Security classification: Public | March 2017

Groundwater dependent ecosystem pictorial conceptual model 'BlueBottle Spring'

Version 1.5

BlueBottle Spring

BlueBottle Spring is a permanent bauxite spring in Weipa Plateau supported by an aquifer overlying, but separate to, the Great Artesian Basin. Weipa Plateau is a remnant of the extensive, deeply weathered western coastal plains of Cape York Peninsula (Winders 2009). This plateau is an estimated 50 km wide with slight elevation of up to 15 m near the coast, rising to 70 m in the east (Winders 2009). The gently rolling hills of the plateau are dissected by discontinuous drainage and deep incisions that have been carved out by major rivers such as the Archer and Wenlock Rivers (Taylor et al. 2008; Fell 2009; Winders 2009).

Based on information collected during a drilling program conducted by Winders (2010), the following sequence of geological layers near BlueBottle Spring is consistent with the broader geological profile of the Weipa Plateau (Eggleton et al. 2008, Jell 2009, Willmott 2009).

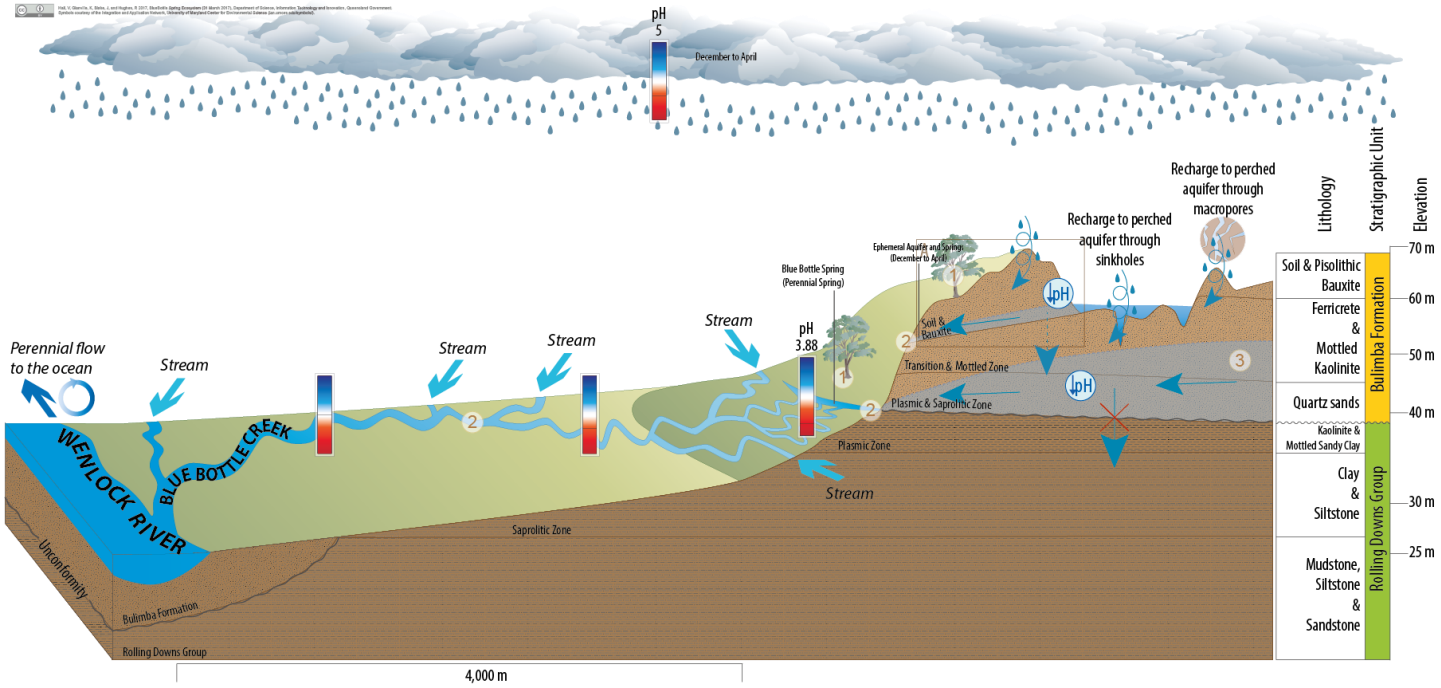
1. Soil – red and yellow kandosols (Eggleton et. al. 2008) mixed with bauxite pisoliths (i.e. small round bauxite pebbles).
2. Bauxite – a bauxite layer occurs directly below the soil layer and is characterised by pisoliths.
3. Ferricrete – a ferricrete layer, containing cemented iron-oxide and some pisoliths, occurs immediately below the bauxite.
4. Mottled Zone – a mottled zone consisting of iron-oxide and kaolinite occurs directly below the ferricrete layer.
5. Plasmic Zone (a) – a pallid or bleached zone of sandy clay consisting of an upper clay (kaolinite) and fine quartz sand unit underlain by a quartz, coarse sand to pebbly conglomerate with varying amounts of kaolinite.
6. Plasmic Zone (b) – a pallid or bleached zone of well-compacted clay (kaolinite).

