

# Characterizing drought: groundwater, wetlands and lakes

*Garth van der Kamp and many others*

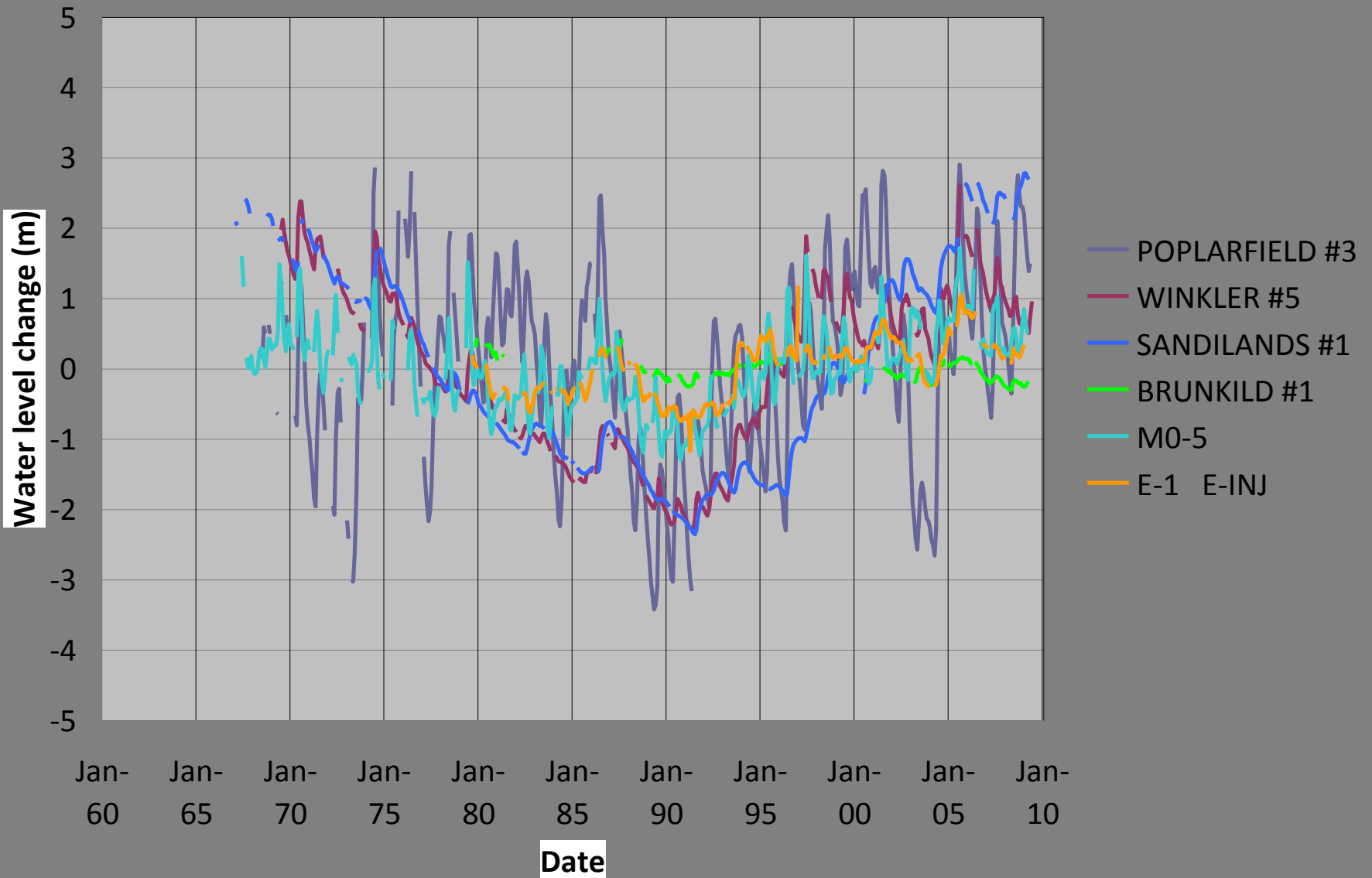


**Masaki Hayashi, Harm  
Maathuis, Randy Schmidt, S  
Marin,**





# Shallow observation wells in MB – water level changes 1967-2009

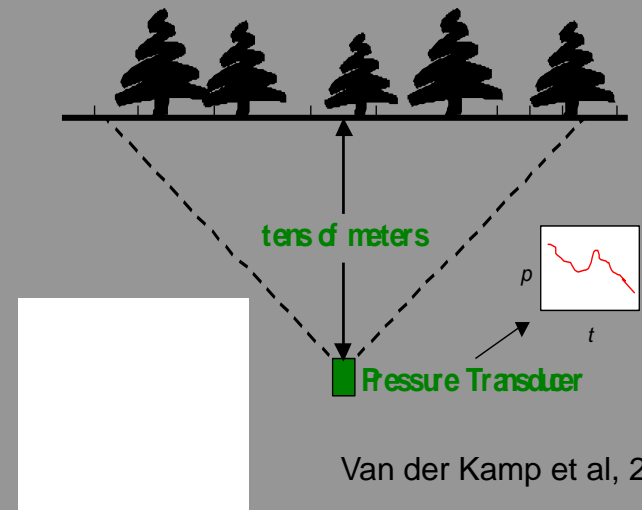


# Overview of the Geological Weighing Lysimeter Instrumentation

## ► Fundamentals

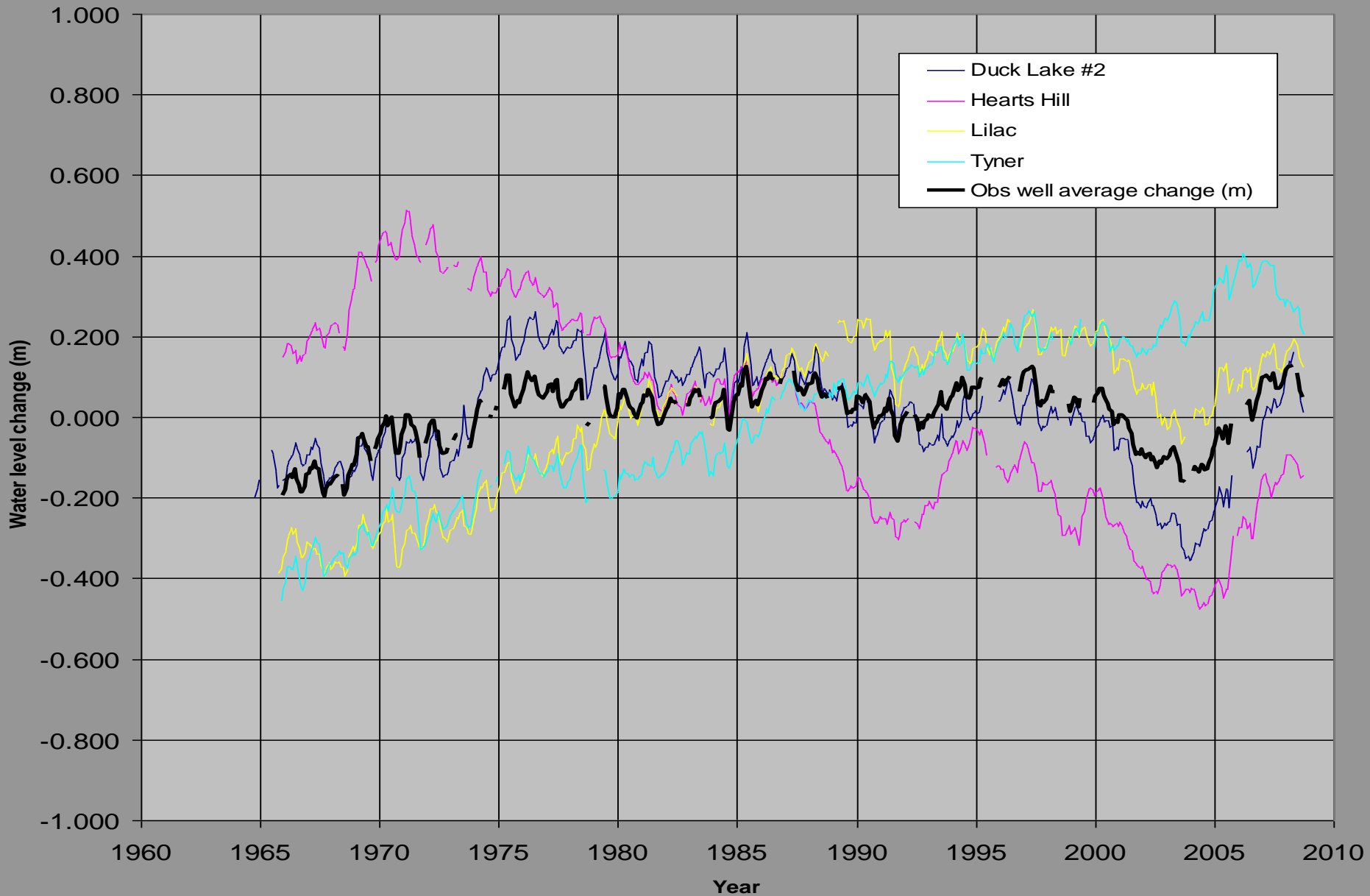
- Change of mechanical surface loading is instantaneously transmitted to deep saturated formations resulting in change of pore water pressure;
- Observation wells in confined aquifers can therefore detect pore pressure changes due to hydrological processes such as:
  - ✓ Snow accumulation;
  - ✓ Rainfall;
  - ✓ Evapotranspiration

