GROUNDWATER CHARACTERISTICS

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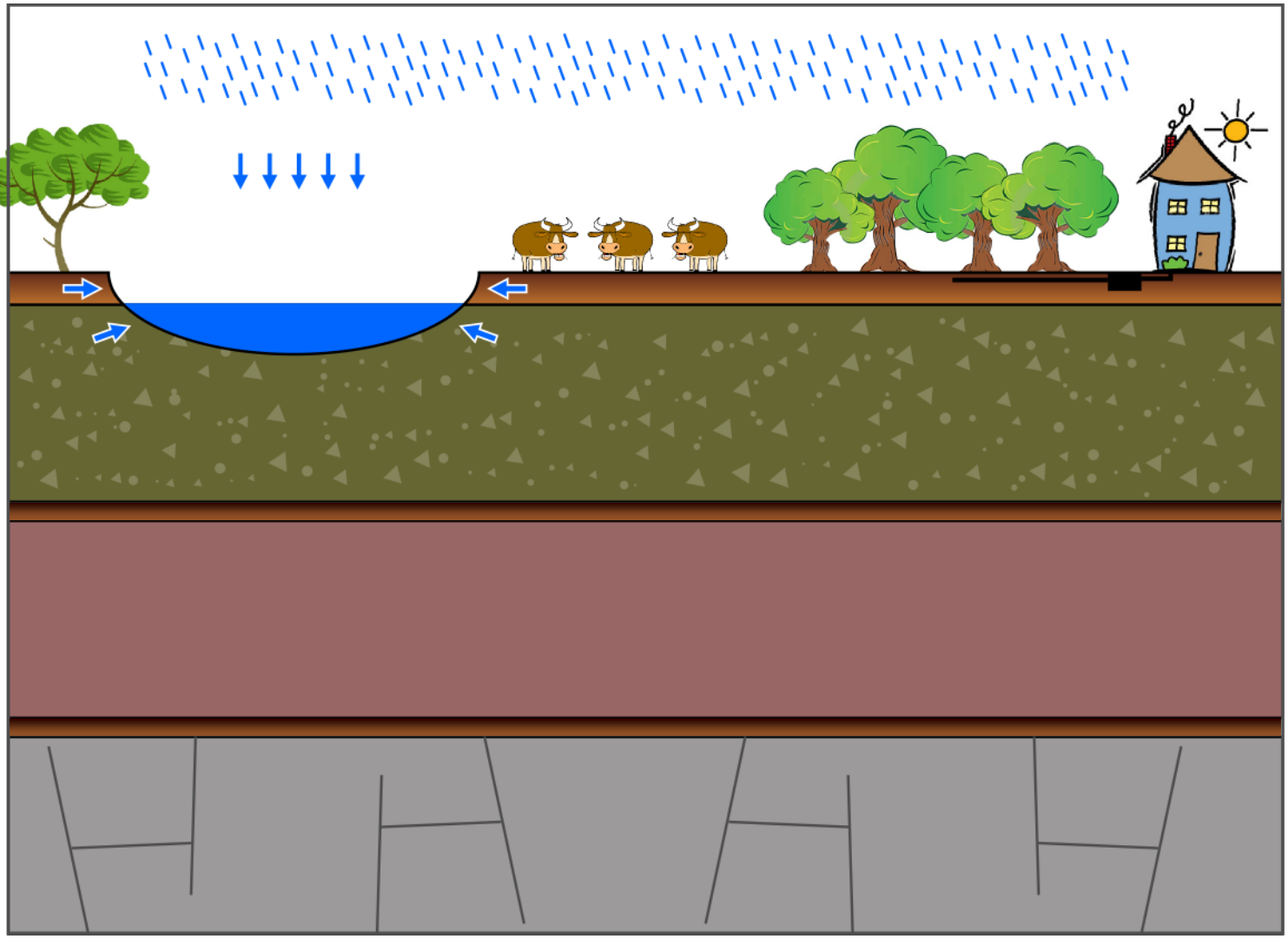


