

6.3 Ground water

This section summarises the results of the groundwater assessment that was completed for the proposal. The detailed assessment is provided in Appendix J.

6.3.1 Methodology

The groundwater assessment adopted the following methodology:

- Review of available groundwater quality data, proposal geotechnical borehole data (Douglas Partners, 2019) and background information on catchment history and land use to define the existing environment
- Collation of registered bores from the NSW Department of Industry – Water Division groundwater database
- Collation of groundwater dependent ecosystems (GDE) from the National Atlas of Groundwater Dependant Ecosystems (Australian Bureau of Meteorology (BoM))
- Assessment of construction and operational impacts to groundwater users, groundwater quality and groundwater dependent ecosystems
- Provision of a consolidated list of measures to be applied during the construction and operational phase to mitigate potential impact to groundwater.

6.3.2 Existing environment

Regional and local hydrogeology

The hydrogeology of the Upper Hunter Valley is dominated by two aquifers: a superficial aquifer hosted by alluvial deposits of Quaternary age and a bedrock aquifer hosted by consolidated sedimentary rocks and coal measures of Permian age.

Within the proposal area the superficial alluvial aquifer is present mainly south of the Hunter River beneath low-lying areas at depths ranging from 5.3 metres to 12.8 metres below the surface. The aquifer comprises sandy gravel and gravel deposits ranging between 3.2 metres and 9.0 metres in thickness. The water table is between nine and 12.7 metres below ground surface. Groundwater quality is moderately alkaline with the groundwater pH ranging from 7.4 to 10.6 and has electrical conductivity levels of 480 to 1300 $\mu\text{S}/\text{cm}$.

Within the proposal area the weathered and/or fractured bedrock aquifer is present north of the Hunter River and comprises fractured, slightly to moderately weathered siltstone and claystone.

Groundwater users

There are nine registered bores/wells located within the proposal area which are all located south of the Hunter River. Three bores are licensed for town water use by Singleton Council. The remaining six bores are licensed for irrigation, stock and domestic uses.

There are three additional bores within the proposal area which are not licensed and have been abandoned and backfilled after being drilled.

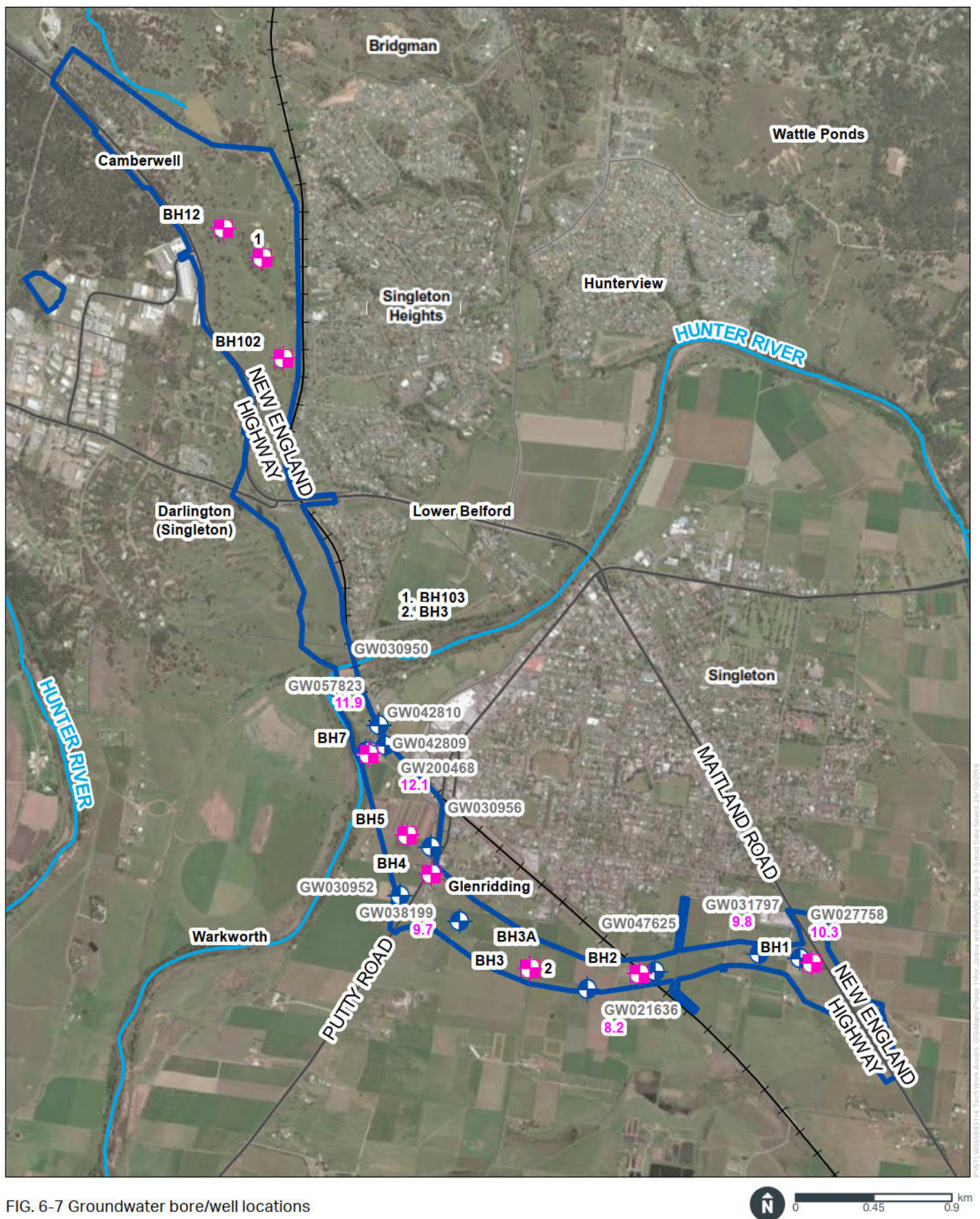
The location of groundwater bores is shown in Figure 6-7.