### Conceptual Sketch of Geological Weighing Lysimeter Installation



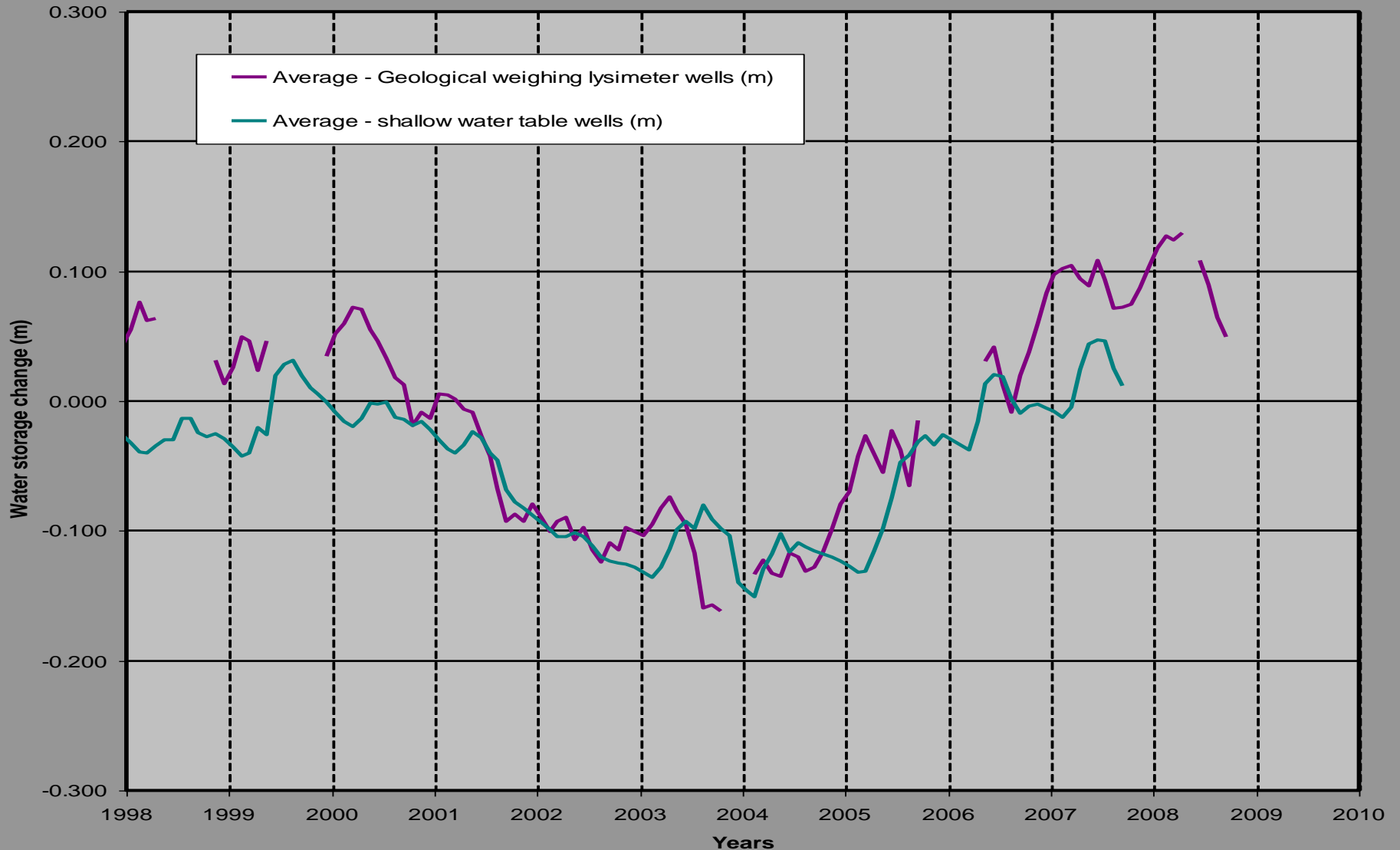
Van der Kamp et al, 2003

# Geological weighing lysimeter wells – southern