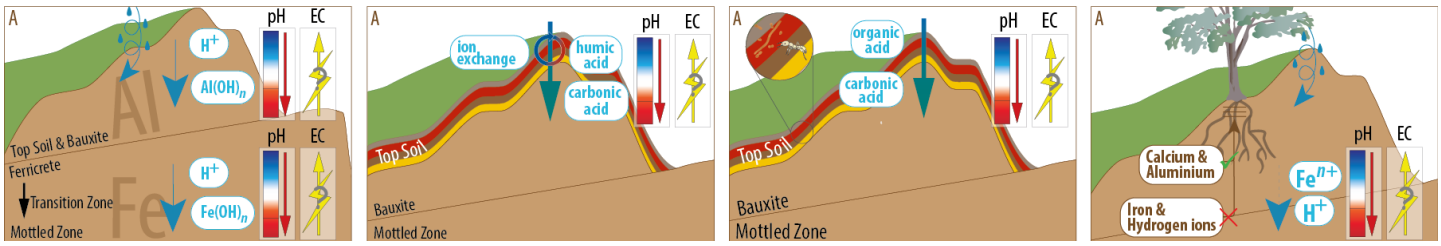
Groundwater discharge can occur where a permeable geological layer (e.g. Bulimba Formation) overlies a less permeable layer (e.g. Rolling Downs Group). At this site plasmic zone (b) is composed of well-compacted clay that acts to slow or prevent vertical groundwater flow. Given sufficient rainfall and recharge, this can result in groundwater accumulating above the clay and flowing laterally until it is discharged to the surface (e.g. BlueBottle Spring). In addition, groundwater may accumulate on less permeable kaolinite in other geological layers (e.g. mottled zone) and flow laterally until it is discharged to the surface or able to continue vertical movement.

BlueBottle Spring occurs in a continuous 650- metre arc at approximately 50 metre elevation near the contact between the Bulimba Formation and underlying the less permeable plasmic zone of the Rolling Downs Group. Groundwater emanating from BlueBottle Spring gradually coalesces into a number of small streams which join to form one stream (Blue Bottle Creek) approximately 400 metres down-gradient of the discharge location. Four kilometres downstream of BlueBottle Spring groundwater discharged from the spring enters the Wenlock River providing significant freshwater flow to the river during the dry season. Flow from Blue Bottle Spring to the Wenlock River remains strong well into the late dry season, except for the last kilometre where infiltration is likely to occur. While groundwater discharge from BlueBottle Spring remains strong each year, there is a slow, steady reduction in flow observed to occur each dry season indicating a local aquifer recharge source.

