PUBLIC ACCOUNTABILITY COMMITTEE

IMPACT OF THE WESTCONNEX PROJECT

Responses to Questions on Notice

Hearing – 7 November 2018

1. The Hon. GREG DONNELLY: I wonder whether you received an email about 12.20 last night. This was a constituent and the video had this work being done. They had not been told about this particular work. It was obviously particularly noisy work. The house was vibrating and they were clearly greatly unsettled by this. These are not infrequent examples that are coming forward. For a project that has been going for a period you would think there would be a refinement in the way in which these matters are dealt with. There just seem to be far too many examples of this going on.

Mr KANOFSKI: In terms of the video you received last night, I mean obviously—

The Hon. GREG DONNELLY: No, of course you have not seen it. I understand that.

Mr KANOFSKI: We have not seen it. We are very happy to take it on notice and investigate the circumstances.

The Hon. GREG DONNELLY: But that is all too late, Mr Kanofski. That is the very point. People need immediate attention.

Response: Community members can submit enquiries and complaints to WestConnex at any time via a number of channels including:

- the WestConnex Information Line (1800 660 248), which is staffed 24 hours a day, 7 days a week
- email (info@westconnex.com.au and project email addresses such as info@newm5.com.au)
- in person at WestConnex Community Information Centres
- by sending a direct message to the WestConnex Facebook account.

In relation to out of hours work, each of the WestConnex projects under construction must meet the requirements of the relevant project Environment Protection Licence (set by Environment Protection Authority) and Conditions of Approval (set by Department of Planning and Environment). Some work must be carried out at night because, in addition to safety reasons, closing roads and carrying out this work during the day would significantly impact traffic flow on the road network and increase the duration of construction.

Before any night work starts, noise assessments are conducted to identify any impacted properties and determine necessary mitigation measures, which could include an offer of temporary relocation.

Work notifications are distributed to nearby residents and businesses prior to our of hours work to be conducted in the area. These work notifications are available at www.westconnex.com.au/local-updates.

2. The Hon. GREG DONNELLY: With respect to Roads and Maritime Services [RMS], are you collecting data or is the RMS, the entity organisation, collecting data on complaints?

Ms DROVER: Yes, because we are responsible for the hotline and the centre.

The Hon. GREG DONNELLY: Are they published?

Ms DROVER: I would have to take that on notice.

Response: Yes. Each of the WestConnex projects keeps a register of complaints received relating to their project. The details of these complaints are also recorded in the WestConnex stakeholder and community database, Consultation Manager. Roads and Maritime Services, Sydney Motorway Corporation (SMC), and each of the WestConnex construction contractors do not publish details of the complaints received. However, in accordance with Conditions of Approval for each of the WestConnex projects, each week the Department of Planning and Environment is provided with a register of complaints received by each project.

3. The Hon. GREG DONNELLY: What information do you have on complaints? Can you give us any ballpark figures on types of complaints around dust, types of complaints about noise, et cetera?

Ms DROVER: I know that most of the complaints for this month have been associated with noise.

The Hon. GREG DONNELLY: Do we have an approximate number?

Ms DROVER: We do have a full breakdown. We can provide that to you on notice.

The Hon. GREG DONNELLY: Do have it there with you?

Ms DROVER: No, I do not have the full breakdown.

The Hon. GREG DONNELLY: Do you have any information in front of you that deals with numbers of complaints?

Ms DROVER: No, I do not.

The Hon. GREG DONNELLY: None at all?

The CHAIR: Take that on notice then. Ms DROVER: I am happy to take that on notice.

Ms DROVER: I am happy to take that on notice.

Response: Please refer to my response to question 2.

4. The Hon. GREG DONNELLY: I will move on. That is to come in the future. I do not wish to repetitive as I have limited time. With respect to the M4 East, how many vehicles that are expected to use, or do use the M4 widened part of WestConnex, will use the M4 East? Do we have some sense of the numbers of vehicles or the percentage of vehicles that use the widened M4 that will ultimately use the M4 East?

Mr KANOFSKI: I do not have that with me. I do not whether Ms Drover does. I am certainly happy to provide you with estimates. The planning approval process would have been supported by traffic modelling that would actually provide the estimates of those. I do not have it.

Ms DROVER: No. I will take that on notice.

Response: This information is available in section 8 (figures 8.4 and 8.5) of Appendix G (Traffic and Transport Assessment) of the M4 East Environmental Impact Statement.

5. Ms CATE FAEHRMANN: Thank you, I have limited time, as you are well aware, on this Committee. What would the reason be for a security guard to accompany RMS employees to knock on doors in relation to compulsory acquisitions?

Mr KANOFSKI: There was a decision made—

Ms CATE FAEHRMANN: Particularly male RMS employees accompanied by a security guard knocking on the door.

Mr KANOFSKI: There was a decision made in one instance at an operational level with regard to security.

Ms CATE FAEHRMANN: Do you know what suburb that was?

Mr KANOFSKI: I do not know, I will have to take it on notice. I do recall there was a time when that operational decision got made. It was made based on a risk assessment of the level of potential angst that may have been associated with that. That is very much not normal practice. I am happy to take this on notice. Ms Drover may know more on this issue. That happened once to my knowledge.

Ms CATE FAEHRMANN: If you can take that on notice. What I have before my is a woman was at home by herself. A male RMS employee—this is in June 2016—accompanied by security guards, plural, knocked on her door to tell her her property was going to be compulsorily acquired. I believe she is a nurse with her husband. I cannot imagine why such a situation would be required by RMS and how intimidating that would have been for her.

Mr KANOFSKI: As I said, I am happy to take the specifics on notice and I am happy to take it on notice because it is very much not normal practice. As I said, an operational decision was made, I think, in one circumstance.

Response: Roads and Maritime and Sydney Motorway Corporation (SMC) staff were accompanied by security guards during doorknocking in June 2016. Due to a reported media leak, Roads and Maritime and SMC staff carried out the doorknock as soon as practicable to inform property owners their homes were required for the M4-M5 Link project. This did not leave time for Roads and Maritime and SMC staff to carry out the safety assessments and Safe Work Method Statement processes usually implemented before this type of activity.

Past experiences of doorknocks of this type have resulted in protester activity and threatening behaviour from some property owners. To ensure the safety of workers, a decision was made by senior project managers to employ security guards in lieu of the regular safety precautions due to:

- The likely scenario of media being present and potentially worsening an already highly distressing event for home owners
- Potential protester activity.

Security guards always kept an appropriate distance and only qualified Roads and Maritime or SMC staff doorknocked the affected homes

Security guards did not speak to any affected homeowners.