Saskatchewan, 1965 - 2008



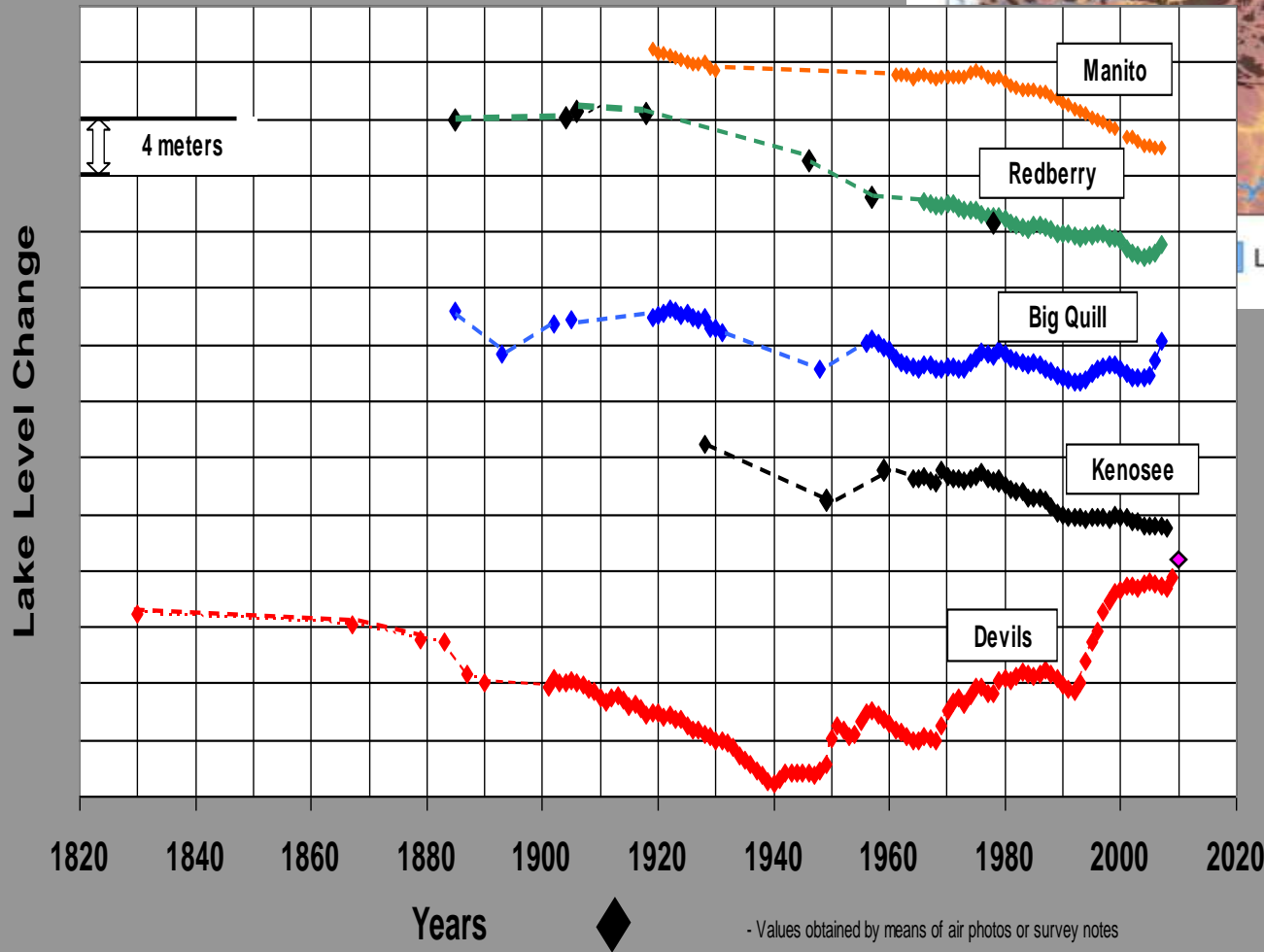
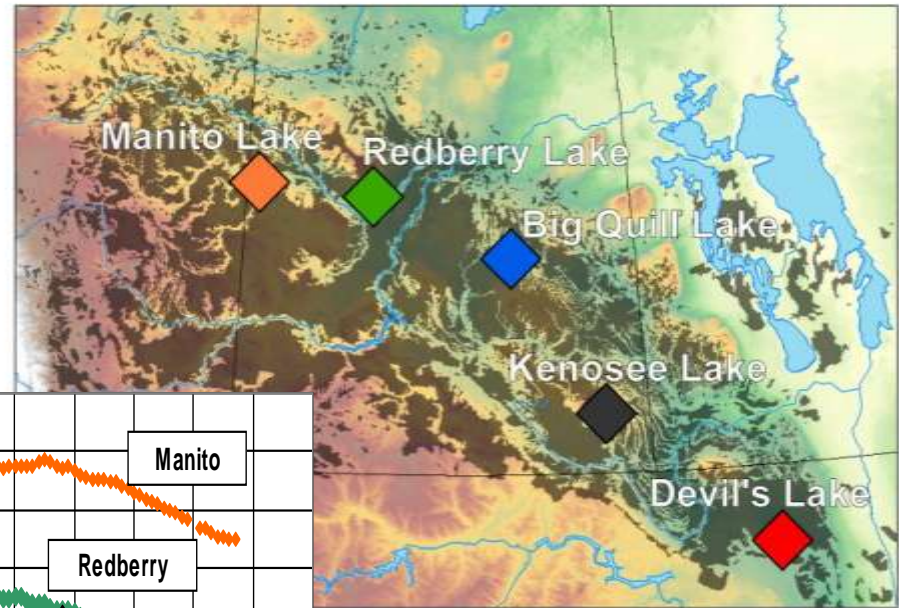
# Regional water storage changes in southern Saskatchewan, 1998 - 2008:

- Average of 4 Geological Weighing Lysimeter wells,
- Average of 9 water table wells in sand aquifers (assuming specific yield = 0.30).



# Prairie lakes 1820 – 2009:

The water levels in Canadian prairie lakes have been falling while nearby Devil's Lake (ND) is rising since 1940:



Lakes Non Contributing Drainage Areas  
Drainage Data from the Prairie Farm Rehabilitation Administration (PFRA)

*Century-long dry and wet periods have always occurred and are still occurring, (unpredictably) – e.g. Devils Lake and Red River flooding since mid-1990's*

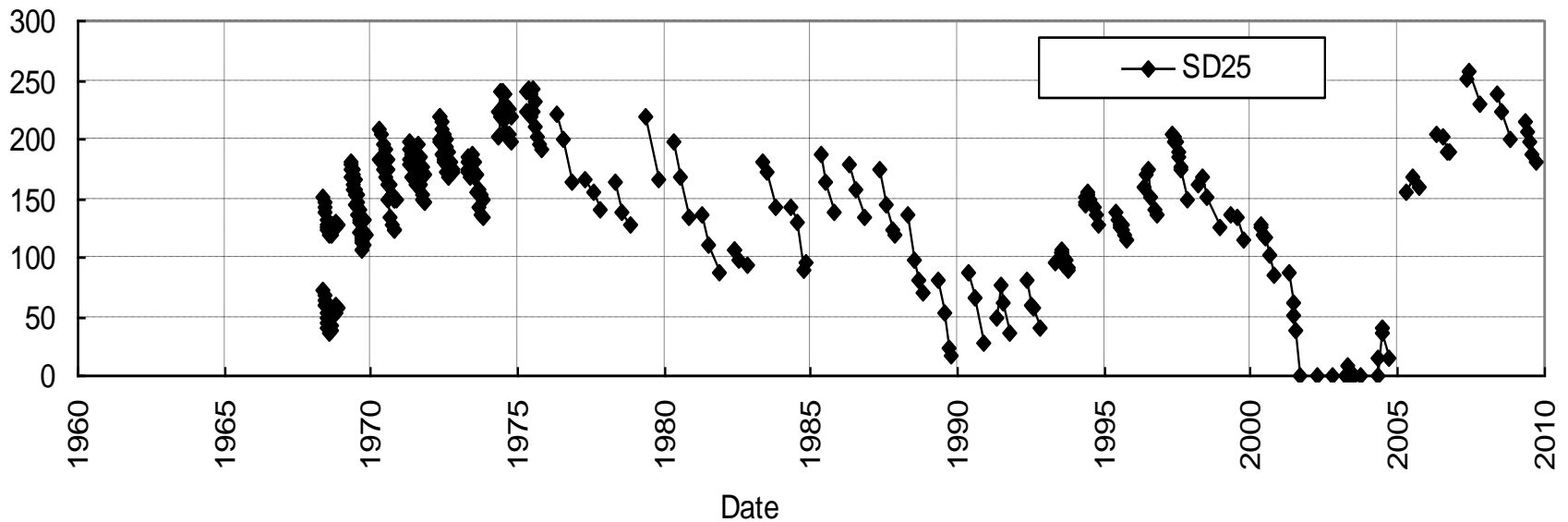
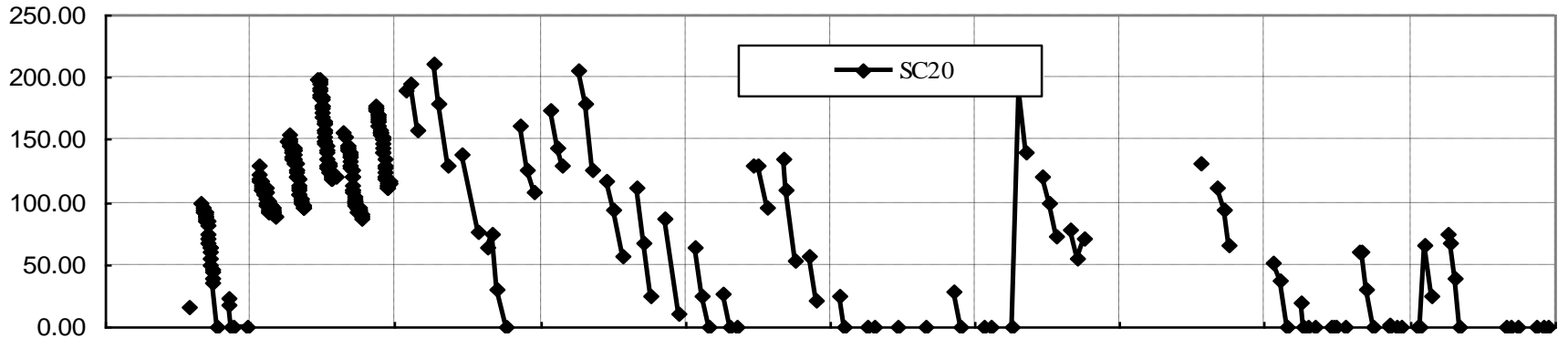
- Values obtained by means of air photos or survey notes



