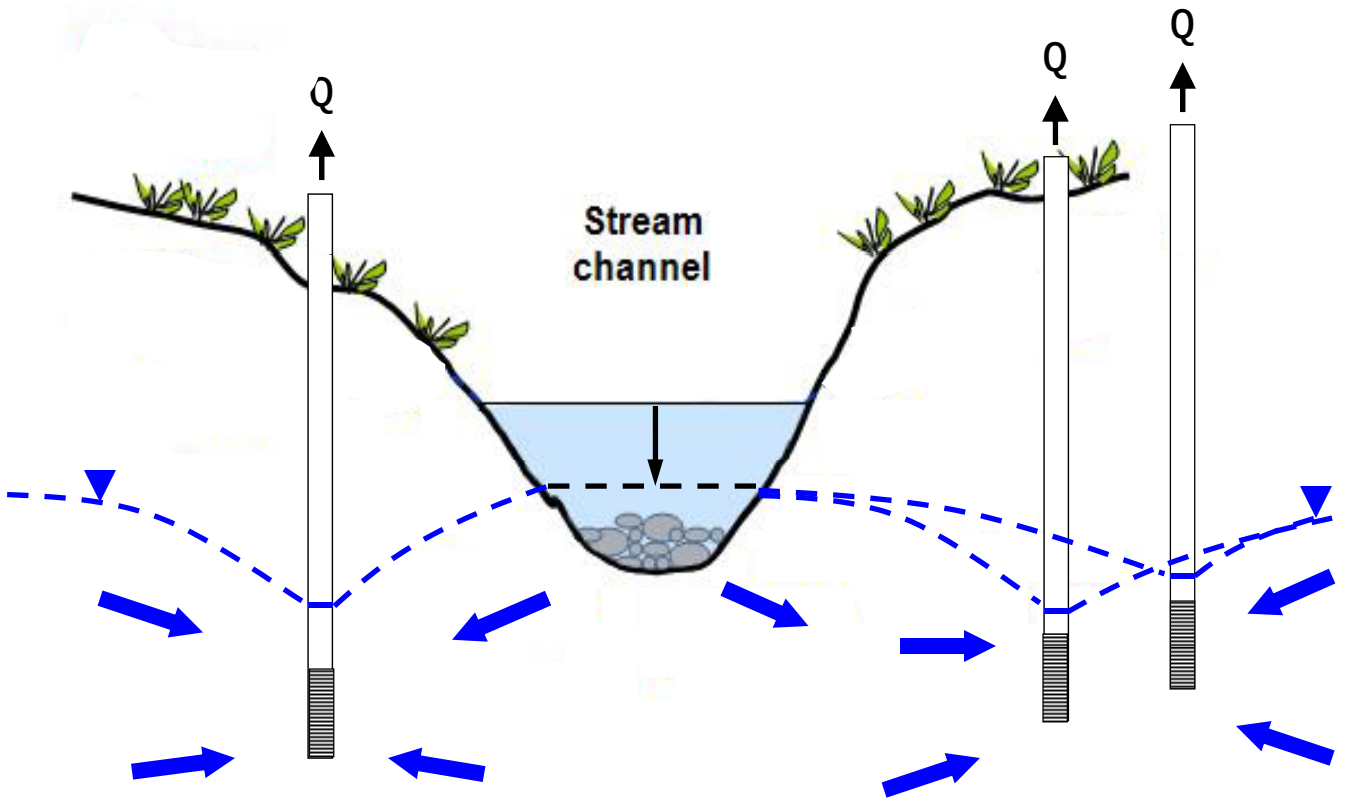
Reduction in streamflows



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