Roads and Maritime is not aware of any doorknocks using security guards since the instance referred to (in June 2016).

6. Ms CATE FAEHRMANN: As I said, we have received quite a number of submissions and heard from witnesses about the appalling behaviour of RMS in relation to compulsory acquisition. She does say that basically the house was acquired. In the settlement it was agreed that "in September 2017 we would become tenants and pay rent for our former home". A rental price was agreed at $550 per week. "Just prior to commencement of rental payments the acquisitions officer contacted my husband and we were informed that the RMS were increasing the rent to $600 per week, a increase of $200 per month". Does that sound reasonable to you?

Mr KANOFSKI: We would have to take the detail of that on notice.

Response: It is Roads and Maritime practice that if a former owner wishes to remain in a property after the sale is completed, and prior to the need for construction, then rental payment is applicable. Roads and Maritime is consistent in applying this approach.

An owner has an option to exchange contracts with Roads and Maritime and have a deferred settlement. In this case, the former owner can remain in the property until settlement of the property sale without the need to pay rent. However, if the owner wishes to remain in the property after the sale is completed, then market rental is payable.

The rental is assessed by the Roads and Maritime valuer and is based on the market rental for such properties. If a former owners wishes to rent back the property after settlement with Roads and Maritime then the rental is discussed and agreed between Roads and Maritime, the owner and their team of lawyers and valuers prior to entering into a lease or licence agreement.

To respond to the specific instances raised, Roads and Maritime would require further detail.

7. Ms CATE FAEHRMANN: Do you think it is quite a heartless decision to put a family through all of this and they have agreed to $550 per week and for some reason RMS comes back and says, "Hang on, we have made a mistake we are going to up it by $50 a week"?.

Mr KANOFSKI: I think what I have said is I will take the specifics of that on notice. I do not know the detail of the circumstances you are referring to. I am very happy to take it on notice and very happy to provide a full response.

Ms CATE FAEHRMANN: We have heard from families as well that they have not had the full bond refunded. Even though their house was going to be demolished RMS was not going to provide a full bond in refund because there was something wrong with the inside of the house. Even though the houses were going to be demolished. Multiple stories in relation to that.

Mr KANOFSKI: I am not aware of that. I am happy to take the detail and deal with it.

Ms CATE FAEHRMANN: It sounds like you are going to have to take all the details on notice so I will put another one before you if you like. This is in relation to a property acquisition in St Peters—again $70,000 below market value. RMS failed to stick to its deadlines with making an offer as well as paying the agreement amount. "This led to me not receiving the final payment until after 2 July 2016". People have not received their payment. Once you compulsorily acquire these properties, through all of the pain and agony, these people are saying that they then do not even receive their payment on the due date.

Mr KANOFSKI: While I am happy to take that on notice the requirement—

Response: Once a property is in Government ownership, it is rented out at market rental. Roads and Maritime is committed to treating all owners in a fair and consistent way.

In assessing compensation for a property, the valuation takes into consideration all fixtures and fittings that are installed in a property.

Accordingly, the compensation an owner gets includes payment for all items in the property and is reflected in the contracts for sale.

If an owner removes any items, then the compensation and contract is adjusted to reflect the value of the items removed. This is generally done in agreement with the former owners.

On some occasions, a former owner entered into a fixed term licence/lease and then extended their occupation on a property. To account for the extension, the rental payments were deducted from the bond held by Roads and Maritime in lieu of additional rental payments.

In relation to payments for compulsory acquisitions, please refer to my answer to question 8.

To respond to the specific instances raised, Roads and Maritime would require further detail.

8. Mr KANOFSKI: Just so we understand the payment process, if a property does go into compulsory acquisition we are in fact required to pay 90 per cent of that. Before the value is determined and before the property is actually purchased we pay 90 per cent of that value at that time. That is what we are required to do. While I am happy to take the detail on notice I would be very surprised.

Ms CATE FAEHRMANN: If you could take on notice how many properties that relates to in terms of initial payment and final payment—both sets of payment you are referring to—with all of the properties you have compulsorily acquired if they have been on the due date?

Mr KANOFSKI: I am very happy to do that. If it goes through compulsory acquisition there is a very clear legal process and if it is done by agreement then there is obviously a binding contract. I would be very surprised if we have not made payments on the due date but I am very happy to investigate any individual circumstances.

Response: Roads and Maritime made payment on time for all compulsory acquisitions (on receipt of necessary settlement documents endorsed by all relevant parties, including mortgagees, for example, and details of the bank account into which to pay).

Where acquisitions are settled by agreement and legal binding contracts have been exchanged, then Roads and Maritime and the owners are both required to settle the contract on the terms and conditions therein.

A land owner who lodges an objection with the Land and Environment Court about the amount of compensation determined by the Valuer General is entitled to be paid 90 per cent of that amount within 28 days after notice of institution of proceedings is given to the acquiring authority. The court process is governed by the *Land and Environment Court Act 1979*.

Roads and Maritime is also bound by the Model Litigant Policy, which is available online at:

https://www.justice.nsw.gov.au/legal-services-coordination/Pages/info-for-govt-agencies/model-litigant-policy.aspx

9. The Hon. Dr PETER PHELPS: Any strict aggregation of those two numbers of complaints could result in double counting of individual complaints. Mr Chair, once again the gentleman in question has decided to laugh out loud during the middle of my questioning. If you are not going to clear the gallery I ask you at least to remove him from the room. He has been a consistent interjector all through the process.

The CHAIR: I have already asked the people in the gallery to restrain themselves and not interfere with the hearing. If they do so I will have no choice; they will have to leave the room.

The Hon. Dr PETER PHELPS: Please continue.

Ms DROVER: To answer your question I think it is possible, although I expect that most of the community complaints will come via the hotline and not go directly to the EPA. The nature of the complaints will tend to be things that we can solve via the D and C contractor or ourselves. The matters that the EPA deal with are a more limited set of issues.

The Hon. Dr PETER PHELPS: Have you looked at the nature of the EPA complaints and compared them to the complaints received by the department's hotline?

Ms DROVER: I have not. I will have to take that on notice to see how much parallel overlapping there is. I am very happy to do that.

Response: For each complaint received, the channel it was received through is recorded (e.g. if the complaint was referred to WestConnex by the Department of Planning and Environment or Environment Protection Authority). We also note whether a complaint was copied to another organisation such as the Department of Planning and Environment, Environment Protection Authority, or a local council.

10. The Hon. Dr PETER PHELPS: Has it been necessary at instances for RMS to take out apprehended violence orders against individuals?