# Wetland water depths records for semi-permanent ponds:

Swift Current #20, 1962-2009

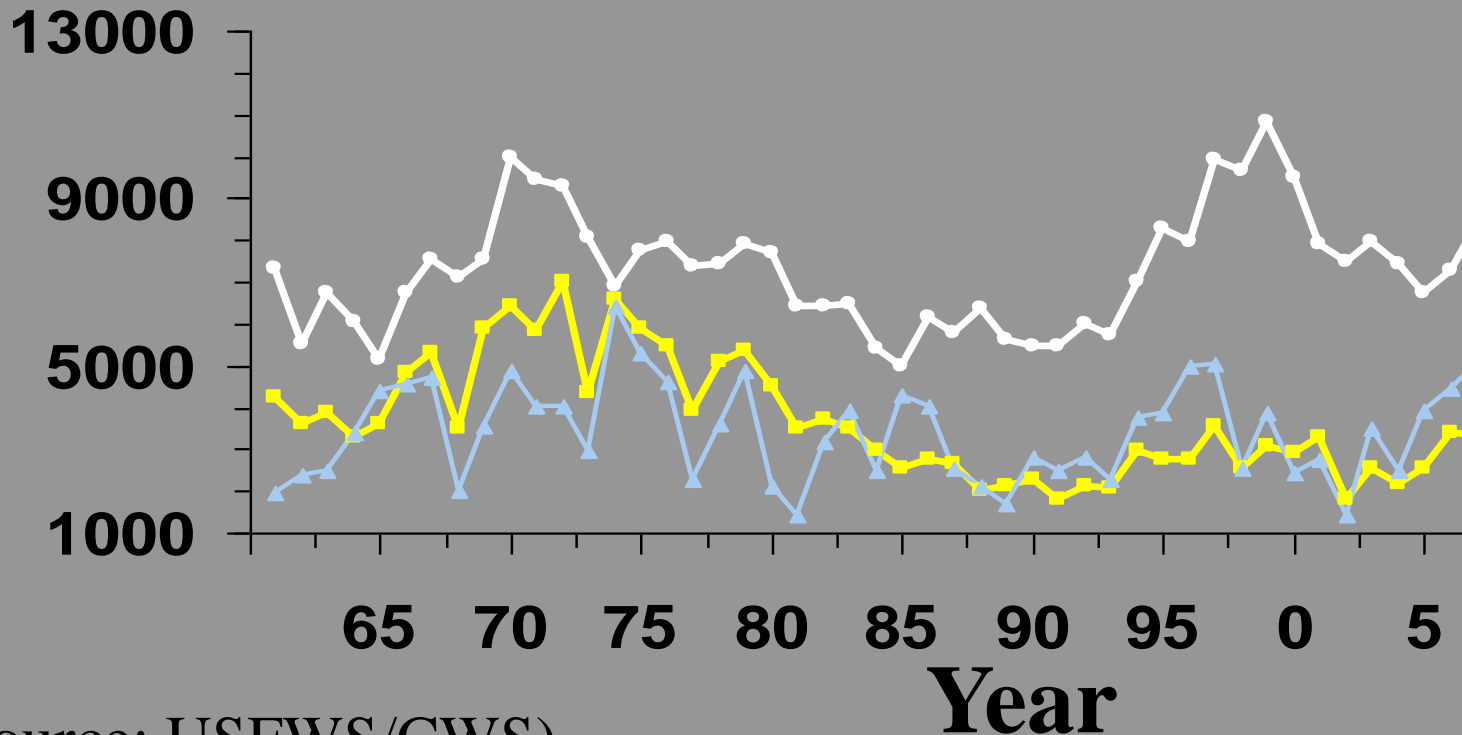
St Denis NWA # 25, 1968-2009



# Ducks/Ponds in Canadian prairie region (thousands)



—○— Mallard —■— Pintail —▲— Ponds (Cdn)



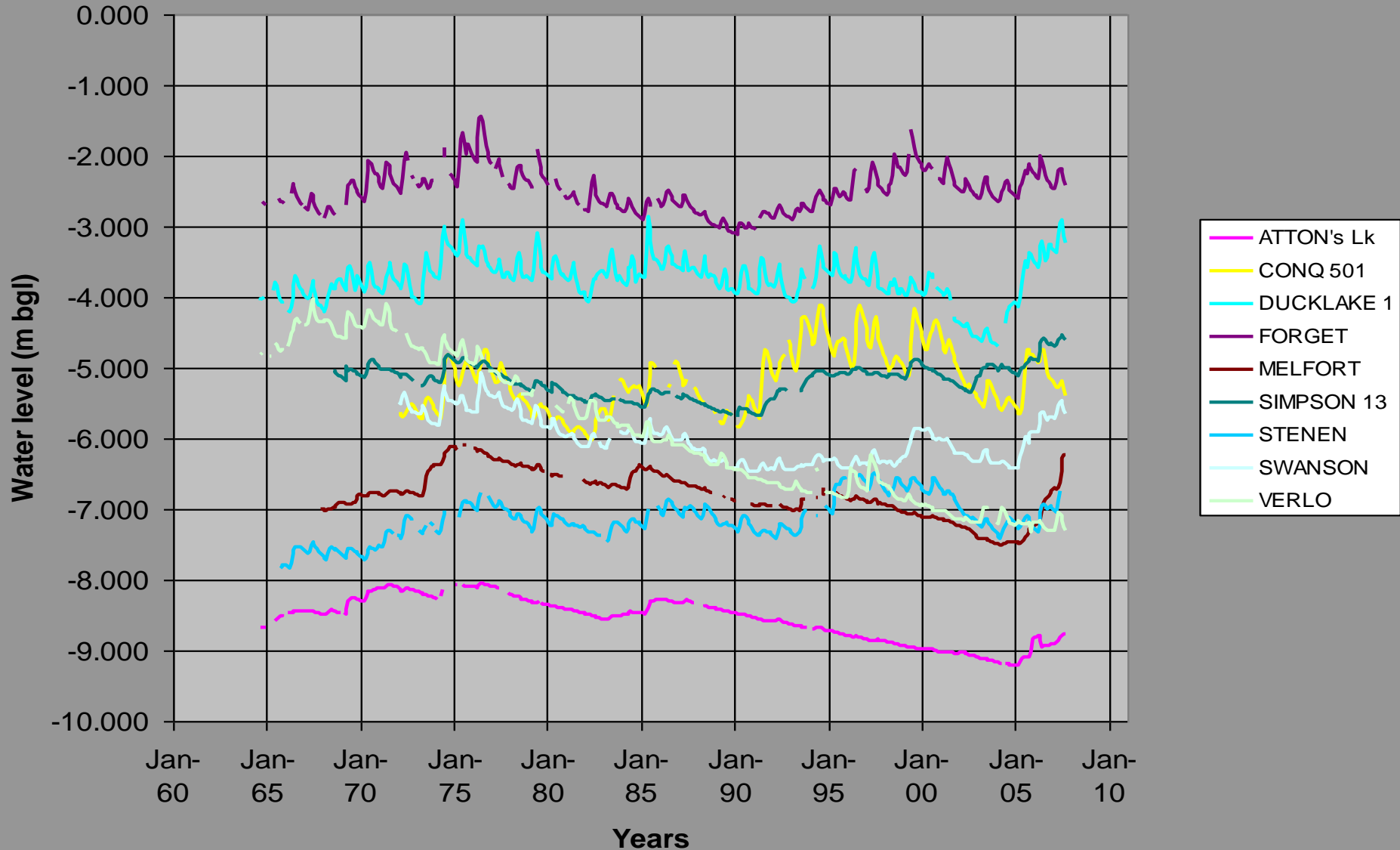
(Source: USFWS/CWS)