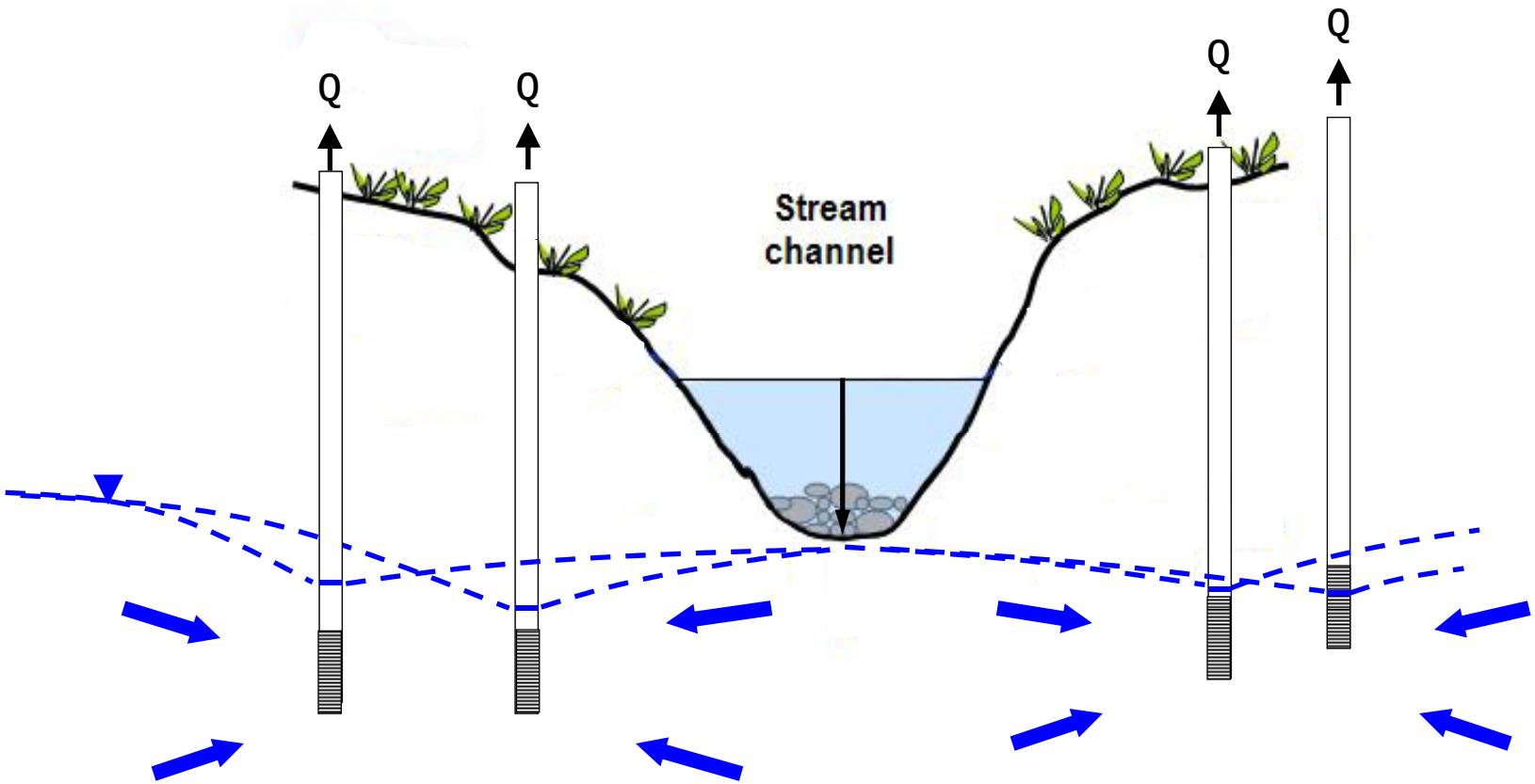
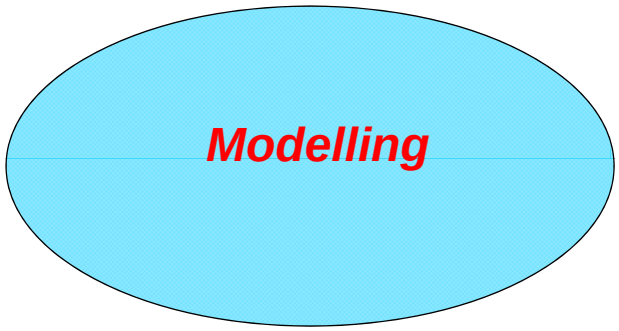
Risks (stream capacity exceeded)