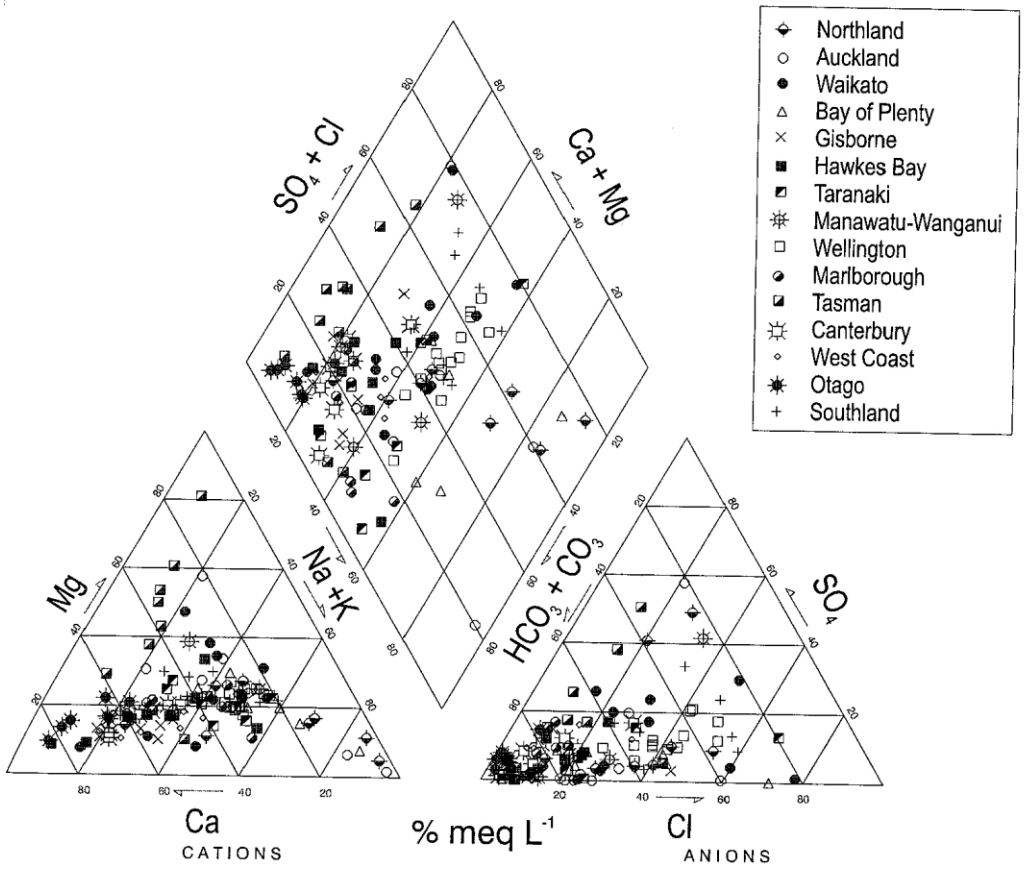
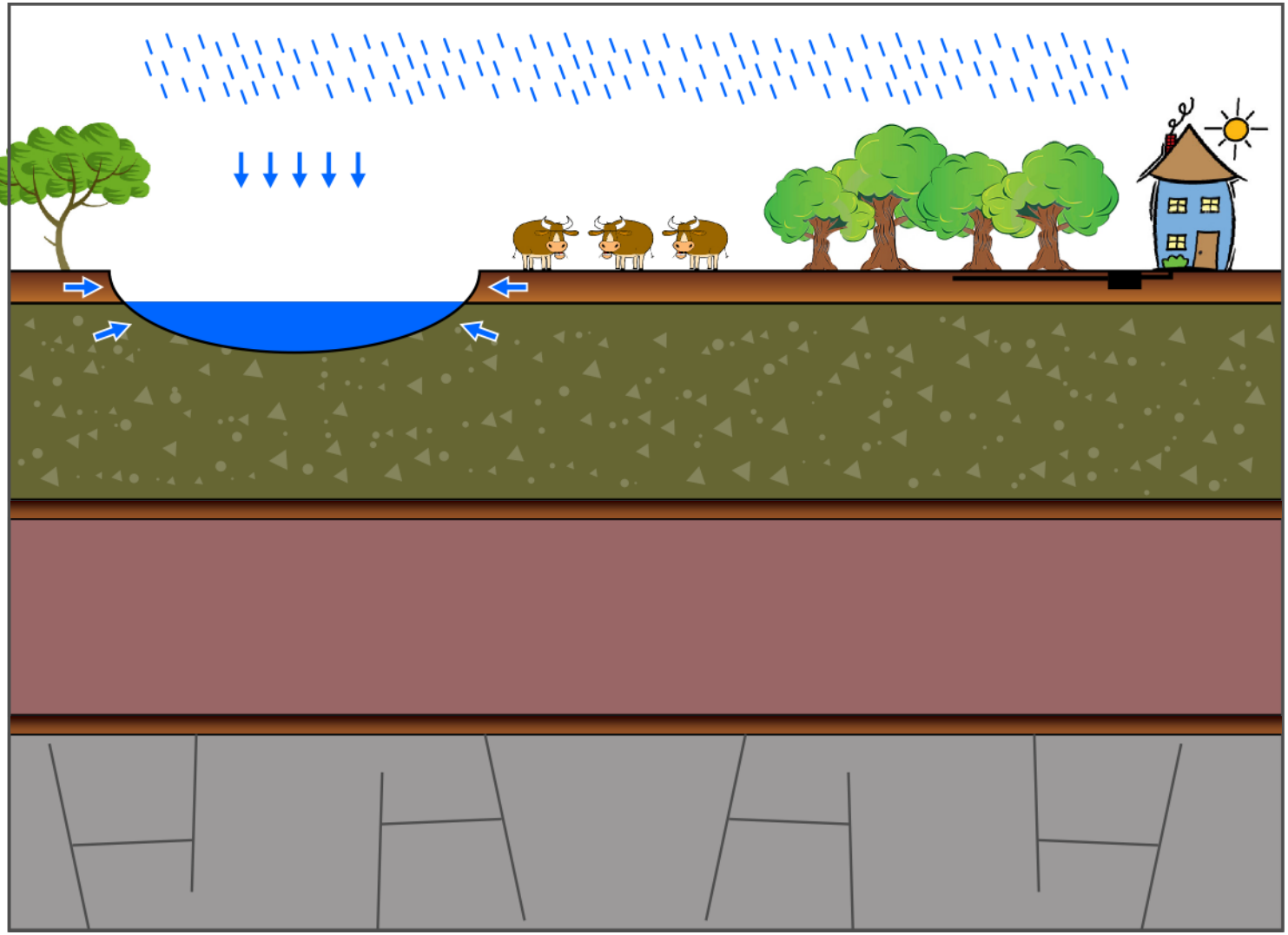