Thank you

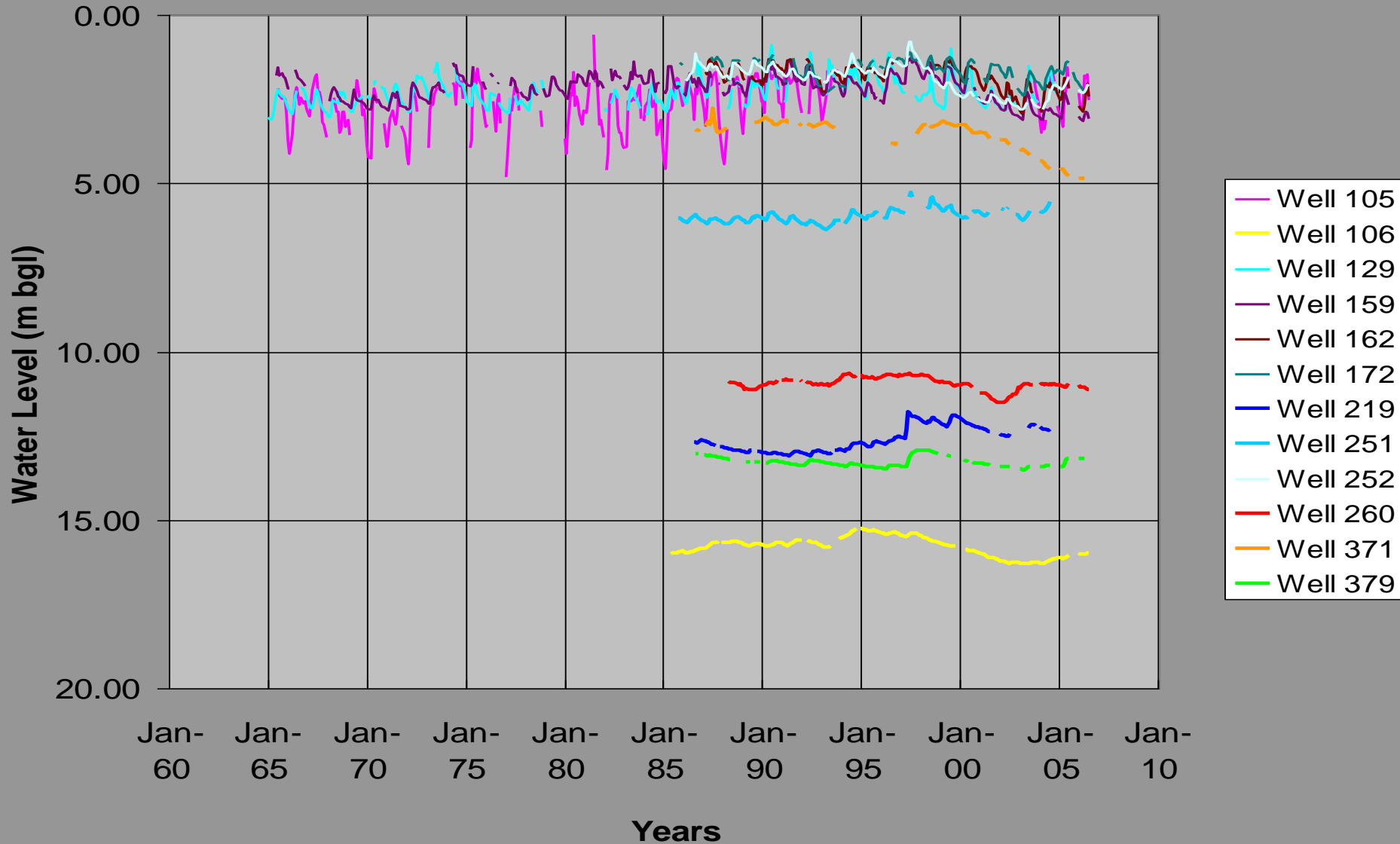


Pond # 90, St Denis NWA, October 2007

# Shallow observation wells in SK – water level records 1964-2007: water table depths below ground level (m)



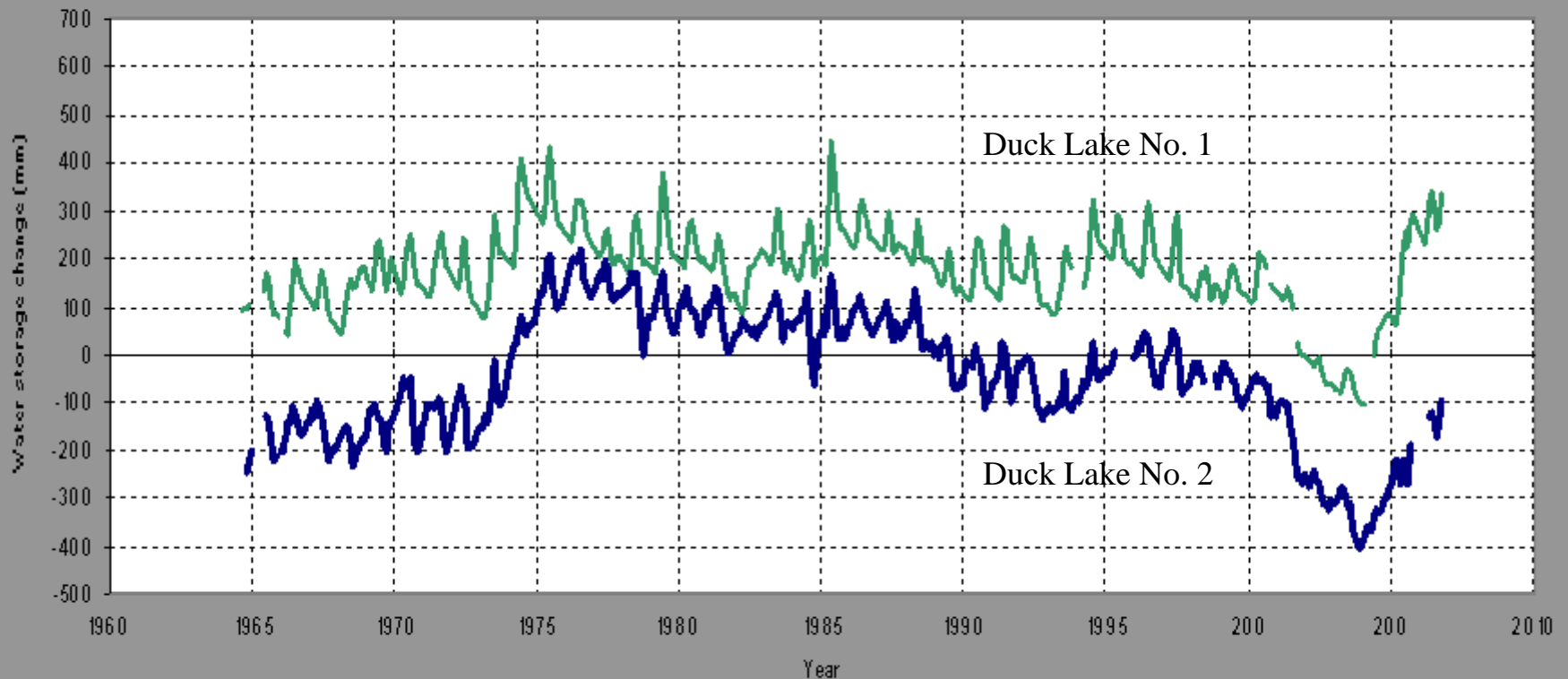
# Shallow observation wells in AB – water level records 1965-2006: water