Mr KANOFSKI: I am not sure that we have taken out apprehended violence orders. I think we may have on occasion but we also—

The CHAIR: Will you take that question on notice?

Mr KANOFSKI: I will take that on notice.

Response: Roads and Maritime has recorded one instance in which two personal violence orders were taken out against the same individual in relation to the WestConnex project.

Incidents of abuse or threats of violence against staff are not recorded centrally. However, it is very rare, and the majority of interactions between Roads and Maritime staff and members of the public for WestConnex have been conducted without such incidents.

11. The Hon. Dr PETER PHELPS: Without identifying individuals, would you be able to take on notice instances and severity of abuse and threats of violence which have been raised against RMS employees?

Mr KANOFSKI: I am happy to do what we can in terms of numerics but, as you say, we certainly would not identify individuals.

Response: Please refer to my response to question 10.

12. The Hon. SHAOQUETT MOSELMANE: Do those five liaison officers and the complaints commissioners speak other languages?

Ms DROVER: I would have to take that on notice. I am not across which languages they speak.

Response: A Translating and Interpreting Service is available for all WestConnex projects, but under the conditions of approval there is no requirement for the Public Liaison Officer positions to speak a language other than English. These positions have now been appointed for the M4-M5 Link Tunnels project.

13. The Hon. SHAOQUETT MOSELMANE: Is there a data breakdown of people who complain and their language background and, therefore, are you able to address or provide more services in that language background?

Ms DROVER: I will take that on notice and confirm but I am sure we record whether a complainant requires a non-English—

Mr KANOFSKI: Translation.

Ms DROVER: —translation. Obviously, the next time we spoke to them, we would ensure that that translator was available.

Response: Roads and Maritime would record if a customer required support from the Translating and Interpreting service. Roads and Maritime does not specifically collect a data breakdown of languages spoken. However, WestConnex communication material and the WestConnex website includes information about how community members can use the Translating and Interpreting Service free of charge. In addition, if we have a communication activity which targets an area where the majority of stakeholders speak a language other than English, we publish material in languages other in English.

14. The Hon. GREG DONNELLY: And there have been six, yes. With respect to the six modifications that I specifically mentioned and which are formally notated or footnoted in the Department of Planning and Environment's paperwork, can you provide to the Committee information about the values of those modifications, or the costs of those modifications, to the project?

Ms DROVER: I will have to take that on notice and give you the exact detail per modification.

Response:

Modification 1: Administrative amendment to Conditions D6-D9 and B58. This was a clarification of the settlement assessment process and administrative in nature. No Project Change has been driven by this modification, and there is no cost to Roads and Maritime.

Modification 2: Administrative amendment to the timing stipulated in Conditions E03 and E44 requiring the six month timing and instead requiring compliance prior to operation. This was a clarification of the timing requirement for compliance with the condition. No Project Change has been driven by this modification, and there is no cost to Roads and Maritime.

Modification 3: Administrative amendment to Condition A4 stating that in the event of different interpretations of terms of the approval, the Secretary's interpretation is final. This was an administrative amendment. No Project Change has been driven by this modification, and there is no cost to Roads and Maritime.

Modification 4: Modification to Condition B64 to remove the reference to cycleway on Euston Road and replace with a pedestrian pathway and verge. This was modification to Condition B64 at the request of City of Sydney Council. A Project Change (CH-00123) incorporates this modification. There is no cost to Roads and Maritime.

Modification 5: Modification to Condition B67 to remove the restriction on open space behind the properties at 178-310 Princes Highway. No Project Change has been driven by this modification (as it existed within the Contractor's scope of works), and there is no cost to Roads and Maritime.

Modification 6: Modification to Condition B63 to align the requirements with the M4 East and M4-M5 Link approvals with regards to permitting the project to plant replacement trees within the project boundary, on public land within 500 metres of the boundary or outside 500m of the boundary if no more plantings are practical. This was a modification to Condition B63 to align with the M4 East and M4-M5 Link Conditions. No Project Change has been driven by this modification, and there is no cost to Roads and Maritime.

There is no cost to Roads and Maritime for the modifications, therefore there is no reason to indemnify SMC for costs.

15. Mr KANOFSKI: All of the modifications are within the contingency band for the project. I think we have taken on notice to give you the exact detail of the costing of the five.

The Hon. GREG DONNELLY: Mr Kanofski, can you provide me with an approximate value, as best you can, of those six modifications?

Mr KANOFSKI: No. I think I have taken on notice that we will—

The Hon. GREG DONNELLY: No, you did not, actually. Ms Drover took it on notice.

Mr KANOFSKI: —provide you with the costings for the modifications.

The Hon. GREG DONNELLY: For each? I would like it for each of those six that I have mentioned.

Ms DROVER: Yes. I said I would do that.

Mr KANOFSKI: Yes. We said we are happy to do that. What I would say, though, is that it is normal in a project of this scale for there to be modifications to it during its delivery. It is normal for the project to carry contingency in order to deal with things such as modifications.

The Hon. GREG DONNELLY: With respect to these modifications I have mentioned, the six of them, is it or is it not the position that RMS has agreed to indemnify the Sydney Motorway Corporation for any extra costs associated with these modifications?

Mr KANOFSKI: We would have to take the precise nature of that on notice, but there are quite a lot of issues that are really client issues.

The Hon. GREG DONNELLY: Well, Mr Kanofski, these are major modifications.

Mr KANOFSKI: True.

The Hon. GREG DONNELLY: If one looks at the paperwork, it goes to over 150 pages; that is, the detailed documents. These are not insignificant modifications. What you are saying is that you are not in a position here today to go into the detail of what they might be valued at, and I accept that. But surely you know, and you can give an answer today, of the position that we understand to be the case, which is that Roads and Maritime Services has agreed to indemnify the Sydney Motorway Corporation for any extra costs associated with the modifications.

Mr KANOFSKI: I was actually attempting to give you an answer to that a little while ago, but I will attempt again to give you an answer to that. As I said to you, within the six I will take on notice the precise issues.

The Hon. GREG DONNELLY: All six.

Mr KANOFSKI: But what I was going to tell you is that it is not unusual. Roads and Maritime Services has certain obligations and we are the ultimate client for the project, so it would not be an unusual circumstance. We are also responsible for obtaining and keeping planning approval. It would not be an unusual contractual situation—

The Hon. GREG DONNELLY: Anyway, you are speculating now because you do not know.

Mr KANOFSKI: Well, for us—

The Hon. GREG DONNELLY: No, no. I have asked you the question in regards to these six modifications. You have effectively taken them on notice and now you are speculating about what are contingencies that you might have with respect to projects. If you cannot answer with respect to these six, we will move on.