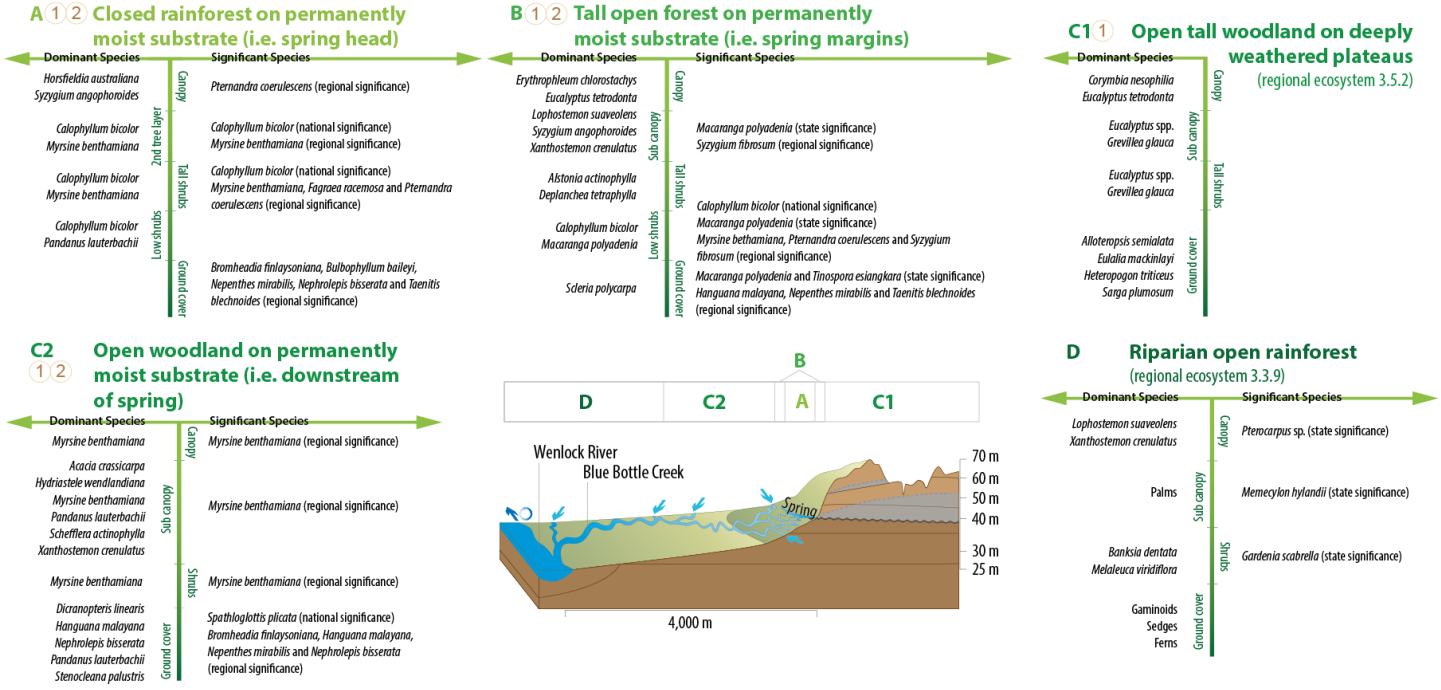
Lyon and Franklin (2009) have indicated that the water draining from the springs is acidic with an observed pH of 3.8 at the point of discharge and noted that the pH of the groundwater decreases with increasing distance from the spring. A number of factors have been identified that may contribute to spring acidity including rainfall acidity, chemical weathering, plant activity, decay of vegetation, termite activity, bacteria activity and fungi activity. Recent research supports the contribution of anerobic microbial degradation to groundwater chemistry (Leblanc et al. 2015). In addition, isotopic values at the spring suggest groundwater has meteoric origins, representing a mix of rainfall events (Leblanc et al. 2015).

Hydrogeology of BlueBottle Spring





Ecology of BlueBottle Spring



Amphibians

Regional significance:
Chirping Froglet (*Crinia deserticola*)
White lipped Tree Frog (*Litoria infrafrenata*)
Wood Frog (*Rana daemeli*)

Introduced:
Cane Toad (*Rhinella marinus*)

Birds

National significance:
Red Goshawk (*Erythrotriorhis radiatus*)
Rose Crowned Fruit Dove (*Ptilinopus regina*)
Wompoo Pigeon (*Ptilinopus magnificus*)

