

## Groundwater Resources in Osoyoos

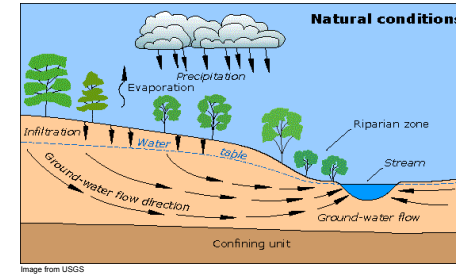
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Environment Canada

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## What is groundwater?

- Water (rain, snowmelt, irrigation, etc) percolates into soil
- Flows underground in aquifer; often connected to lakes/streams



## Why is groundwater important?

- **Major water supply source**
  - Approx. 1/3 of BC's population, 2/3 of Washington's population
  - Also water supply for agriculture & industry
  - Reliance can be up to 100% locally
- **Influences surface water hydrology**
  - Drainage from aquifers supports water levels in dry periods
  - Moderates water temperatures: winter-warm, summer-cool
  - Moderates peak water levels by absorbing storm inputs
- **Potential pathway for contaminants to rivers & lakes**
  - Link from land surface/subsurface → surface water bodies

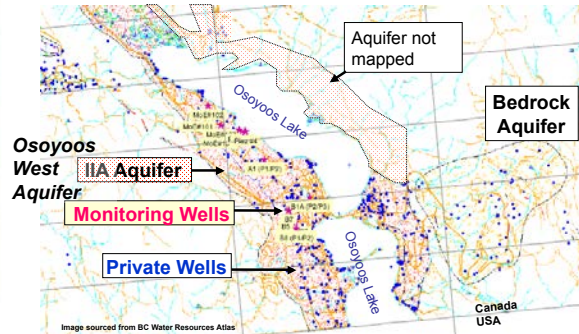
## Osoyoos aquifers: origins

- Sand and gravel deposited by glacial activity in the last ice age



## Osoyoos aquifer map

- IIA classification: moderate development, high vulnerability
- Transboundary aquifer; hydraulic link to transboundary lake

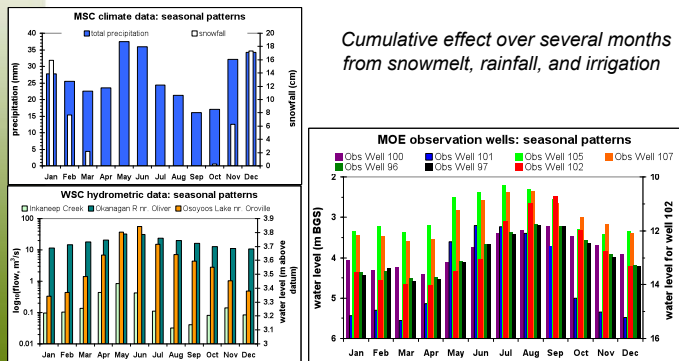


## Knowledge sources

- **Routine ~ongoing monitoring**
  - BC Ministry of Environment well networks
  - Environment Canada well network
  - Measure water level & water chemistry → long-term databases
- **Project work**
  - Government
  - University Research
  - Private sector (consultants)
  - Focussed project scope: address a specific question
- **Work has focussed on area west/northwest of lake**

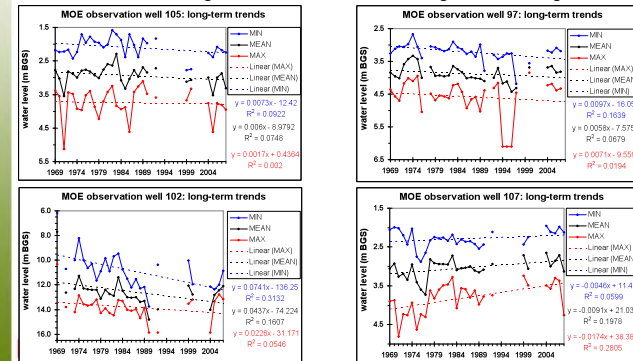
## Seasonal groundwater cycle

- Seasonal groundwater peak lags weather & surface water



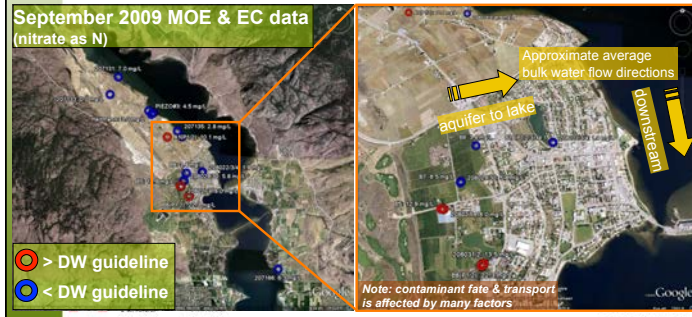
## Water level changes

- Negligible/mixed changes overall – but tendency for declines
- Subtle changes in climate/extraction/irrigation recharge?*