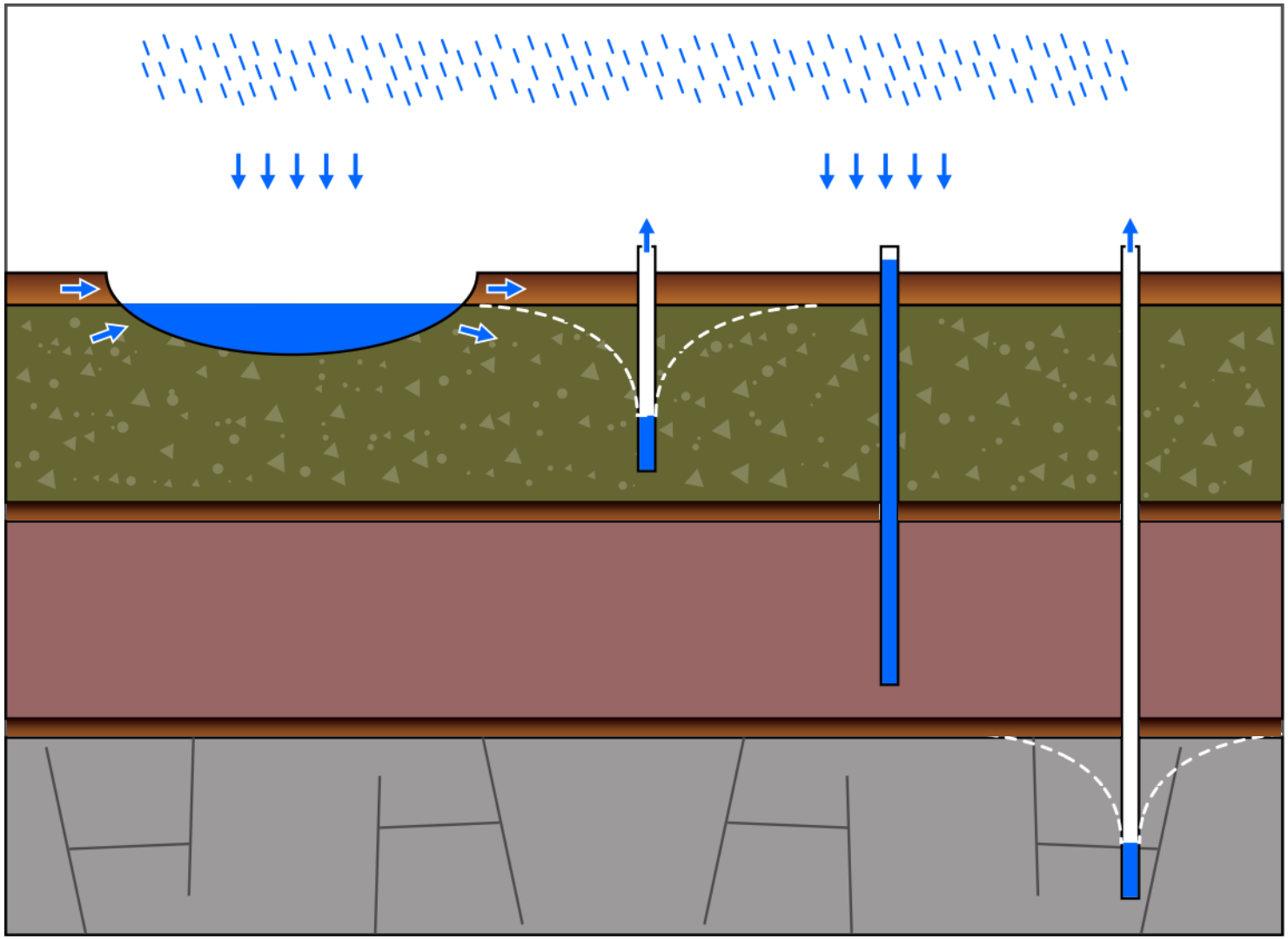
Figure 4.2 *Piper diagram of NGMP wells.*