Mr KANOFSKI: I think I have taken that on notice.

The Hon. GREG DONNELLY: You have taken that on notice.

Response: Please refer to my response to question 14.

16. Ms CATE FAEHRMANN: You may have to take this question on notice. What price per tonne of carbon did RMS use in the WestConnex updated strategic business case to calculate the greenhouse gas emissions in the savings of $3.58 billion as a result of the WestConnex project?

Ms DROVER: I will definitely take that on notice.

Ms CATE FAEHRMANN: Another one: What is the total amount of tonnes of carbon emissions used to calculate the savings in the business case? Will you take that on notice as well?

Response: Greenhouse gas emissions in the WestConnex Full Scheme: Economic Appraisal (prepared by KPMG, November 2015) were estimated using fuel consumption equations given in 2014 National Guidelines for Transport System Management Environmental Parameter Values [PV4]. CO2 emission factors were sourced from the National Greenhouse Accounts, and the social cost of CO2 emission factors was sourced from the 2014 National Guidelines for Transport System Management Environmental Parameter Values [PV4].

The 2014 National Guidelines for Transport System Management Environmental Parameter Values [PV4] states that “the climate change greenhouse gas $/tonne values is based on the lower estimate used in CE Delft et al. (2011). The lower cost estimate [is] €25 per tonne of CO2.” This was then “adjusted to June 2013 using average cost base data from CE Delft et al. (2011) across EU27 countries. Values were converted to AU$2008 from €2008 via the exchange rate (historical exchange rate data sourced from the RBA); adjusted from June 2008 to June 2013 values (AU$) using CPI (historical CPI data was sourced from the ABS for All groups); adjusted for Australia in terms of key factors per country and per mode (e.g. population density) using Australian population density data, PPP and vehicle occupancy; adjusted in terms of pkm and tkm weighted by country and mode to obtain one weighted average estimate for Australia; and values as per $/pkm and $/tkm per mode were then converted to $/vkt using Australian data.”

The September 2015 WestConnex Updated Strategic Business Case states that "The economic assessment found that WestConnex will produce a greenhouse gas emission saving of $3.58 billion (undiscounted). This means that in 2021, WestConnex will contribute to a reduction in CO2 emissions of 610,719 tonnes. By 2031 this rises to 1,417,420 tonnes."

17. Ms DROVER: But all motorway tunnels, whether being built now, in the future or in the past will be subject to an environmental protection licence. The EPA will determine every year what is required. At the moment they are suggesting filtration is not required.

The CHAIR: It would be cheaper though if the filtration is put in at the beginning, as we found with the M5 East rather than after construction when it is a lot more expensive.

Mr KANOFSKI: I do not think the filtration was put in after the event, but I am happy to that on notice. The scrubbing system on the M5 was put in at the start I think.

Response: The cost of installing filtration systems depends on many factors.

The M5 East opened for operation in December 2001. To gather firsthand information on tunnel air treatment, the NSW Government ran a filtration trial in the M5 East from March 2010 to September 2011. The filtration system was put in place in 2010 to commence the trial. Further information about the trial is available at:

https://www.rms.nsw.gov.au/documents/about/environment/factsheet-tunnel-ventilation-and-filtration.pdf

18. The Hon. Dr PETER PHELPS: I want to refer to toll fatigue. When was the toll on the M4 first removed? Do you know what year that was?

Mr KANOFSKI: I will take it on notice but there was a cashback scheme on the M4 for a period in the 1990s.

The Hon. Dr PETER PHELPS: When was it finally removed?

Mr KANOFSKI: Sorry, I would have to take that on notice. My apologies.

Response: The original M4 toll was removed at midnight on 15 February 2010.

19. The Hon. Dr PETER PHELPS: That is a key point, is it not? It is built for but not with, because when you have the northern link you are going to have to deal with additional capacity on that system, are you not?

Mr KANOFSKI: There is an ultimate plan for an integrated transport network which incorporates an integrated motorway network. Clearly we have to have some view for what future demand would look like. Tunnels are very hard to augment; it is very difficult and expensive. I think we found out on the M2 that when you try and widen a tunnel it is a pretty arduous process and has pretty big impacts on customers. So typically tunnels are not augmented; you build them and that is the size they are. But I will let Ms Drover talk in detail about the capacity and planning.

Ms DROVER: We did look very closely at that submission. I am happy to take this offline and provide more detail on notice.

The Hon. Dr PETER PHELPS: It would be good if you could put it as a response to this Committee because we are going to have to deal with it in our final report. If you have a critique of it that is well founded I would be very much appreciative if you could add it as an additional submission.

Response:

1) A lane capacity of 2000 to 2050 vehicles per hour may be theoretically correct for a “basic freeway segment” as described in the Highway Capacity Manual (or the Austroads Guide to Traffic Management) but, in practice, this does not apply to tunnel segments. The base conditions for a basic freeway segment are defined (in Austroads Guide to Traffic Management Part 3 p. 46) by a number of characteristics:

- minimum lane widths of 3.6 m
- minimum left-shoulder lateral clearance between the edge of the travel lane and the nearest obstacle or object that influences traffic behaviour of 1.8 m
- minimum median lateral clearance of 0.6 m
- traffic stream composed entirely of passenger cars
- five or more lanes for one direction (in urban areas only)
- interchange spacing at 3 km or greater
- level terrain, with grades no greater than 2%
- a driver population composed principally of regular users of the facility
- the free speed is 120 km/h in rural areas and 110 km/h in urban areas.

Many of these factors do not apply in tunnel environments (and adjustments need to be applied to take changes in the environment into account). In practice, the lane capacity of a tunnel is much lower. It is important to also note that the capacities in the Austroads Guide to Traffic Management (and the Highway Capacity Manual) are in Passenger Car-Equivalent Units (PCUs), not vehicles.

2) The use of vehicles per hour to measure capacity (and volume relative to capacity) is not common practice, particularly for design purposes. Austroads uses PCU to reflect the impact of heavy vehicles. For roads where there is a high volume of heavy vehicles this can substantially increase the volume (as one heavy vehicle is equivalent to around 2.4 cars) relative to capacity.

3) For motorway performance, Roads and Maritime has required the design to operate under forecast conditions at a level of service D or better. Austroads Guide to Traffic Management for a 90 km/h freeway (as this is the lowest freeway speed), defines a maximum flow rate per lane of 1955 PCU/hr to achieve level of service D (Austroads Guide to Traffic Management Part 3 Table 4.5). Note that this does not take into account that the M4-M5 Link is in a tunnel environment, which would reduce this further. For comparison purposes only, we can convert this to vehicles per hour, assuming 10 per cent heavy vehicles and a PCU factor of 2.4. To achieve a level of service D with these assumptions, the maximum hourly flow rate is around 1700 vehicles per lane per hour.

