



OUT20/15449

Belinda Scott  
Planning and Assessment Group  
NSW Department of Planning, Industry and Environment

[belinda.scott@planning.nsw.gov.au](mailto:belinda.scott@planning.nsw.gov.au)

Dear Ms Scott

**Beaches Link & Gore Hill Freeway extension (SSI 8862) –  
EIS**

I refer to your email of 9 December 2021 to the Department of Planning, Industry and Environment (DPIE) – Water about the above matter. This advice has been provided by DPIE - Water and the NSW Natural Resources Access Regulator (NRAR).

A number of recommendations and comments regarding licencing, controlled activities on waterfront land, vegetation management, surface water impacts and groundwater management (inflows, modelling, management plans, monitoring, etc.) are provided in **Attachment A**.

Any further referrals to DPIE – Water & NRAR regarding this matter can be sent by email to:  
[landuse.enquiries@dpie.nsw.gov.au](mailto:landuse.enquiries@dpie.nsw.gov.au).

Yours sincerely

Mitchell Isaacs  
Chief Knowledge Officer, Chief Knowledge Office  
**Department of Planning, Industry and Environment: Water**  
19 March 2021

## ATTACHMENT A

### Advice to DPIE Planning & Assessment regarding the EIS for the Beaches Link & Gore Hill Freeway extension (SSI 8862)

---

DPIE – Water and NRAR provide the following recommendations.

#### Water Licencing

---

##### 1 Pre-approval Recommendation:

The proponent should quantify any predicted operational water take, including incidental take from tunnelling, as a result of the project and clearly demonstrate that appropriate Water Access Licences (WALs) are held or can be obtained to account for this take or clearly describe any exemptions that apply. It is recommended that Transport for NSW meet with DPIE Water and NRAR to discuss the regulatory requirements.

##### Explanation

Under Schedule 4, Part 1, clause 2 of the Water Management (General) Regulation 2018, roads authorities are exempt from the requirement to hold a Water Access Licence (WAL) to take water for road construction and road maintenance only. There is no current exemption for operational water take, such as ongoing groundwater ingress to tunnels. The proponent has predicted the volume of ingress to tunnels to be up to 551 ML/year during operation.

#### Controlled Activities and Vegetation Management Plan

---

##### 2 Pre-approval Recommendation:

The proponent should demonstrate due consideration of the guidelines including detailing setbacks and the establishment of vegetated riparian zones where works occur beside watercourses.

##### Explanation

It is unclear how the development complies with the NRAR Guidelines for controlled activities on waterfront land or what activities will be occurring on waterfront land associated with the watercourses.

A map of works that may occur on waterfront land would assist NRAR in our assessment. The NRAR Guideline is found here:

[https://www.industry.nsw.gov.au/\\_data/assets/pdf\\_file/0004/156865/NRAR-Guidelines-for-controlled-activities-on-waterfront-land-Riparian-corridors.pdf](https://www.industry.nsw.gov.au/_data/assets/pdf_file/0004/156865/NRAR-Guidelines-for-controlled-activities-on-waterfront-land-Riparian-corridors.pdf)

##### 3 Post-approval Recommendation:

Vegetation establishment that may occur on waterfront land beside Flat Rock and Burnt Bridge Creek should be managed under a Vegetation Management Plan (VMP) with appropriately structured riparian zone.

The preparation of the VMP should be in accordance with the NRAR Guideline here -

[https://www.industry.nsw.gov.au/\\_data/assets/pdf\\_file/0006/160467/licensing\\_approvals\\_controlled\\_activities\\_veg\\_mgt\\_plans.pdf](https://www.industry.nsw.gov.au/_data/assets/pdf_file/0006/160467/licensing_approvals_controlled_activities_veg_mgt_plans.pdf)

## Surface Water

---

### 4 Pre-approval Recommendation:

The proponent should quantify the potential impacts on baseflows in detail, and develop appropriate monitoring and mitigation strategies.

#### Explanation

The EIS identifies potential significant drawdown of groundwater in the construction and operational phases of the project, and notes that this will likely have an impact on baseflow in surface waters. Further information is needed to adequately assess the extent of impact on baseflow and dependant ecosystems.

