North - East Link Project

BabEng

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Alignment Constraints

- Overburden towards Hurtsbridge rail line
- Overburden towards the 450 mm transmission gas main
- Maximum tunnel gradient of 4 %
- Maximum gradient for entry and exit ramps at Grimshaw Street - Interchange of 6 %
- Optimized land acquisition
Extension Options

Option A1
- Mined
- Extension: + 900 m
- Ignored due to geology

Option A2
- TBM
- Extension: + 2 500 m
- Further investigation

Option A3
- TBM
- Extension: + 2 700 m
- No Grimshaw Interchange

Option A4
- Mined
- Extension: + 3 400 m
- Ignored due to geology
Vertical alignment – Option A2

- Overburden towards rail line and gas main ✓
- Maintaining the functionality of interchanges ✓
- Maximum ramp gradient ✓
- Land usage ✓
Grimshaw Intersection – Site Plan & Cross Sections

- Surface roads and lane model by community stakeholder. Other models are possible as well.
- Cross Section (XS) A-A showing the different height levels at Grimshaw Street Bridge.
- XS B-B displaying the different height levels at the portal. Here especially the distance between SB tunnel and rail tunnel.
- XS C-C developing the lengths of the NEL SB merge lane and inclinations.
Grimshaw Street Intersection – Cross Section A-A

- 10 m difference between road surfaces of NEL and Grimshaw Street bridge. Situation as current.
- NEL north and south bound with three lanes.
- The north ramp could be used as space for the ventilation and operation centre.
- NEL north and south bound with three lanes.
Grimshaw Street Intersection – Cross Section C-C

NEL Tunnel portal

NEL

NEL SB ramp

Rail tunnel

Inclination 4%, continuing into the tunnel

Inclination 6% maximal

Merge length

Access length

Joint length

Total length 240 m
Own position south and below tunnel alignment; looking north to the portal. Rail tunnel in red. On the top, road pavements of Greensborough Road in grey.

Shortest distance between SB tunnel and rail tunnel 7 m. This small distance might require additional protection measures for the rail line, like compensation grouting. This is subject to further investigation.
Interim conclusion

- Evaluation Process:
<table>
<thead>
<tr>
<th></th>
<th>Option A2 V1</th>
<th>Option A2 V2</th>
<th>Option A2 V3</th>
<th>Option A2 V4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of TBMs</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Direction</td>
<td>North to south</td>
<td>Centre to shaft</td>
<td>Centre to shaft</td>
<td>Centre to shaft</td>
</tr>
<tr>
<td>Duration Tunnelling</td>
<td>20 months</td>
<td>12 months</td>
<td>21 months</td>
<td>16 months</td>
</tr>
<tr>
<td>Duration Completion</td>
<td>37 months</td>
<td>29 months</td>
<td>36 months</td>
<td>32 months</td>
</tr>
</tbody>
</table>
## Land utilization & construction volume

<table>
<thead>
<tr>
<th>Construction volume</th>
<th>Reference Design</th>
<th>Option A2</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trench</td>
<td>57,000 m$^2$</td>
<td>0 m$^2$</td>
<td>100 %</td>
</tr>
<tr>
<td>Concrete retaining wall</td>
<td>172,200 m$^3$</td>
<td>58,000 m$^3$</td>
<td>66 %</td>
</tr>
<tr>
<td>Bridges</td>
<td>11,735 m$^2$</td>
<td>2,135 m$^2$</td>
<td>82 %</td>
</tr>
<tr>
<td>Land use</td>
<td>80,310 m$^2$</td>
<td>21,900 m$^2$</td>
<td>73 %</td>
</tr>
</tbody>
</table>
Volume estimation

In lack of resilient costing data, BabEng prefer to compare changes in volume of the different structures and options.
TBM Disassembly

Example of a TBM disassembly in a congested situation

Construction site plan TBM dismantling

Example of a TBM disassembly in a congested situation
Information about geotechnical and hydrogeological conditions

**Question:** Proper basis for understanding the effects of tunnel construction?

- Corridor A: well documented
- Effects on hydrogeology and surface structures: descriptions & graphics
- Explanations: expected ground & effects of tunnelling through contaminated ground
Information about geotechnical and hydrogeological conditions

**Question:** Proper basis for understanding the effects of tunnel construction?

**Modification A2**

- Available documents → only general rock or soil type
- No geotechnical or hydrogeological parameters

- Information in the EES alone are insufficient to develop alternative tunnel options with the desired accuracy.
- Volume loss as indicator for assessing the effects of tunnel construction
- VL of 0.8% overly conservative

<table>
<thead>
<tr>
<th>Location</th>
<th>Volume loss – VL%</th>
<th>Reasoning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Plenty Road to Leura Avenue (TBM)</td>
<td>0.8</td>
<td>Faulted zones have been detected near the temporary portal in the vicinity of Lower Plenty Rd. Reduced ground cover above the tunnel, with some superficial soil.</td>
</tr>
<tr>
<td>Leura Avenue to Banyule Flats (TBM)</td>
<td>0.2</td>
<td>Greater than one-tunnel diameter of cover above the tunnel crown and ground is believed to be mainly competent siltstone.</td>
</tr>
<tr>
<td>Banyule flats northern valley interface (TBM)</td>
<td>0.8</td>
<td>Reduced ground cover above the tunnel crown beneath the Yarra Valley. The ground cover consists of a thick layer of geologically ‘recent’ alluvial soils and highly fractured rock; potential ‘mixed ground’ conditions in TBM face.</td>
</tr>
</tbody>
</table>

*Table 5.4 from NELP-EES-Technical-Report-M-Ground-Movement.pdf*
Engineering, geotechnical and hydrological conditions

**Question:** Are there reasons why the tunnel can not be extended?

**North**
- EES does not contradict an extension.
- Distance between existing railway tunnel and new tunnel. Risks seem acceptable after rather small mitigation measures.

**South**
- Preliminary study of ground description and proposed structures
- Feasible with a soft-ground TBM
Question: What would be the implications for tunnel design at the interchange?

**North**
- Grimshaw Street interchange:
  - Tunnel can be elevated, enough space for merging lanes and ramps
  - EES does not give reasons that might prevent an extension

**South**
- Only, due to the short tunnel length:
  - Preferred excavation method Cut & Cover or Mined
  - Radii of curved tunnel feasible

*Model of Grimshaw Street Interchange*
Improvement of tunnel design

Financial & Logistic Advantages:

- TBMs already engaged on site:
  - Northward extension rather unproblematic
  - Financial impact minimised

Environmental Advantages:

- Disturbance at surface only around shafts and structural elements
- Possibility to recover free space on surface
- Impact due to open trench minimised
Feasibility

- Extension to the north is feasible
  - Ground conditions favourable
  - Distance between railway tunnel and south bound tunnel is feasible
  - Launch location Lower Plenty Road does not require reconfiguration of lanes, since the construction of ramps will start after launching the TBM
  - Further elevating of the start shaft is possible, which will have additional advantages for the ramp design

*Distance between southbound tunnel and rail tunnel (red)*

*Example of a TBM disassembly in a congested situation*
Feasibility

- Functionality of Greensborough Road remains during construction
- No further land acquisition at Watsonia Primary School and AK Lines Reserve

**Possible temporary diversion road at the northern portal**
Feasibility

- Connection to Grimshaw Street Interchange possible
Feasibility

- Space required for TBM disassembly is sufficient.