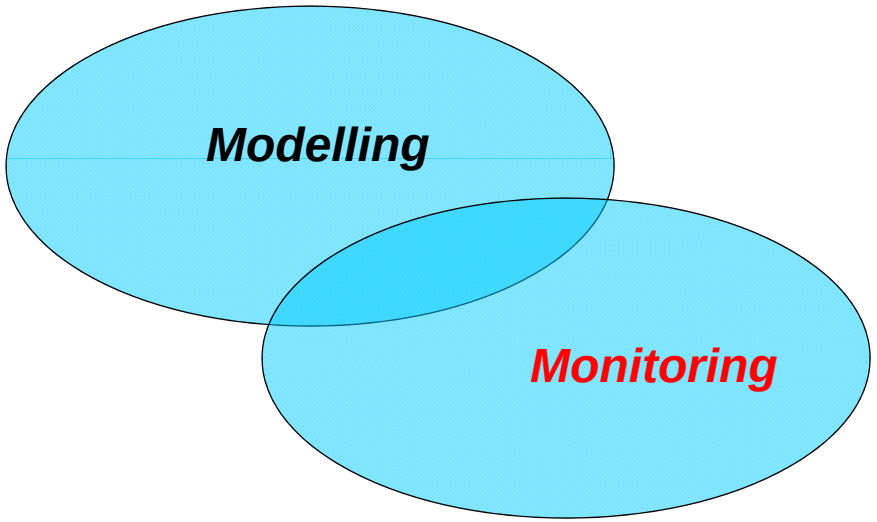


What can we do?