### 5 Pre-approval Recommendation:

The proponent should develop appropriate plans for monitoring impacts to geomorphology resulting from the project and also put in place an action plan to mitigate any actual impacts that are detected by monitoring.

#### Explanation

In terms of mitigation, the proponent commits to implementing standard sediment control measures to limit sedimentation and erosion in and around waterways. However, there appears to be no provision for any monitoring of geomorphic impacts on waterways, including sedimentation and erosion. Geomorphic impacts are likely given the potential for changes in flow quantity and timing, as well as instream works including re-routing reaches. Although much of the catchment area is impacted by urbanisation, sedimentation or erosion may have detrimental effects on downstream receiving environments, including the waterways leading to estuaries.

## Groundwater

---

### Groundwater Take / Inflows

### 6 Pre-approval Recommendation:

**Please note that DPIE - Water recommends that the following be included as Conditions of Consent:**

- a. Consistent with the conditions of consent for similar recent projects, the proponent must take all practicable measures to limit operational groundwater inflows into each tunnel to no greater than one litre per second across any given kilometre (1 L/s/km). Compliance with this condition cannot be determined by averaging groundwater inflows across the length of the tunnels.
- b. Measurement devices must be in place at the completion of the tunnel construction to measure tunnel groundwater take at 1 km intervals and reported in the water monitoring and management plan.

#### Explanation

Total inflow during construction is predicted to be 2,817 megalitres (ML). This peaks at 899 ML per year (ML/year) in 2024. The predicted peak inflow during operation is 551 ML/year (0.86 L/s/Km) in the first year of operation (2028). This declines to 436 ML/year (0.69 L/s/Km) by 2128.

Annual inflows were calculated by the proponent to be less than about two per cent (2%) of the unassigned water under the long-term average annual extraction limit (LTAAEL) for the Water Sharing Plan for the *Greater Metropolitan Region Groundwater Sources 2016, Sydney Basin Central Groundwater Source*.

DPIE - Water notes that similar Sydney infrastructure projects include a Minister's Condition of Approval that states '*The Proponent must take all practicable measures to limit operational groundwater inflows into each tunnel to no greater than one litre per second across any given kilometre (1 L/s/km). Compliance with this condition cannot be determined by averaging*

groundwater inflows across the length of the tunnel.' DPIE - Water firmly recommends the inclusion of this condition in the Project's approval.

## Groundwater Modelling

### 7 Post-approval (prior to construction) Recommendation:

The proponent is to update the groundwater conceptual and numerical models to include data collected after 1 December 2017. The project construction must not be started before confirming that the updated models suggest similar or smaller effects than those predicted in the groundwater modelling report dated December 2020. The updated modelling is required to include the following as a minimum on top of the previous modelling:

- a. Present evidence that the current version of the model was independently reviewed by a qualified third-party hydrogeologist or modeller as recommended in the Australian Groundwater Modelling Guidelines 2012.
- b. Updated report with adequate quality control (proofreading, improved plots, additional maps like for potential and actual evapotranspiration, coordinates shown on maps, etc.).
- c. Cross-sections perpendicular to the tunnel alignment to support the conceptual modelling and 3D representation of the conceptual model.
- d. Composite parametric sensitivity analysis (parameter identifiability) to provide basis for model calibration and uncertainty analysis. This must include all parameters (hydraulic conductivity, storage parameters, recharge, evapotranspiration, GHB and bed conductance terms, etc.).
- e. Reconsider the representation of evapotranspiration in the project's groundwater models.
- f. Using updated end of calibration period heads and boundary conditions as starting initial conditions in predictive modelling.
- g. Assessment of the Project's full surface water depletion effects, not just its baseflow reduction effects (i.e. include assessment of the potential to increase losses from surface water features where they already occur).
- h. Considering the need to represent existing and approved fully tanked tunnel sections in the groundwater models as flow barriers.
- i. Improved sensitivity analysis based on the results of parameter identifiability to support model calibration efforts.
- j. Improved model calibration (against longer monitoring records and additional hydraulic testing data).
- k. Improved contaminant transport risk assessment, including particle tracking modelling as a minimum.
- l. Consideration of the need for additional uncertainty analysis.
- m. Assessment of tunnel groundwater inflows over sections of no more than 1000 m in length and representing this information in suitable table and map formats for each year during the construction phase, the first year of operation, and every ten years from the end of operation for 100 years.
- n. Compare the pressure heads obtained from the MODFLOW-USG 3D groundwater flow modelling against those obtained from the coupled CTRAN/W–SEEP/W 2D saline water intrusion model to cross-validate the models.