4) In Stage 3A, there is not only a tunnel environment but also weave areas that further reduce capacity. This is primarily between Wattle Street and the Rozelle Interchange, but there is also weaving between Rozelle Interchange and St Peters Interchange.

5) When examining tunnel capacity it is not good practice to look at two-way flows for design purposes. All design is undertaken using one way flows as the spare capacity in the counter-peak direction is not available for use in the peak direction (particularly in a tunnel environment).

6) Lastly, the capacity of the tunnel has been designed to accommodate future potential motorway connections. This is part of "future-proofing" the design. Tunnels cannot be easily widened so the design needs to be considerate of potential future projects.

Note: For a basic freeway segment, level of service D is defined by Austroads as: *"the level at which speeds begin to decline slightly with increasing flows, with density increasing more quickly. Freedom to manoeuvre within the traffic stream is seriously limited, and the drivers experience reduced physical and psychological comfort levels. Even minor incidents can be expected to create queuing, because the traffic stream has little space to absorb disruptions."* (Austroads Guide to Traffic Management Part 3, p48)

20. The CHAIR: What is the height, roughly, that you are talking about?

Ms DROVER: I would have to take on notice the exact height where it is mixed with the background air, but certainly, where it is ejected, it is about 35 to 40 metres above ground level.

Response: The height of the ventilation outlets is dependent on the surrounding terrain, geography and airflow. The heights of the ventilation outlets for WestConnex Stage 3 are around 35 to 40 metres. Elevated ventilation outlets are very effective at ejecting tunnel air high into the atmosphere through a combination of natural buoyancy and speed. The warm tunnel air (heated by vehicles using the tunnel) is ejected upwards at speed through the outlet by strong axial fans. This air continues to rise high into the atmosphere as it is warmer than the surrounding air. Once in the atmosphere, the ejected tunnel air is diluted as it mixes with the surrounding air.

21. Ms CATE FAEHRMANN: I have a question in relation to a supplementary question that we got back from RMS. It was about a discussion with you, Mr Kanofski, from the previous day, when I asked for the $2.5 million grant that RMS provided to Lendlease to undertake an airport access link reference design. I asked you if you had seen the document. You said you would take it on notice as you did not know the document off the top of your head. The response was that in 2012 and 2013, Roads and Maritime Services engaged with multiple industry partners who had sufficient experience, capability and expertise to provide the services required to identify a technically feasible solution for Sydney's congestion. One of the engagements was with Baulderstone, now Lendlease, and Bouygues joint venture. That was not what I asked you to take on notice, which was the $2.5 million grant to Lendlease to undertake an airport access link reference design. I asked whether RMS had a copy of that design and you said that if you did you would take it on notice and have a look. You did not say in the response that you had the design.

Mr KANOFSKI: I am not sure, sorry.

Ms CATE FAEHRMANN: This was a supplementary question—a question on notice in the first instance anyway.

Mr KANOFSKI: My apologies. I am happy to relook at it if we have not answered the question.

Response: In 2012 and 2013 Roads and Maritime Services engaged with multiple Industry Partners who had sufficient experience, capability and expertise to provide the services required to identify a technically feasible solution for Sydney's congestion.

One of the engagements was with Baulderstone (now Lendlease) Bouygues joint venture (BBJV). BBJV prepared a report to present the investigations and key findings of its studies, covering: 'the Inner West Tunnel including Camperdown connection; Airport Access Link; and M5 East Duplication eastern portal…[to] ascertain preferred route alignments, connection points, and to provide supporting information in the preparation of a business case' for WestConnex.

The report produced by BBJV is attached.

22. Ms CATE FAEHRMANN: If you have the design will you give it to the Committee?

Mr KANOFSKI: Certainly.

Ms CATE FAEHRMANN: When you find the airport access link reference design that Lendlease produced under that $2.5 million grant, do you commit today to provide that to the Committee?

Mr KANOFSKI: Certainly. I think I gave the answer in two parts last time. One is that we will confirm whether we have it or not. I will absolutely confirm whether we have it or not and then I will seek to understand the status of that document in terms of whether it is to be provided because I do not know whether it was done under a Cabinet process or some other process that might limit my ability to provide it to you.

The Hon. Dr PETER PHELPS: Point of order—

The CHAIR: That is all right; it is just a bit of laughter at the back.

Mr KANOFSKI: But I am happy to confirm on notice. We will confirm whether we have such a document. If we have then I will—

Response: Please refer to my response to question 21.

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1.0 EXECUTIVE SUMMARY

1.1 The BBJV Team

The Baulderstone and Bouygues Construction Australia Team, referred to as BBJV, was appointed by the Sydney Motorway Project Office (SMPO) to undertake investigations and studies for the Inner West Tunnel and Airport Access Link components of the WestConnex Motorway.

We bring the local knowledge of successfully constructing the existing M5 East and Cross City Tunnels as well as the international expertise of tunnel construction in the Northern Hemisphere.

The primary objective of the Industry Development Team was to identify innovative solutions that provided the required connections and functionality for the Strategic Transport Network, but achieved them at a lower cost than had been identified as the Project Cost by the NSW Government by earlier studies.

1.2 Recommended Route

The BBJV Team has identified a more preferable route for this portion of the WestConnex Motorway that:

+ Provides an alternate connection to the Airport via Airport Drive approximately midway between the International and Domestic Terminal entries;
+ Provides an option with suitable grades that permits high clearance trucks (4.6m) to connect from Foreshore Drive, Port Botany to either the Inner West Tunnel and M4 Motorway, and the M5 Motorway by realignment of the M5 East Duplication to adjacent the Princes Highway rather than to Marsh Street;
+ Provides a connection that facilitates and supports the future development of the Mascot Employment Lands;
+ Permits the selection of additional enhancements that provide connections from the west to and from Parramatta Road, Camperdown and Parramatta Road near Arundel Street. It also permits connections from and to the west and to and from the south into Henderson Road near Australian Technology Park;
+ Permits the provision of connections at Parramatta Road, Taverners Hill where the Inner West Tunnel is proposed to join with the Motorway being brought from the existing M4.

The BBJV Team identified an alternate route that avoids unfavourable ground conditions that would require structure, and also reduces the amount of at-grade roads or elevated structures, thereby reducing land acquisition costs.