table depths below ground level (m)



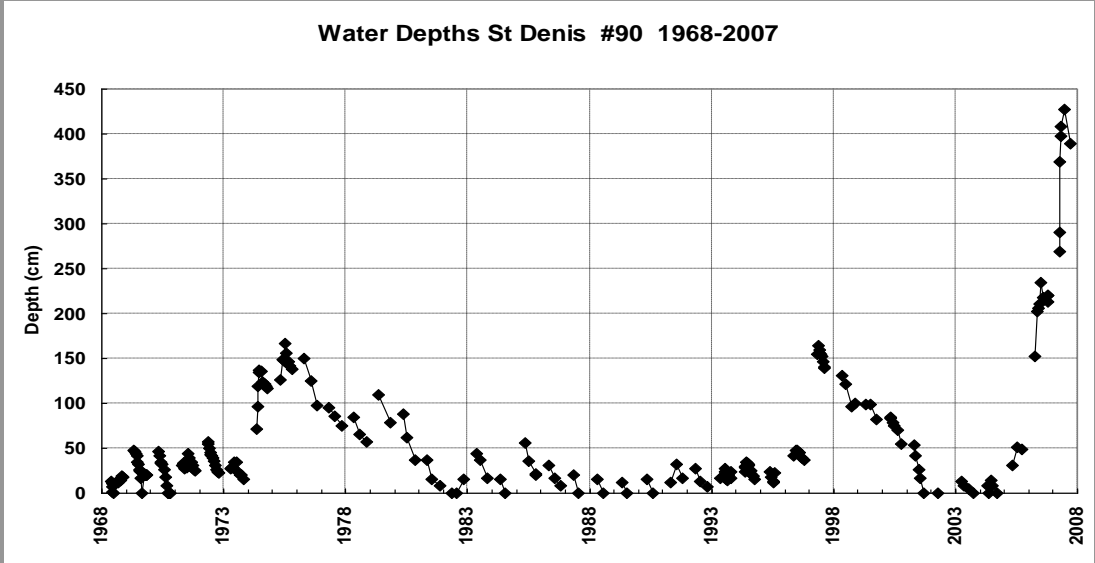
## Water storage changes observed for Duck Lake SK observation wells 1965-2007:

Duck Lake No. 1 – Shallow water table well with specific yield = 0.30

Duck Lake No. 2 – Deep well in confined aquifer (geological weighing lysimeter)



