New England Highway bypass of Muswellbrook

Chapter 6.3 Groundwater

Transport for NSW | October 2021

6.3 Groundwater

A Surface and Groundwater Assessment was prepared by AECOM (2021) for the proposal (refer to Appendix I).

6.3.1 Methodology

The groundwater assessment adopted the following methodology:

- Review of the legislative context within which the proposal lies and relevant guidelines
- Define the area that influences the groundwater environment
- Collate registered bores from the NSW Department of Industry – Water Division groundwater database
- Identify GDEs from the National Atlas of GDEs (Australian Bureau of Meteorology (BoM))
- Define the area that influences both the surface and groundwater environments
- Assess construction and operational impacts to groundwater users, groundwater quality and GDEs
- Provide a consolidated list of measures to be applied during the construction and operational phase to mitigate potential impact to groundwater.

Study area

For the purpose of the groundwater assessment, the study area included a 500 metre buffer around the construction footprint, to allow for the evaluation of groundwater related influences directly and indirectly related to the proposal.

6.3.2 Existing environment

Regional and local hydrogeology

The hydrogeology of the Upper Hunter Valley is dominated by two regional aquifers:

- An unconfined superficial aquifer hosted by alluvial deposits of Quaternary age
- A bedrock aquifer hosted by consolidated sedimentary rocks and coal measures of Permian age.

The unconfined superficial aquifer is highly permeable and is comprised of sandy gravel and gravel deposits ranging between three metres and nine metres in thickness. Groundwater is found between 4.3 metres and 15.0 metres below ground surface. Water quality is fresh to brackish. It is recharged predominantly through percolated rainwater through unsaturated soils and discharges to the Hunter River (and tributaries) as baseflow.

The bedrock aquifer is comprised of fractured, slightly to moderately weathered siltstone and sandstone. This aquifer is recharged regionally and directly by rainfall infiltration through fractures and weathered outcrops. Water quality is brackish to saline.

The unconfined superficial aquifer is present in low-lying areas along the northern sections of the study area (i.e. Hunter River floodplain) and along Muscle Creek. The bedrock aquifer is predominantly found in the central high lying portion of the study area.

Registered groundwater bores

The WaterNSW website identified 20 registered groundwater extraction bores within the study area, with three being located within the construction footprint. Of the registered extraction bores within the construction footprint, two are licensed for commercial and industrial purposes and three are licensed for irrigation purposes. Final installed depths of groundwater bores ranged between 6.7 metres to 24.0 metres.

Groundwater users within the study area use the unconfined superficial aquifer for agricultural, stock and domestic purposes. As mentioned above, water quality in this aquifer is generally fresh to brackish making it potable or suitable for stock watering purposes.

Groundwater dependent ecosystems

The dependence (or interaction) of vegetation communities identified within the construction footprint, on groundwater is determined by aligning them with the GDE types identified in Section 6.1.2. Two GDEs, PCT 42 River Red Gum / River oak riparian woodland wetland in the Hunter Valley and PCT 485 River oak riparian grassy tall woodland of the western Hunter Valley (Brigalow Belt South Bioregion and Sydney Basin Bioregion), are highly likely to be GDEs reliant on surface expressions of groundwater or on subsurface groundwater. PCT 1693 Yellow Box – Rough-barked Apple grassy woodland of the Upper Hunter and Liverpool Plains is likely to be a terrestrial GDE which may access the water table on an intermittent basis.

Groundwater quality

Potential contamination sources within the study area include restored mining land, a former timber mill, dairy farms, Muswellbrook substation and former power station, an open cut coal mine operated by MCC, a quarry and the Muswellbrook Waste Management Facility. These locations have the potential to leach contaminates into the groundwater although no evidence of this was found in the publicly listed data reviewed.

6.3.3 Potential impacts

Construction

Cuts in the topography, to achieve the required road grades, can result in groundwater discharge (dewatering) if the cuts extend below the water table. There is however a low potential for interaction with groundwater during construction, as groundwater has generally been reported to be at four metres below ground surface. There may be some interaction with groundwater during construction in areas of perched (seasonal) groundwater or close to the surface water – groundwater interaction zone(s). Additional geotechnical investigations would be undertaken during the detailed design phase of the proposal to determine the need for dewatering, the likely dewatering volumes, the impacts on draw down and the quality of groundwater that would be encountered during construction. The manner in which extracted groundwater would be discharged would depend on the groundwater quality and if it would require treatment prior to discharge. Options include discharge to creeks, temporary storage in detention basins to reduce turbidity prior to discharge, or re-use for dust suppression.