This route directs the Inner West Tunnel away from the existing filled brickpits at Sydney Park, skirting the open former brickpit at St Peters to surface adjacent the Princes Highway between Canal Road and the Port Botany Rail Line. The realigned M5 East Duplication also is directed to this area, and forms an interchange that provides two routes to the east to Mascot and to Airport Drive. One is via a widened Canal Road, the other via a new road parallel with the Port Botany Rail Line. Both roads provide grade separated connections to and from the realigned M5 East Duplication and the Inner West Tunnel.

An exhaustive review of the various options for designing and constructing the tunnel has been carried out, for both the 2x2 lanes and 2x3 lanes configuration including rectangular shape using roadheader, stacked carriageways using roadheader and/or TBM, twin-tunnel circular shape on TBM, in gripper mode with rockbolts and shotcrete, or shielded with full concrete segmental lining.

The findings of the study show that the rectangular roadheader option appears to be slightly more effective in terms of construction duration, flexibility and costs for the current 5km long scheme. The TBMs should be further investigated, in particular in the context of a possible longer tunnelled scheme. A particular focus should be the advantages of a fully lined tunnel in terms of maintenance and durability, as well as on the positive effect of the wider circular shape on the ventilation design and the related Capex and Opex.

The recommended construction methodology fully utilises the nature of horizontal bedding in Sydney sandstone by adopting rectangular shaped headings for mined tunnels which can be achieved using roadheaders and is consistent with all other road tunnels built in Sydney.

Trough and portal structures would be carried out using conventional methodologies of cut-and-cover construction. These would be constructed off-line from live traffic.

Realignment of the proposed M5 East Duplication avoids the following construction issues:

+ Constructing tunnel drives and structure in and adjacent to live traffic in a very constricted zone at the M5 East Marsh St portal;
+ The conversion of one of the existing tunnels to the opposite traffic direction, while still providing daily traffic flow (it has been assumed that the existing M5 must remain open to traffic during peak hours); and
+ Realignment places the new route within more favourable geological conditions, avoids the Wolli Creek under crossing and consequent steep grades at the west end to connect more efficiently with the M5 Motorway.

1.3 Spoil Re-use Or Disposal

It is estimated there is about 1 million m^3 of spoil generated by the Inner West Tunnel and Airport Access Link works.

Given the lack of certainty over timeframes for the delivery of the various components of the WestConnex Motorway the cost effective disposal of tunnel spoil may be an issue. The identification of sites for beneficial reuse of spoil, or as disposal sites by Government would help to manage this risk. The main issue for spoil disposal may be the imposition of the NSW Government Waste Levy (currently $95.20 per tonne). This could add approximately $200M to this section of the Project.

1.4 Budget Costing

The BBJV Team have optimised the scope and risk profile of the Project that results in an improved Value for Money outcome for the Government, with significant savings in construction budgets that lead to overall savings for the Project Budget.

These savings could be used to provide identified enhancements, such as additional ramps closer to the Sydney CBD, and thus better connectivity within the Motorway Network.

1.5 Operational Costs

During the Development process, BBJV were requested to provide assessments for tunnel services, particularly ventilation, and the effect this has on power usage.

The BBJV Team identified an optimal relationship between tunnel cross-sectional area and the number of fans required to meet congested traffic conditions. This needs more study to balance the construction and operation costs.

Along with this, BBJV identified several opportunities that can be further examined by the SMPO in their evaluation and Project Definition.

1.6 Revenue Generation

BBJV were not required to examine revenue streams from the Motorway.

However, it is evident that maximising sections of the Motorway, that can be distance tolled, provides a revenue stream. Other sources of revenue that can be explored include the redevelopment of acquired land surplus to the Motorway, or land, such as a former brickpit, that could be enhanced by use for spoil disposal so that it can be redeveloped.

More sources can potentially be obtained by value capture of currently underutilised land that is value enhanced by its connection to the Motorway.

Another potential source may come from the sale of treated tunnel water as a source of grey water to Local Council, or to nearby developments.

These would need further research and evaluation during Project Definition and subsequent Design Phases.

1.7 Urban Regeneration

Our team has identified parcels of land that that may be of interest to developers for redevelopment at the conclusion of construction.

1.8 Project Procurement

The BBJV Team has identified potential package sizes that can be readily accommodated within the current Australian market, and across various tiers of the construction market. These have been provided in a suggested order that enables sequential opening of new roads and connections that offer potential early revenue streams.

Various strategies have been discussed with SMPO, on how the NSW Government can utilise to the Governments best advantage the skills and resources of the private sector, while still retaining 'competitive tension' in the market. These could include simple competitive Early Contractor Involvement or Managing Contractor roles, where the private sector provides the additional skilled resources not normally available to the NSW Government through Agencies and consultants.

1.9 Future Actions

Additional certainty in the proposals for the Recommended Route can be obtained by carrying out further work in the following areas at minimal cost to the Project Development:

+ Site Investigation in select locations (portals, valleys)
+ Traffic analysis and testing of the proposed routes and portal locations
+ Fieldwork and Desktop studies to further identify and quantify constraints, such as services
+ Further optimisation and innovation leading from the above investigation results.
+ Ranking of options to assist SMPO in the evaluation of the Base Case and additional enhancements.

This further information can provide greater certainty for the proposals and reduce the Project's risk profile.

The BBJV Team can provide assistance to undertake analysis of options, or mobilise resources to undertake field investigations, including detailed services investigations on behalf of SMPO.

1.10 The BBJV Study Achievements

The outcome of the BBJV Team's review and recommendations is significant.

Innovation has been applied to produce an outstanding result offering cost savings, better use of land and better connectivity.

+ An indicative 35% saving in the Project Cost for the combined Airport Access Link and the Inner West Tunnel, depending on final scope definition
+ A 70% reduction in the required land acquisition
+ The potential for higher value land use in the Mascot and Airport areas as a result of the motorway being placed underground
+ The potential for more connectivity to the city by reinvesting the identified savings
+ Reduced project risk by avoiding or minimising the impact of those local features that are likely to increase the construction cost and the Motorway operational cost

The BBJV Team appreciates the opportunity of being involved in the WestConnex project at such an early stage and being given the opportunity to influence the development of the project at a stage when the alignment and associated land acquisition is open to review and innovation.