#### Explanation

The predictive modelling includes the following

- Scenario 1 ('Null' run) that does not include any tunnelling component.
- Scenario 2 (existing and approved tunnels run) that includes Metro and Western Harbour Tunnel and Warringah Freeway Upgrade (WHTWFU).

- Scenario 3 (cumulative run) that includes Metro, WHTWU and Beaches Link tunnels, no ground treatment other than join segments adjacent to the harbour.

The models provide good basis for the assessment of potential impacts on surrounding land uses, groundwater users, groundwater dependent ecosystems (GDE), surface waters, as well the potential for causing saline water intrusion. The models are used to estimate the licensable take from both surface and groundwater despite the exemption of this requirement for the Project under Schedule 5, Part 1, and clause 2 of the Water Management (General) Regulation 2011. The models also assist in addressing Level 1 Minimal Impact Considerations of the NSW Aquifer Interference Policy (2012) and assessment of compliance with the Water Sharing Plan.

Basic but useful uncertainty analysis have been made for the model predictions. It included the alteration of the calibrated parameters to achieve conditions set in the following two uncalibrated scenarios:

- Scenario A involves adjusting parameters to yield greater groundwater inflows to the project tunnels and, consequently, greater groundwater level drawdown. The scenario does not represent the most severe groundwater-related impacts that could possibly occur.
- Scenario B involves adjusting parameters to yield lesser groundwater inflows to the project tunnels, simulating tunnel lining, and, subsequently, lesser groundwater level drawdown.

The reported groundwater modelling work for the project is based on limited data and information and involves limited sensitivity analysis. Otherwise, it generally follows best practice as recommended in relevant guidelines.

The proponent assigns the modelling work Confidence Level Class 2 with some Confidence Level Class 3 attributes as prescribed in the Australian Groundwater Modelling Guidelines 2012. As such the modelling is deemed fit for the purpose of informing initial decisions by the proponent, stakeholders, and regulatory agencies. However, the proponent does not present evidence that the current version of the model was independently reviewed by a qualified third-party hydrogeologist or modeller as recommended in the Australian Groundwater Modelling Guidelines 2012.

DPIE - Water notes that evapotranspiration accounts for more than half of the outflows in the steady-state and transient models, without any conceptual or numerical modelling evidence. The proponent is required to reconsider the representation of evapotranspiration in the project's groundwater models.

The proponent states that the groundwater modelling provides a conservative assessment by excluding any designed tunnel linings. Further, that parameters included in sensitivity analysis equivalent to tunnel lining beneath the Flat Rock creek and Quarry Creek areas indicates a significantly reduced drawdown of groundwater, of around 8m less than without lining. Resulting in approximately 3m less drawdown after 100 years of operation. The proponent has proposed tunnel linings in areas of modelled high groundwater inflow as a mitigation measure.

DPIE - Water notes that the proponent has demonstrated that installation of tunnel lining makes significant contribution to mitigation of potential groundwater drawdown, groundwater inflow, and baseflow impacts. Therefore, the proponent should include lining of tunnels where there is an indicated degree of higher risk and where higher inflows are detected during construction.

The conceptual and numerical models require updating and validation to collated ongoing groundwater monitoring data prior to the start of construction and finalising of the final design.

## **Acid Sulphate Soils and Contamination**

### **8 Post-approval (prior to construction) Recommendation:**

The proponent should undertake assessment for Acid Sulphate Soils (ASS) at all surface disturbance sites.

If any potential ASS is indicated at these sites the proponent must develop, provide for review, and implement an appropriate ASS Management Plan.