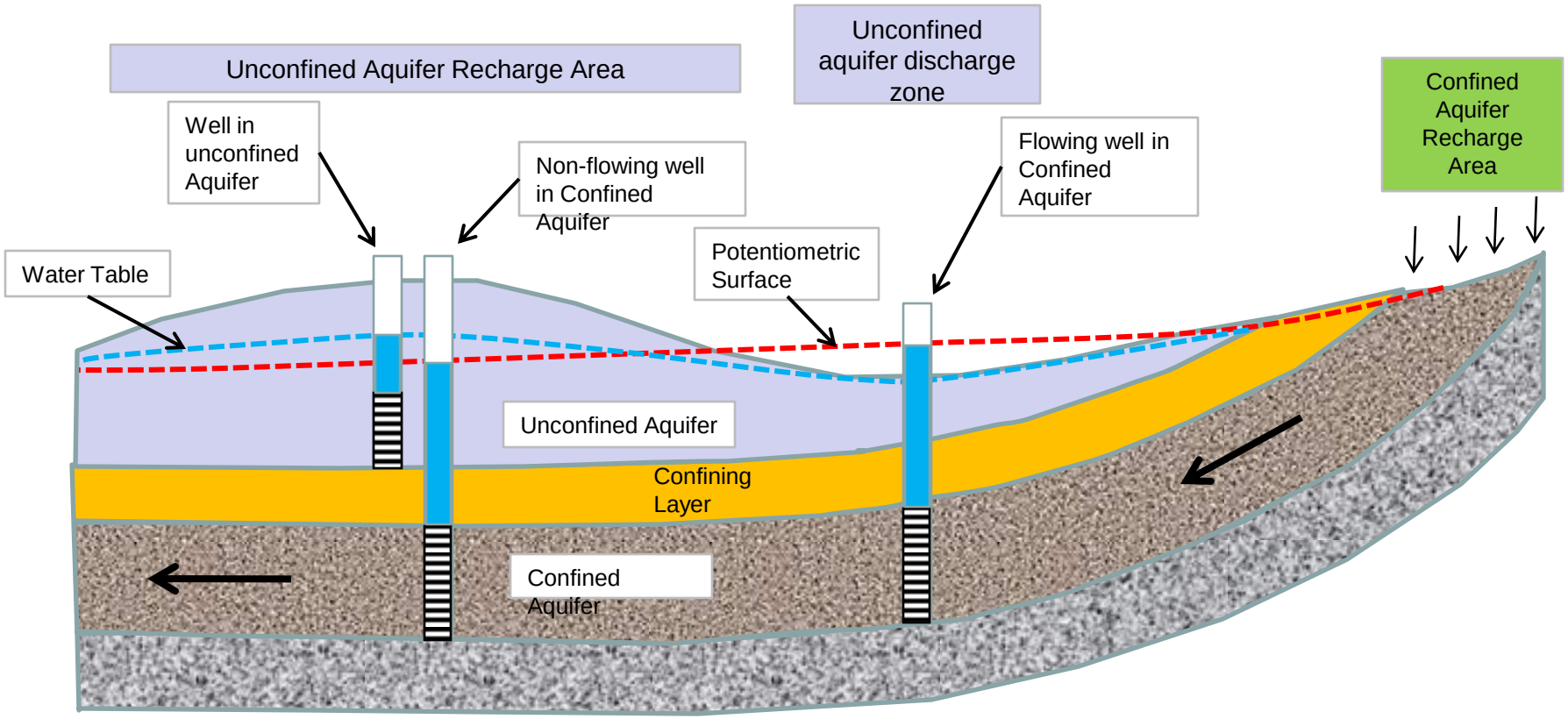
3 *Principal water types in NGMP wells. The number of wells of each type are in parentheses.*