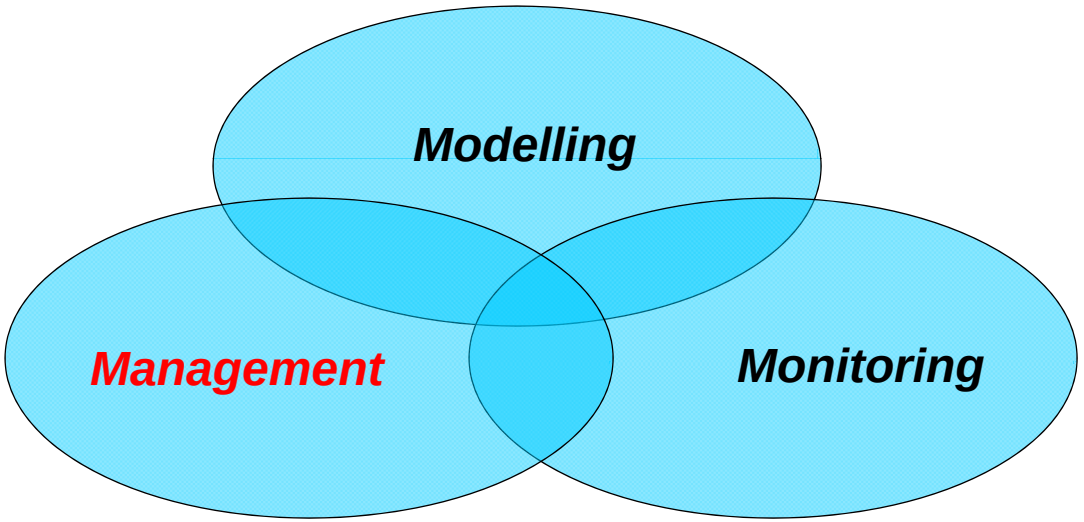
Forecast



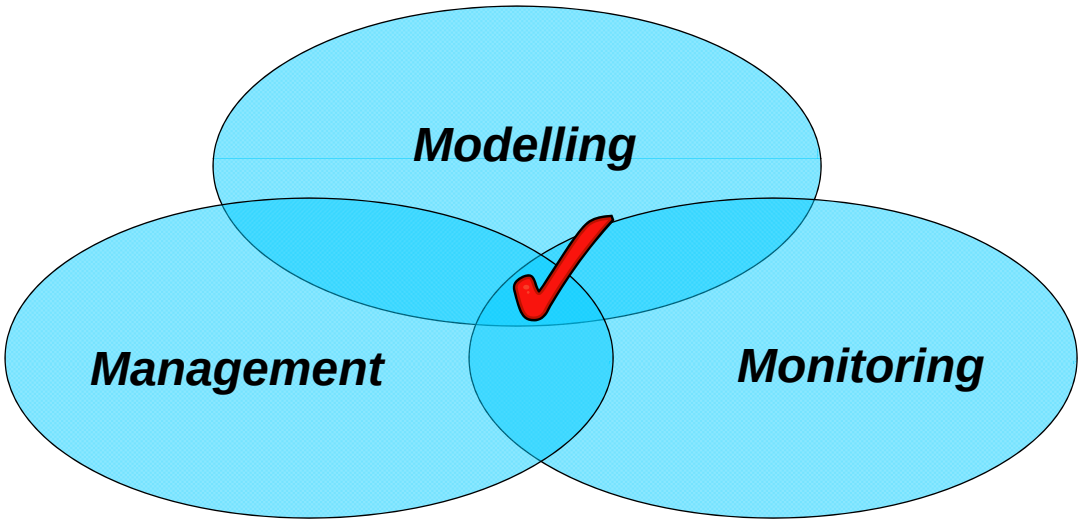
Assess



Respond

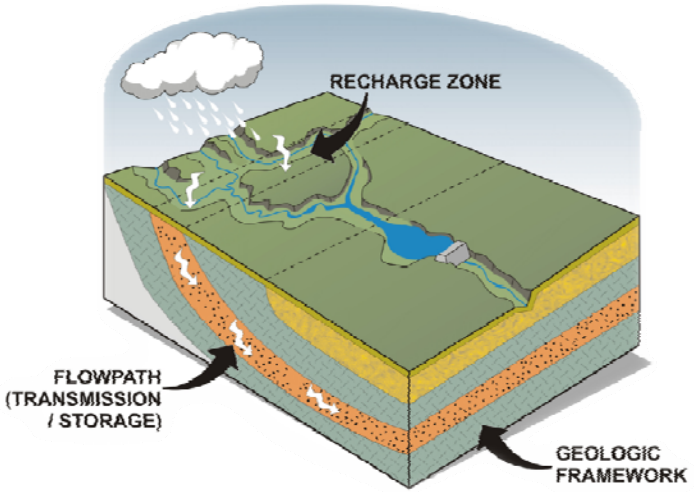


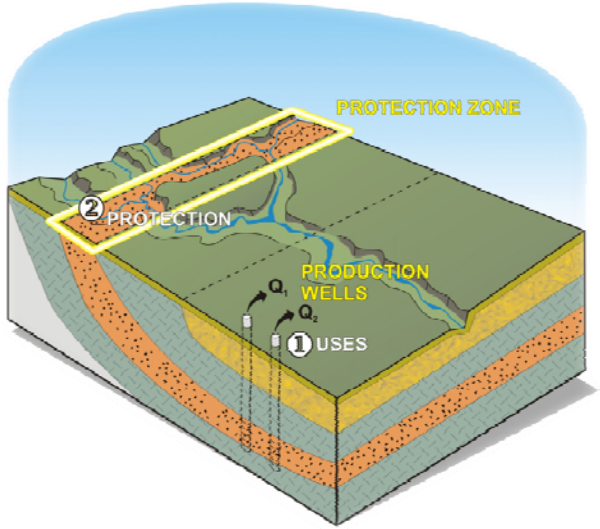
Integrate



Plan strategically

- Quantification / Framework
  - Spatial distribution / geometry of aquifers
  - Major surface water sources
  - Circulation regime; interactions; IFOs
  - Transmission / storage characteristics
  - Water quality
- Set of Strategies
  - Demand management / conservation
  - Storage / conjunctive use
  - Protection *(recharge area, well-head)*
  - Licensing / land-use planning
- Monitoring, evaluation & response
  - Early detection of change / trends
  - Framework upgrades *(adaptive management)*





It's all about….

SUSTAINABLE DEVELOPMENT

Isn't it?

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Recommendations

1. Meet with stakeholders to discuss opportunities for conjunctive use strategy or wider "Integrated Basin Water Management Plan"
   - Build capacity to think "innovatively"
   - Interact strategically
   - Understand cumulative pressures

2. Develop "Water Security Working Group" to explore long-term options *(including storage and conjunctive use options)*
   - Okotoks, High River, Turner Valley, Black Diamond and Longview
   - AENV
   - Utility provider(s)

3. Implement integrated management plan to ensure security of supplies with water balance options, in addition to market mechanisms and allocation system changes

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Discussion