#### **Explanation**

No work to identify and test the acid generating potential of soil and rock in the project area has been provided in the EIS. If areas of ASS are identified, the proponent will need to implement an ASS Management Plan outlining measures to mitigate the impacts.

### **9 Post-approval (prior to construction) Recommendation:**

The proponent should conduct contamination risk assessments, including evaluation of the potential for mobilisation towards the tunnels due to groundwater drawdown, at all potential contaminations sites along and adjacent to the twin tunnels alignments.

#### **Explanation**

Moderate to high risk areas for contamination, including Environmental Protection Agency notified contaminated sites, relevant to the project under the description of contaminated sites in Schedule 3 of the Water Sharing Plan have been identified.

As the hydraulic gradient will alter to flow towards the drained tunnels contamination mobilised would flow to the tunnels, with contaminants potentially remaining within 40m of the tunnel, as indicated by the proponent. Any captured potentially contaminated groundwater or saline water will be treated through the installation of water treatment plants (WTPs).

Discharged water quality is to be monitored and is required to meet the appropriate NSW water quality guidelines, and all regulating authority requirements.

Water quality monitoring of groundwater inflow prior to treatment and before discharge must be detailed in the developed Groundwater Management Plan. DPIE - Water expect the NSW Environmental Protection Authority (EPA) will have further comments on the contamination issues.

The proponent has stated the need to conduct contamination risk assessments at several localities prior to construction, it is essential these assessments include evaluation of the potential for mobilisation towards the tunnels due to groundwater drawdown.

## **Groundwater Management and Monitoring Plans**

### **10 Post-approval (prior to construction) Recommendation:**

The proponent should develop and implement a detailed Groundwater Management Plan (GMP) including a detailed groundwater monitoring programme, groundwater impact trigger criteria, mitigation measures and trigger action response plan with appropriate timeframes for implementation of response actions. This should include the following elements:

- a. GMP to be provided to DPIE - Water for review three months prior to commencement of construction activities.
- b. Include planning to reduce all occurrences of high groundwater inflow, predicted or encountered during construction. This must include the mitigation measures (e.g. grouting of the formation prior to tunnelling, tunnel lining, unforeseen water ingress handling strategy) to be implemented to manage these occurrences.
- c. Include provisions to undertake a groundwater bore census prior to construction, and periodically for the life of the project. This is to ensure any impact to any private bores is captured throughout the life of the project. The bore census details need to be included in the Annual Environmental Review.

- d. All 'make good' provisions are to be detailed in the GMP and occurrences of 'make good' provisions being implemented are to be detailed in the Annual Environmental Review.
- e. Water quality monitoring of groundwater inflow prior to treatment and before discharge must be detailed.

#### 11 **Post-approval (prior to construction) Recommendation:**

The proponent should prepare a Groundwater Monitoring Plan acceptable to DPIE - Water for additional hydrological and hydrogeological investigations and monitoring based on the recommendations made in the Technical Report on Groundwater, the Modelling Report, and DPIE - Water's assessment. The Groundwater Monitoring Plan must include:

- a. Adequate network coverage, including sentinel bores, to enable satisfactory assessment of potential contamination plume development, groundwater drawdown and baseflow reduction in areas of recognised higher risk. Detail of the groundwater level monitoring and monitoring of any induced water stress in the vegetation communities to be undertaken in areas of bushland and recreational parklands highly valued by the general public and local communities.
- b. Adequate monitoring site coverage to enable the proponent to demonstrate there is no saltwater intrusion during the life of the project.
- c. Monitoring and recording of any significant groundwater inflows along the entire tunnel alignment, including but not limited to the predicted high inflow areas.
- d. Collection of additional permeability data regarding vertical gradients and vertical hydraulic conductivity.
- e. The groundwater monitoring plan is required to be fully implemented at least one-year prior to commencement of construction.

#### Explanation

##### Aquifer Interference Policy (AIP, 2012) Assessment

Section 3.3 of the AIP identifies caverns, tunnels and cuttings as a defined minimal impact aquifer interference activity if a WAL is not required. The Beaches Link project, in relation to potential impact to groundwater entities, primarily consist of tunnels, caverns and cuttings (box cuts). Given the size and extent of the proposal as recommended in Section 1 of this advice, we would like to meet with the proponent to discuss whether licence entitlement is required before confirming whether these activities fall under this category.