Groundwater dependant ecosystems

GDEs identified in the National Atlas of Groundwater Dependent Ecosystems that may be present within the proposal area include the following terrestrial GDEs:

- Hunter-Macleay dry sclerophyll forests
- Coastal swamp forests
- Eastern riverine forests.

No aquatic or subterranean GDEs have been identified in the proposal area.



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6.3.3 Potential impacts

Construction

Interaction with groundwater is anticipated during the construction of bridge piles and piers for the proposal at the following locations:

- Southern connection
- Bridge over the floodplain
- Putty Road northbound entry ramp
- Bridge over Rose Point floodway
- Hunter River.

The pile holes for the bridge over the Hunter River would intersect the superficial alluvial aquifer on the southern side of the river and weathered and fractured bedrock on the northern side of the river.

To minimise the potential of encountering groundwater, the pile holes would be installed by advancing steel casing into the ground as they are drilled. The steel casing will pass through one to two metres of gravel below the existing water table. Once the casing has been advanced to the bedrock, groundwater is generally not expected to be encountered.

While geotechnical investigations did not identify groundwater north of the Hunter River, deep excavations for the proposal at the McDougalls Hill (including around the northern connection) may intersect minor groundwater flows from the base of the weathered and fractured bedrock interval at 10 to 15 metres depth once it is exposed.

Groundwater users

Potential direct impacts to groundwater users are limited to three private groundwater bores used for irrigation. These bores may need to be relocated as they are within the impact area of the proposal. Potential impacts to other groundwater users are likely to be avoided.

No earthworks south of the Hunter River would extend to the water table and therefore dewatering and drawdown-related impacts to groundwater users are considered to be unlikely.

Groundwater quality

During construction there is a risk that groundwater could be contaminated during the construction program from activities including:

- Leaks or spills of fuels, oils and lubricating fluids used by construction machinery
- Seepage from spoil areas containing soils derived from below the water table (from excavated pile holes and deep excavations that expose fresh bedrock) that may contain unstable sulphide minerals.

Potential impacts associated with seepage are considered to be low. The proposal's risk to groundwater from acid sulphate soils is considered to be low given geotechnical investigations (Douglas Partners, 2019) identified that the water table is below the planned depth of excavation within the proposal area. Activities that may disturb materials potentially containing unstable sulphide minerals are limited to pile holes for the bridge over the floodplain and bridge across and south of the Hunter River, and excavations at McDougalls Hill.

Groundwater dependant ecosystems

There is the potential for GDEs to be impacted by the construction of the proposal at the bridge across the Hunter River due to pile construction and for the excavations at McDougalls Hill.

The Hunter River GDE is not expected to be disturbed by installation of the bridge's pile foundations. Each pile hole would be cased-off with steel piping to avoid the need to dewater the superficial alluvial aquifer that supports nearby GDEs. The aquifer has a high level of permeability (ie groundwater can easily flow through the aquifer) and therefore any minor inflows to the pile holes are unlikely to result in a measurable change to the water table.

Potential impacts to nearby GDEs located west of the excavations at McDougalls Hill to the west of the New England Highway outside of the proposal area is not expected because:

- The GDEs are up gradient and therefore the excavations would not affect the amount of groundwater recharging the local water table aquifer where the GDEs are located
- The minor amounts of groundwater that may be drained during excavations would not result in an area of groundwater drawdown that would extend to these GDEs.

Operation

Groundwater users

Minor changes to groundwater flows due to the presence of operational infrastructure for the proposal would be quickly balanced within the local groundwater system due to the high permeability of the aquifer south of the Hunter River. The operation of the proposal would not result in substantial changes to the recharge of groundwater within the proposal area and therefore no ongoing impact to groundwater users is anticipated.

Groundwater quality

There is the potential for groundwater to be contaminated in the event of an accidental spill on the road surface that is not managed and is conveyed to the groundwater system. The proposal includes the provisions for two spill containment basins north and south of the Hunter River, with a minimum volume of 25,000 Litres, to contain flows for treatment. In other areas sufficient storage is provided in the road catchment and drainage system to allow for the spill to be contained and treated through normal emergency response procedures.

Groundwater dependant ecosystems

The area of the pile foundations would be very small relative to the extent of the aquifer that supports the GDEs at the bridge over the Hunter River. Changes to groundwater flows and potential impacts to GDEs for the operation of the proposal in this area would therefore be negligible.

In the event that groundwater is intercepted during excavations at McDougalls Hill, the GDEs located west of the New England Highway are not anticipated to be impacted during operation of the proposal by the ongoing interception of groundwater flows due to the low permeability of this aquifer.

6.3.4 Safeguards and management measures

Mitigation measures provided in Section 6.2.4 would be implemented to minimise potential impacts to water quality.