State significance:
Grey Goshawk (*Accipiter novaehollaniae*)
Marbled Frogmouth (*Podargus ocellatus*)
Palm Cockatoo (*Probosciger aterrimus*)
Red Goshawk (*Erythrotriorhis radiatus*)
Rose Crowned Fruit Dove (*Ptilinopus regina*)
Wompoo Pigeon (*Ptilinopus magnificus*)

Regional significance:
Brown Backed Honeyeater (*Ramsayornis modestus*)
Papuan Frogmouth (*Podargus papuensis*)
Pied Imperial Pigeon (*Ducula bicolor*)
Tawny Breasted Honeyeater (*Xanthostis flaviventer*)
Trumpet Manucode (*Manucodia keraudrenii*)
Varied Thriller (*Lalage leucomela*)
Yellow Billed Kingfisher (*Syma torotoro*)
Yellow Spotted Honeyeater (*Meliphaga notata*)

Fish

Fimbriate Gudgeon (*Oxyeleotris fimbriata*)
Lorentz Gudgeon (*Pingalla lorentzi*)
Northern Purple Spotted Gudgeon (*Mogurnda mogurnda*)
Spangled Perch (*Leiopotherapon unicolor*)
Spotted Blue-Eye (*Pseudomugil gertrudae*)

Regional significance:
Aru Gudgeon (*Oxyeleotris aruensis*)
Banded Rainbowfish (*Melanotaenia trifasciata*)
Black-banded Rainbowfish (*Melanotaenia nigrans*)
Poreless Gudgeon (*Oxyeleotris nullipora*)
Sailfin Glassfish (*Ambassis agrammus*)

Mammals

State significance:
Spotted Cuscus (*Spilocuscus maculatus*)

Regional significance:
Cape York Melomys (*Melomys capensis*)
Red Legged Pademelon (*Thylogale stigmatica*)

Introduced:
Feral Pig (*Sus scrofa*)

Reptiles

Regional significance:
Brown Headed Snake (*Furina tristis*)
Macfarlane's Skink (*Carlia macfarlani*)
Night Shiny Skink (*Glaphyromorphus nigricaudis*)
Northern Death Adder (*Acanthopis praelongis*)
Northern Tree Snake (*Dendrelaphis calligaster*)

Cyanobacteria sources of nitrogen

Scytonema sp.
Symplocastrum sp.

Red Beech or Golden Guinea (*Dillenia alata*) at BlueBottle Spring (Water Planning Ecology, Department of Science Information Technology and Innovation)

Spathoglottis sp. orchid in bloom at BlueBottle Spring (Water Planning Ecology, Department of Science Information Technology and Innovation)

Common Swamp pitcher Plant (*Nepenthes* sp.) at BlueBottle Spring (Water Planning Ecology, Department of Science Information Technology and Innovation)

Flora at BlueBottle Spring (Water Planning Ecology, Department of Science Information Technology and Innovation)

Geology legend

Moderate to high permeability rock
Stores and transmits groundwater through void spaces in the rock

Low permeability rock

Groundwater hydrology legend

Moderate to high permeability rock (unsaturated)

Moderate to high permeability rock (saturated)

Low permeability clay dominated rock (unsaturated)

Low permeability siltstone unsaturated)

Infiltration and percolation
Rain infiltrates through the soil to recharge the aquifer below

Groundwater table

Direction of groundwater movement

Negligible groundwater movement

Groundwater leakage

Groundwater dependent ecosystems legend

1 Terrestrial GDEs
Regional ecosystems and riverine wetlands may depend on the subsurface presence of groundwater within the capillary zone for some or all of their water requirements.

2 Surface expression GDEs
Lacustrine wetlands, palustrine wetlands and riverine water bodies may depend on the surface expression of groundwater for some or all of their water requirements.

3 Subterranean GDEs
Aquifer and cave subterranean wetlands may depend on the subterranean presence or expression of groundwater for some or all of their water requirements.

Citation

Queensland Government (2017) *Groundwater dependent ecosystem pictorial conceptual model ‘BlueBottle Spring’: version 1.5,* Queensland Government, Brisbane.

Content derived from work by Hall V, Glanville K, Blake J, and Hughes R (Department of Environment and Heritage Protection).

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