Groundwater impacts during construction and operation are discussed generally satisfactorily. However, there are several notable exceedances of the level 1 minimum impact criteria of the AIP (2012).

Potential impacts to nearby users, registered bores: GW107970 – up to 7m, GW108224 – up to 5m and GW108991 – up to 3m, exceedance of 2m drawdown criteria; and vegetation communities have been modelled and outlined. Management strategies, including "make good provisions", and mitigation measures to minimise any potential impacts outlined are generally satisfactory. The proponent must undertake a groundwater bore census prior to construction, and periodically for the life of the project, to ensure that any impact to any private bores throughout the life of the project is captured and managed. All 'make good' provisions are to be detailed in the Groundwater Management Plan and occurrences of these being implemented are to be detailed in the Annual Environmental Review, along with the findings of the bore census.

Some adjoining areas of Coastal Sandstone Gully Forest, Sandstone Riparian Scrub and Coastal Sand Forest at Flat Rock and Quarry Creek areas would be subject to groundwater drawdown impacts of up to 4 metres predicted by 2028 (end of construction) and 11 metres by 2128 (100 years of operation). The level of groundwater dependency of this vegetation is unknown. Groundwater drawdown as a result of the project could potentially contribute to trees dying or becoming stressed during periods of prolonged drought.



The maximum predicted baseflow impact to Flat Rock Creek after 100 years of operation of the project is a reduction of 84.7 kilolitres per day, equating to a flow reduction of 39 per cent. The maximum predicted baseflow impacts to Quarry Creek after 100 years of operation would be a reduction of 11.4 kilolitres per day, equating to a flow reduction of 69 per cent. Proposed operational wastewater treatment plant discharges to Flat Rock Creek may offset this impact.

Notably, several areas of known environmental interest for moderate to high contamination adjoining the tunnels are predicted to experience groundwater level drawdown of from 11 meters to 22 meters. However, water quality of the aquifer is not predicted by the proponent to be reduced. All water captured by the construction and operational tunnels will be treated prior to release to conform to the requirements of the governing authorities.

The proponent has predicted peak inflow during operation for the whole of project of 0.86 L/s/Km in the first year of operation (2028), declining to 0.69 L/s/Km by 2128. Whilst these predicted inflow rates are lower than the required 1 L/s/Km level compliance cannot be determined by averaging groundwater inflows across the length of the tunnels. DPIE - Water consider drained tunnels should not have more than 1 L/s per kilometre of groundwater inflow any 1-kilometre portion along the tunnel. A drained tunnel will dewater in perpetuity and create drawdown impacts maximised near the tunnel. During pre-construction drilling it is important that any significant groundwater inflows are recorded and monitored. Planning to reduce high groundwater inflow needs to occur pre-construction, and this may require measures such as grouting of the formation prior to tunnelling.

During construction, accurate measures of inflows will need to be recorded, mapped, and a documented grout sealing process undertaken to reduce the inflow. Areas close to estuaries with thin veneer cover over fractured rock formations will require tanking. Documented evidence of these management and mitigation measures is to be provided in the Groundwater Management Plan and of the activities in the Annual Environmental Review.

#### Groundwater Dependent Ecosystems

There are no registered high priority Groundwater Dependent Ecosystems (GDEs) (in the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011) along the alignment or that are predicted to be impacted by the project. However, there are GDEs or sensitive environments within the area of predicted drawdown which are recognised as sensitive plant community types by the proponent.

There are also several noted bushland and parks areas, referred to as opportunistic groundwater vegetation communities by the proponent, along the alignment or adjacent to it, several of which have significant predicted groundwater level drawdown and baseflow reduction. These bushland and parks are highly valued environments by the general public and local communities.

The proponent has outlined management strategies to mitigate or assist in reducing the potential drawdown impact / baseflow reduction, such as:

- Tunnel linings to be designed and installed under several of the areas to reduce operational groundwater inflows into the tunnels.
- The release of treated waters along the watercourses within these areas to offset potential impacts from the predicted drawdown.