1.11 SMPO Objectives Traceability Matrix

1.11.1 Transport Planning

To inform the WestConnex strategic design, a set of transport planning objectives is needed. Four core transport planning objectives have been identified as follows, supported by principles to achieve them:

1 Serves market and customer needs	○ Understands and responds to customers and what they need.	Yes	The BBJV recommended option provides the customer efficient connectivity to major transport destinations such as the Sydney Airport and the City. Refer to Section 5 of the Report for further details.
	○ Serves transport customers in terms of: ○ Mobility – Ease of movement.	Yes	Refer to Section 5.1 – Recommended Option, Outline of Scheme
	○ Accessibility – Connects key land uses.	Yes	Refer to Section 5.6 – Traffic; and Enhancement Options Appendices M1 – M4
	• Legibility – Direct and clear routes to major destinations.	Yes	Refer to Section 5.6 – Traffic; and Appendix A - Key Plans
	○ Productivity – Values time, reliability and costs for business trips by all vehicles from light vehicles to larger heavy vehicles.	Yes	Refer to Section 5.6 – Traffic; and Section 5.6.2 – Truck Connections Section 5.6.3 – Cooks River Terminal
	○ Safety – For all road users, including professional drivers.	Yes	The BBJV Recommended Option is designed to the appropriate Austroads and RMS standards. Refer to Section 5.1 – Recommended Option, Outline of Scheme; and Appendix E – Geometric Design Criteria Appendix F – Tunnel Design Criteria; Appendix J – Assumptions on Motorway Operations
	○ Experience – Comfort and information.	Yes	Refer to Section 5 – Recommended Option
2 Integrates with the existing transport system	○ Integrates with Sydney's existing road hierarchy, expanding its Primary Freight Network and connecting with the State Road Network.	Yes	The BBJV recommended option integrates with the existing road hierarchy with connections to the M5 East Motorway Duplication, and Parramatta Rd Camperdown. There is the potential for connections to a number of regional and sub-regional roads, depending on enhancements adopted Refer to Section 5; and Appendix A, Appendix L, and Enhancements Option Appendices M1 – M4
	○ Provides high quality connections with other Primary and Secondary Freight Routes.	Yes	Refer to Section 5; and Appendix A, Appendix L, and Enhancements Option Appendices M1 – M4
	○ Facilitates longer road-based trips, encouraging shorter trips by public and active transport options	Yes	Facilitates longer based trips from the South West and West, whilst encouraging short trips through numerous connectivity points on the project. Refer to Section 5; and Appendix A, Appendix L, and Enhancements Option Appendices M1 – M4
	○ Supports the implementation of Sydney's Core Bus Network (Tier 1 and 2) with priority infrastructure.	Yes	Refer to Section 2.1
	○ Retains a suitable network of toll free routes at surface.	Yes	The BBJV Recommended Option retains the existing road network for toll free routes.
	○ Retains a suitable network for dangerous goods movements.	Yes	The BBJV Recommended Option retains the existing road network for dangerous goods movements. Refer to Section 5.6.2
	○ Supports road movements to/from intermodal facilities at the Enfield and the Cooks River Intermodal Terminals	Yes	The BBJV Recommended Option retains and can enhance movements from the Cooks River Terminal. The scheme supports movements from the Enfield Terminal via connectivity from the M5 East Duplication. Refer to Section 5.6.3

3 Transforms the city and reshapes local travel	○ Optimises use of the new infrastructure of the Project and reduces traffic on the existing road network.	Yes	The BBJV Recommended Option optimises the new infrastructure, whilst reducing local road traffic through efficient connectivity to major transport destinations such as the Sydney Airport, ON TO Port Botany, Mascot Employment Lands, and the City. Refer to Section 5.
	○ Creates a new motorway link in the State Road hierarchy that reduces "rat-running" on local and regional roads.	Yes	The BBJV Recommended Option provides connectivity to the motorway network of the M5 East Duplication and M4 Motorways. Refer the Section 5
	○ Creates new opportunities to positively change the functionality and operation of Sydney's State Road network, including new ways of managing some roads.	Yes	The BBJV Recommended Option provides opportunities to positively change the functionality and operation of the Road Network through the connectivity alternatives offered. Refer to Section 5; and Appendix A, Appendix L, and Enhancements Option Appendices M1 – M4
	○ Creates new opportunities to reallocate road space to public transport, such as better facilitating turning movements and changing signal phasing to improve more sustainable localised travel where feasible.	Yes	Refer to Section 5
	○ Creates new opportunities for reallocating road space on the existing road network away from private vehicles to public transport, cyclists and pedestrians.	Yes	Refer to Section 5; and Appendix A, Appendix D, Appendix L, and Enhancements Option Appendices M1 – M4
	○ Improves travel times on east-west and north-south bus and bus/rail trips, cycling and walking trips	Yes	Refer to Section 5; and Appendix A, Appendix D, Appendix L, and Enhancements Option Appendices M1 – M4
	Improves opportunities for on street parking in the off peak to support retailing and urban renewal.	Yes	Refer to Section 5; and Appendix A, Appendix D, Appendix L, and Enhancements Option Appendices M1 – M4

4 Future proofs for long term growth and change	○ Allows for future extensions, connections and access points to and from – • Sydney's north (potentially Victoria Road or a Third Harbour Crossing),	Yes	Refer to Section 7
	• Sydney's south (F6 Corridor) and	Yes	Refer to Section 7.1
	• Sydney's west (access between North Sydney, the CBD and Airport via the Inner West Tunnel).	Yes	Refer to Section 7
	○ Preserves opportunities for a potential mass transit system in the longer term, including rapid bus and/or light rail on Parramatta Road.	Yes	Refer to Section 5; and Appendix A, and Appendix D
	Provides opportunities for growth and change in higher productivity vehicles using the Project, which have greater efficiency through greater height, length and mass requirements.	Yes	Refer to Section 5; and Appendix A, Appendix L, and Enhancements Option Appendices M1 – M4

1.11.2 Urban Renewal Objectives

To continue to inform and the development of the WestConnex proposal a set of more detailed set of urban renewal objectives is needed. The renewal objectives for WestConnex are to plan and design an outcome that:

1 Optimises and balances land use	○ Maximises the land available for renewal along the Parramatta Road corridor.	Yes	Provides for opportunity for both Parramatta Road and the Princes highway. Refer to Section 5, Section 6, and Appendix D
	○ Supports an appropriate mix of land uses for the Parramatta Road corridor.	Yes	Provides for opportunity for both Parramatta Road and the Princes highway. Refer to Section 5, Section 6, and Appendix D
	○ Improves living conditions by reducing traffic flow along Parramatta Road.	Yes	Provides potential for alternate Parramatta Road cross section configuration. Refer to Section 5, Section 6, and Appendix D
	○ Creates excellent outcomes by integrating urban form and road design to create high quality, memorable places that complement and enhance the character of the corridor.	Yes	Refer to Section 4.8 Refer to Section 5, Section 6, and Appendix D