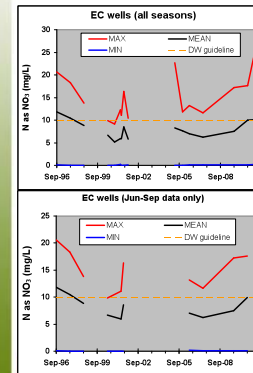
## Osoyoos aquifer water quality

- Main focus has been nitrate: elevated concentration over time
- Issue worldwide: usually, over-enthusiastic fertilizer use
- Varies across aquifer: ~0 to > 2x the 10 mg/L DW guideline

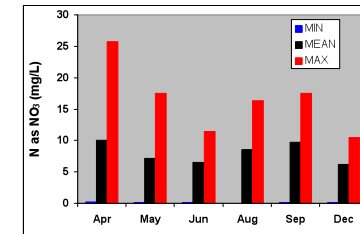


## Nitrate variation over time

- Preliminary assessment of EC network data:



*No strong & clear seasonal pattern or change over time, especially in light of sample size issues – but that doesn't mean such patterns don't exist*



## Nitrate correlations

- Do all wells vary in sync with each other?
- Mixed answer: some do, some don't, and some go opposite
- Suggests some complexity in nitrate dynamics

	A1(P1)	A1(P2)	B5	B9	B1A(P1)	B1A(P2)	B1A(P3)	B7(P1)	B7(P2)	B8(P1)	B8(P2)
A1(P1)	1										
A1(P2)	<b>0.59</b>	1									
B5	-0.20	-0.28	1								
B9	-0.39	0.23	-0.36	1							
B1A(P1)	0.36	-0.01	-0.10	-0.09	1						
B1A(P2)	0.13	-0.05	<b>-0.75</b>	0.25	<b>0.53</b>	1					
B1A(P3)	-0.24	-0.29	<b>0.55</b>	-0.14	-0.33	<b>-0.69</b>	1				
B7(P1)	0.15	<b>0.62</b>	-0.04	<b>0.61</b>	-0.12	-0.06	-0.15	1			
B7(P2)	0.24	<b>0.71</b>	-0.01	0.40	0.01	-0.04	-0.20	<b>0.93</b>	1		
B8(P1)	0.13	0.45	0.22	0.07	0.04	-0.37	0.25	<b>0.57</b>	<b>0.62</b>	1	
B8(P2)	0.12	0.37	0.15	-0.04	0.21	-0.24	0.07	0.44	<b>0.55</b>	<b>0.92</b>	1

blue:  $r > 0.5$  across different depths at a given location (concentrations at different depths tends to track each other over time)  
 red:  $r > 0.5$  across wells at different locations (concentrations at different locations tend to track each other over time)  
 red:  $r < -0.5$  across depths at a given location (concentrations tend to vary oppositely from each other at different depths)  
 brown:  $r < -0.5$  across wells at different locations (concentrations at different locations tend to vary oppositely from each other)  
 black:  $|r| < 0.5$  (little to no evidence that concentration variations over time track each other)

## Project work

- Project work also plays important role in improving knowledge
- Eg., U. Saskatchewan MSc: Panagiota Athanasopoulos (2009)
- Study drew inferences from abundances of different isotopes
- Some conclusions drawn:
  - Predominant N source: chemical fertilizer (not manure or septic)
  - Shallow GW: recharge is from irrigation return flow in irrigated areas - elsewhere, from local precipitation
  - Concentrations in agricultural tile-drain systems have declined

## Summary

- Groundwater is an important resource with strong ties to surface water quantity and quality
- Seasonal groundwater level pattern has average peak in mid-to late-summer, lagged behind weather and surface water
- Some weak tendency toward groundwater level declines over time
- Osoyoos West Aquifer nitrate concentrations: locally elevated
- Implications: local GW users/lake water quality/transboundary
- Some evidence that chemical fertilizer is predominant source
- Nitrate concentrations vary across the aquifer
- Also vary over time – but statistically meaningful patterns might not be reliably identifiable in available data

## Knowledge gaps

- Detailed shallow groundwater flow patterns and surface water-groundwater interactions, including GW seepage rates and nitrate loadings to Osoyoos Lake
- Mountain recharge & deep/bedrock groundwater flow patterns
- Groundwater level and chemistry conditions and trends on the east side of Osoyoos Lake
- Occurrence of other potential groundwater contaminants
- Past lapses in field sampling: contribute to uncertainties in trends/patterns in water levels and, in particular, nitrate concentrations

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- BCMoE and BCMFLNRO (Penticton office) are valuable additional sources of groundwater information in the area and contributed some of the data used in this presentation