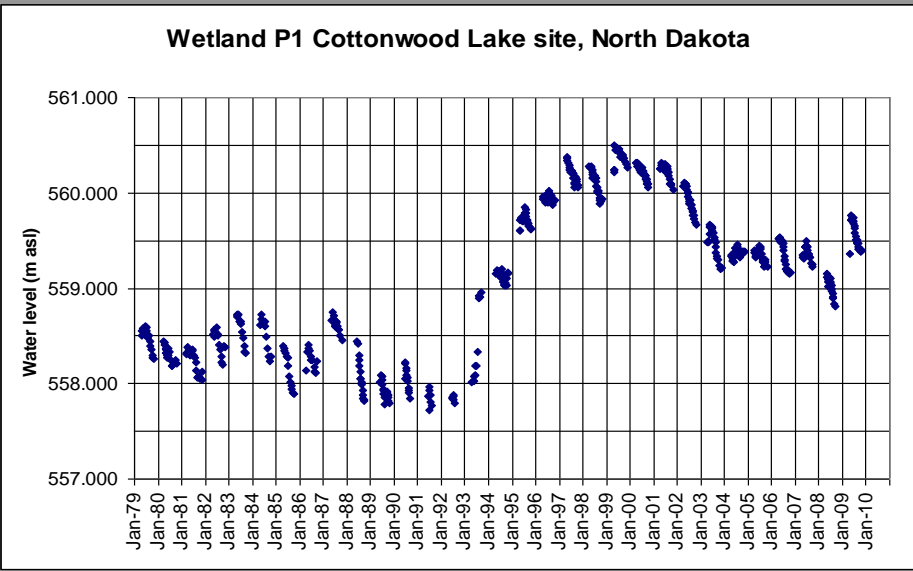
# Wetlands, land-use change and climate variability 1968-2007



St Denis NWA – no significant drainage, little land-use change

**Variability of precipitation is the key driver of wetland variability !**

St Denis NWA



The USGS Cottonwood County wetland research site, near Devils Lake. There has been no land-use change at this site.

North Dakota [USGS]

# Effective drainage areas –

## pond 90 St Denis:

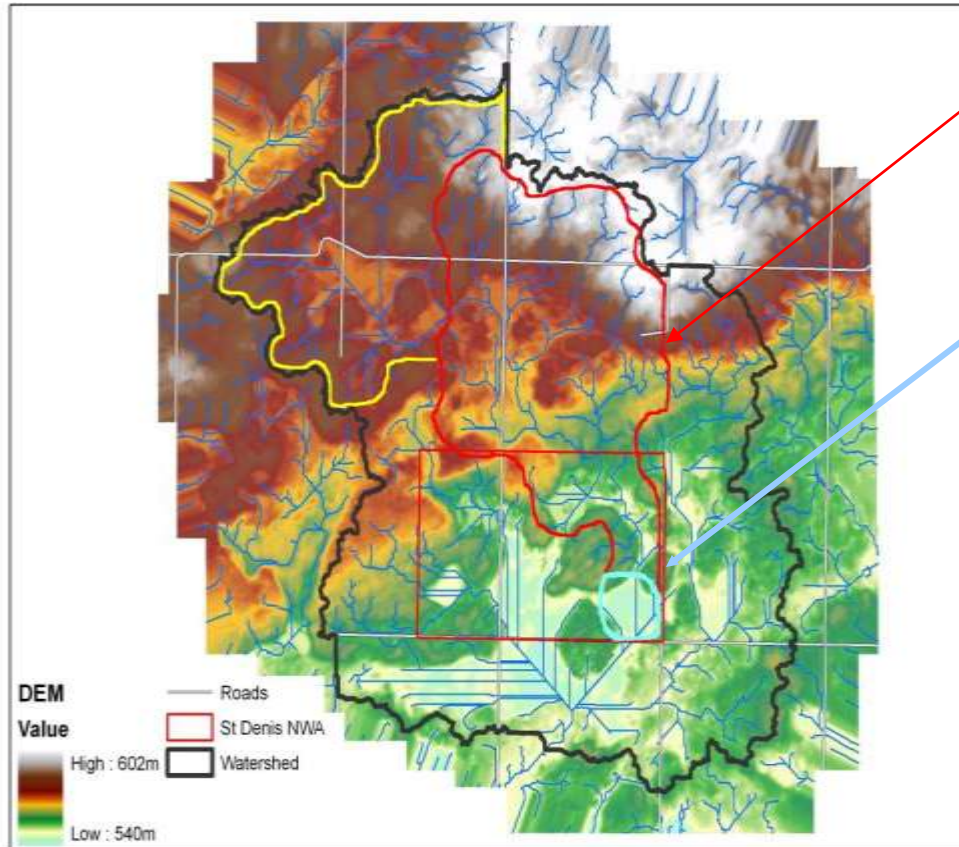
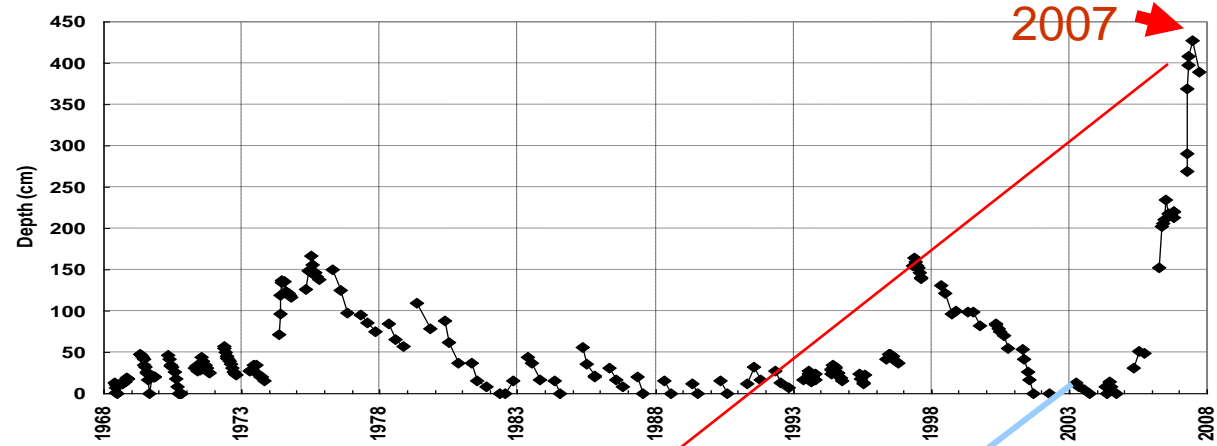
Blue – 2003

Red - 2007

Yellow + red: gross watershed

Black – gross watershed for St Denis NWA,

Water Depths St Denis #90 1968-2007



October 2007



## Wetlands and groundwater:

- The central ponds interact strongly with the riparian vegetation through shallow groundwater flow.
- Groundwater exchange with regional aquifers is very slow and has little effect on the wetland water balance