Water type	No. of wells
$Na\text{-}Ca\text{-}HCO_3\text{-}Cl$ (6)	19
$Na\text{-}Ca\text{-}HCO_3$ (4)	
$Na\text{-}Ca\text{-}Mg\text{-}HCO_3\text{-}Cl$ (5)	
$Na\text{-}Ca\text{-}Mg\text{-}HCO_3$ (4)	
$Ca\text{-}Na\text{-}HCO_3$	15
Ca-HCO3	14
$Ca\text{-}Na\text{-}HCO_3\text{-}Cl$ (7)	14
$Ca\text{-}Na\text{-}Mg\text{-}HCO_3$ (7)	
$Na\text{-}Mg\text{-}Ca\text{-}HCO_3\text{-}Cl$	6
$Ca\text{-}Mg\text{-}HCO_3$ (3)	5
$Ca\text{-}Mg\text{-}Na\text{-}HCO_3$ (2)	
$Ca\text{-}Na\text{-}Mg\text{-}HCO_3\text{-}Cl$	3
$Na\text{-}HCO_3\text{-}Cl$	3
$Mg\text{-}Ca\text{-}HCO_3\text{-}SO_4$	2

Rosen et al: Groundwaters of New Zealand p85.






Unconfined Aquifer Recharge Area
Unconfined aquifer discharge zone
Confined Aquifer Recharge Area
Well in unconfined Aquifer
Non-flowing well in Confined Aquifer
Flowing well in Confined Aquifer
Water Table
Potentiometric Surface
Unconfined Aquifer
Confining Layer
Confined Aquifer

Groundwater Movement

If we assume a reasonably permeable unconfined aquifer of sand and gravels it will have an hydraulic conductivity of approximately	**10 m/d**.
The cross-sectional area of groundwater flow could be 100 m width x 5 m thickness =	**500 m^2**
The hydraulic gradient, measured between the two monitoring wells 1km apart with water levels at 22m and 20m respectively is (22-20)/1000, or	**0.002**
Flow from Darcy's Law would be 10m/d x 500m^2 x 0.002 =	**10 m^3/d**
If we assume a porosity of 0.3 for the sandy gravel then the water stored in the aquifer between the two wells would be 500 m^2x 1000m x 0.3 =	**150,000m^3**
The time for groundwater to move 1000 m from the well at 22m to the well at 20 m would be **15,000 days** or approximately	**41 years**.

Martha Mine Groundwater

After 20 years of pumping, groundwater level has been pumped down some 220 m from standing water level
The groundwater level in the mines is at an elevation of some 120 m below sea level
Water from the mines is mineralised and is treated to a high standard at a cost of approximately $1,000,000 /year before discharge to surface water.
Discharge of treated groundwater to surface water is beneficial during low stream flow periods.
• There is no effect on shallow groundwater from the deep dewatering
• There is no effect on plant growth from the deep dewatering.
• There are no effects on the production from other wells in the area.
• There is no effect on stream ecology from the treated discharge.
• On completion of mining groundwater levels will recover.
• There will be no long term effects on groundwater levels.

Conclusions

Groundwater is different from surface water and needs to be considered and managed in a different manner to surface water.