A further mitigation measure of pre-grouting (at depth) before excavation is recommended.

Significant groundwater level monitoring and monitoring of any induced water stress in the vegetation communities will need to be undertaken in areas of bushland and parklands highly valued by the general public and local communities.

#### Saltwater Intrusion

The potential for additional Project induced saline water intrusion has been assessed through density dependent groundwater flow analysis using the finite element program CTRAN/W coupled with SEEP/W. The predicted maximum lateral movement of saline water towards inland areas over 100-year period is negligible.



The project consists of predominantly unlined tunnels which will be permanently dewatered to the base of the tunnel from construction into perpetuity.

Whilst the proponent has noted the natural saline nature of the groundwater and the low permeability of the aquifer material, with negligible predicted saltwater intrusion, the permanent groundwater sink that will be created by the tunnels adjacent to the harbour shoreline could potentially induce saltwater intrusion overtime, especially where the tunnels intersect unknown geological structures that also penetrate the geological formation out to the harbour.

The proponent needs to demonstrate there is no saltwater intrusion during the life of the project, or to determine this is not the case, and alleviate any public concern. The salinity modelling should be updated with collated groundwater salinity monitoring data post approval prior to finalising final design.

A suitable programme for monitoring of potential saltwater intrusion is to be included in the Groundwater Monitoring Programme and Groundwater Management Plan.

DPIE - Water supports the recommendations made in Appendix N Technical Report on Groundwater and the Modelling Report with regards to the gathering of additional data including carrying out continuous stream flow monitoring along Flat Rock Creek, Quarry Creek, and Burnt Bridge Creek, and the assessment of leakages from the water supply network.

Further, the groundwater monitoring program outlined is recommended to be implemented. DPIE - Water notes that the planned monitoring sites are linear in nature, being largely aligned along the tunnel alignment.

#### Groundwater Monitoring Program

DPIE - Water are aware of limiting issues with regards to placement logistics for monitoring bores in a highly urbanised environment. However, the project would benefit from additional monitoring between the tunnel alignments and natural or other highly valued by the community features (e.g. open spaces; golf courses, recreational parks, National Parks, nature reserves, and water reservoir reserves).

Further benefit would come from including monitoring in zones of potential or perceived potential for saltwater ingress (e.g. immersed tunnel joins and the harbour, geological structures linking from Middle Harbour shoreline).

The existing network does not include many bores perpendicular to the tunnels alignment that would be required as sentinel bores. Installation of sentinel bores should be investigated at or near to the immersed tunnel section joins with the mined underground tunnel sections to monitor for any induced saline groundwater intrusion. Installation of several monitoring bores along the Seaforth tunnels section between the tunnel and the Middle Harbour would improve the groundwater – saline water monitoring network, as would monitoring the groundwater level between the tunnels and the Manly Reservoir Dam.

The use of existing registered bores for monitoring purposes should be discussed with the holders of those bores, this could be done in conjunction with a census of the nearby bores.

Groundwater level and quality monitoring should be ongoing to bring the level of available background data for modelling up to the recommended 24 months of information.

Further, a suitable groundwater monitoring programme, including periodic review and assessment of site-specific limits and impacts, along with applicable management strategies and mitigation measures to minimise any potential impacts are to be included in a Groundwater Management Plan for the project prior to commencement of construction.

## **Additional Recommendations not required pre-approval or post-approval / pre-construction**

---

- 12** During construction, accurate measures of inflows are required to be recorded, mapped and the grout sealing process undertaken to reduce the inflow documented. This information is to be included in the monitoring data presented in the Annual Environmental Reports and any further modelling or planning process during construction.
- 13** Areas close to estuaries with thin shallow veneer of cover over fractured rock formation are required to be fully tanked.
- 14** After commissioning of the tunnels, the proponent is to verify the groundwater models after 10 years of the project's operation. The modelling of groundwater monitoring data collected during the first 10 years of operation of the tunnels is acceptable, provided, the previously predicted groundwater impacts are verified and no exceedances of these or the trigger criteria in the GMP have occurred during that time.

**END ATTACHMENT A**