Piling activities required for the five bridges have the potential to impact on groundwater flow patterns, where shallow groundwater can mound on the upgradient side of the piles and drawdown on the downgradient side. Cast-in-place piling results in the removal of groundwater with sediment intersected in the pile location. The removal of groundwater associated with a typical 20 metre to 25 metre deep pile is only around 10 litres. Accordingly, the impact of groundwater removal due to construction of the piles would be temporary and not have a marked impact on groundwater levels.

Potential sources of contamination are from leaching of spills into groundwater. Impacts could potentially occur from fuel and oils used by construction plant and equipment, concrete batching plant, waste, fertilisers, herbicides and pesticides (used in site landscaping), paint and paint wastes, acid from acid-based washes and the disturbance of contaminated soils.

Spill occurrences would be readily cleaned up as part of routine construction activities and addressed by the proposed sediment basin discharge limits. The potential for impacts to groundwater from surface spills is considered low with the implementation of management measures and safeguards.

Two groundwater bores located within the construction footprint would be impacted during construction, while a third may be impacted. The two groundwater bores not able to be retained during construction would be capped and the owner would be compensated. Groundwater use from the bores located outside the construction footprint but within the study area is not expected to be disturbed during construction.

Construction activities within proximity of Muscle Creek, Sandy Creek and their tributaries have the potential to impact GDEs as discussed in Section 6.3.2. Mitigation measures which would be included in the proposal to reduce impacts on GDEs include minimising interruptions to water flows during detailed design (refer to Section 6.3.4).

Operation

The introduction of hard road surface areas into mostly greenfield environments would increase runoff and decrease groundwater recharge, due to the loss of permeability. The decrease in recharge rates would however be minor, given the small road surface of the proposal compared to the remainder of the catchment.

Road runoff could contain pollutants associated with vehicular movements, leaks, spills and crashes, which could lead to the contamination of groundwater. The contaminants could include hydrocarbons (petrol, diesel and oils), metals and suspended solids. Measures to minimise surface water impacts (as described in Section 6.2.4) would contain the risk to groundwater quality.

Aquatic GDEs within the study area are considered a sensitive receiving environment in connectivity with the Hunter River, Sandy Creek and Muscle Creek, which would receive runoff, both directly and indirectly, from the proposal. Therefore, if an incident were to occur, there is potential for environmental harm. The potential for interaction with groundwater during operation is considered to be low given the expected depth to groundwater along the proposal alignment.

Under normal operating conditions, the proposal is not expected to result in changes to the quality of groundwater in the local or regional aquifers. Similarly, impacts to groundwater availability would be negligible as the proposal does not require substantial groundwater extraction or inhibit recharge. Operation of the proposal would not impact GDEs.

6.3.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Reference
Groundwater dewatering	Any dewatering activities will be undertaken in accordance with the RTA Technical Guideline: Environmental management of construction site dewatering in a manner that prevents pollution of waters	Construction contractor	Detailed design and construction	Additional safeguard
Groundwater dewatering	If required, groundwater abstraction requirements during the development phase of the proposal will form part of the condition stipulated in the EPL for the proposal	Construction contractor	Detailed design and construction	Additional safeguard
Groundwater impact mitigation	Any dewatering activities will be undertaken in accordance with the RTA Technical Guideline: Environmental management of	Construction contractor	Detailed design and construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Reference
	construction site dewatering in a manner that prevents pollution of waters			
Groundwater impact mitigation	Additional geotechnical investigations will be undertaken to determine the: • Need for dewatering • Likely dewatering volumes • Impacts on draw down • Quality of groundwater that would be encountered during construction	Construction contractor	Detailed design	Additional safeguard
Groundwater impact mitigation	To minimise the potential of encountering groundwater during construction, pile holes should be installed by advancing steel casing into the ground as they are advanced	Construction contractor	Detailed design and construction	Additional safeguard

Other safeguards and management measures that would address groundwater impacts are identified in Section 6.2.