2 Improves the economic performance of the Parramatta Road corridor	○ Improves the financial performance of existing buildings in the Parramatta Road corridor such that the private sector is encouraged to renew existing structures.	Yes	Refer to Section 6, and Appendix D
	○ Encourages urban renewal without the need for large scale Government intervention in the property market.	Yes	Refer to Section 6, and Appendix D
	○ Captures part of the increase in value attributed to WestConnex and transport improvements.	Yes	Refer to Section 6, Section 8, and Appendix D

1.11.3 Environmental Objectives

To inform the design and development of the WestConnex proposal a set of environmental objectives is needed. A core environmental objective has been identified for WestConnex supported by principles to achieve it as follows:

1 Enhance the environment and protect natural and cultural resources	○ Maintain regional air quality so as not to have a detrimental impact on human health	Yes	Refer to Section 7, Appendix D, and Appendix I
	○ Minimise adverse impacts at a local level on air/noise quality	Yes	Refer to Section 7, Appendix D, and Appendix I
	○ Ensure air quality in tunnel meets EPA standards and visibility expectations	Yes	Refer to Section 7, Appendix D, and Appendix I
	○ Minimise impacts on natural systems including biodiversity	Yes	Refer to Section 7, Appendix D, and Appendix I
	○ Minimise impact on Aboriginal and European cultural heritage	Yes	Refer to Section 7, Appendix D, and Appendix I
	○ Protect surface and groundwater sources and water quality including management of contaminated areas	Yes	Refer to Section 7, Appendix D, and Appendix I
	○ Minimise construction and operational energy use ○ Identify and implement construction and operational processes which are sustainable	Yes	Refer to Section 7, Appendix D, Appendix J, and Appendix I
	○ Provide for improvement of social and visual amenity	Yes	Refer to Section 7, Appendix D, and Appendix I
	○ Minimise impacts on surrounding land uses and support urban renewal objectives	Yes	Refer to Section 7, Appendix D, and Appendix I
	○ Maintain access to and quality of community recreation and open space areas.	Yes	Refer to Section 7, Appendix D, and Appendix I

1.11.4 Communications and Community Engagement Objectives

1	Active listening and evidence – based learning	○ Ensure stakeholder groups engage with the project in a way that is appropriate and achieves a new standard for concept development.	Yes, Future	The project can provide the basis for active engagement. Refer to Appendix D
		○ Balance pre-empting any decisions that will result from the development of the Business Case with ensuring a consistent and coherent narrative that provides opportunities to engage with communities, stakeholders, media and industry.	Yes, Future	The project can provide balance through demonstration of good outcomes that are based on practical outcomes not only cost driven imperatives. Refer to Appendix D
2	Whole of project perspective	○ Test the parameters of the concept.	Yes, Future	The project can provide information to demonstrate that parameters have been tested. Refer to Section 3, Section 5, and Appendix D
		○ Ensure key local audiences understand the rationale for the project's 'big picture' benefits.	Yes, Future	The project provides a 'big picture' view of issues. Refer to Section 3, Section 5, and Appendix D
		○ Manage the road vs public transport debate and position WestConnex within the framework of the Long Term Transport Master Plan as well as the State Infrastructure Strategy.	Yes, Future	The project provides a 'big picture' view of the issues. Refer to Section 3, Section 5, and Appendix D
3	Engage widely / stakeholder mapping	○ Segment messages and input according to the target audiences.	Yes, Future	The project provides a list of issues and target audiences. Refer to Section 8
		○ Facilitate a coalition of active supporters of the project.	Yes, Future	The project provides a list of potential active supporters. Refer to Section 8
		○ Manage expectations of each of the targeted audiences e.g. Industry will understand that ground will not be broken for at least two years but they will need to be assured that the project is real.	Yes, Future	The project provides a list of potential issues and explanations. Refer to Section 8
4	Prepare grounds for the successful release of the Business Case	Engage with communities and industry to a level that their input informs the evolution of the Business Case.	Yes, Future	Refer to Section 3, Section 5, Section 8, and Appendix D
		Ensure there is enough local story elements and activity to fill the void so that the story is not taken over by others.	Yes, Future	Refer to Section 3, Section 5, Section 8, and Appendix D

2.0 REPORT SCOPE

2.1 Introduction

This Report has been prepared by the BBJV Team to present the investigations and key findings of the studies done as an Industry Partner Development Team. The WestConnex components that are the subject of this Report are:

+ Inner West Tunnel including Camperdown connection
+ Airport Access Link
+ M5 East Duplication eastern portal

The Report outlines the potential route for urban motorway tunnels and location of tunnel portals, surface connections and at grade or above ground structures, and network connections now and in the future.

This Report is intended to be used by SMPO to ascertain preferred route alignments, connection points, and to provide supporting information in the preparation of a business case for NSW Government consideration.

2.2 Overview of WestConnex Project

The WestConnex Motorway Project has developed from a number of studies by NSW Government Agencies over the last seven years.

The formulation as WestConnex Motorway was in the NSW Draft Long Term Transport Masterplan issued in 2012. More detailed concepts for the WestConnex Motorway were included in the NSW State Infrastructure Strategy 2012 - 2032 prepared by Infrastructure NSW.

WestConnex Motorway is required to connect from the current east end of the M4 Motorway at Concord Road, North Strathfield, along the Parramatta Road Corridor providing intermediate on-ramps and off-ramps, and then to the east end of the proposed M5 East Duplication via St. Peters and Tempe. Connections are required to be facilitated to the Mascot Employment Lands, to the Airport, and ultimately to the Port Botany Terminals.

2.3 Project Objectives

As outlined in the SMPO Request for Proposals issued November 2012, the stated objectives of WestConnex are:

+ Support Sydney's long-term economic growth through improved motorway access and connections linking Sydney's international gateways and Western Sydney and places of business across the city.
+ Relieve road congestion so as to improve the speed, reliability and safety of travel in the M4 and M5 corridors, including parallel arterial roads.
+ Along these corridors cater for the diverse travel demands that are best met by road infrastructure.
+ Create opportunities for urban renewal, improved liveability, public and active transport improvements along and around Parramatta Road.
+ Enhance the productivity of commercial and freight generating land uses strategically located near transport infrastructure.
+ Fit within the financial capacity of the State and Federal Governments, in partnership with the private sector.
+ Optimise user pays contributions to support funding in a way that is affordable and equitable.

These Objectives are further detailed by the WestConnex 'Transport Planning Objectives & Network Design Targets' issued 19 Feb 2013. These are summarised in the following key points:

+ Serves key market needs and customer needs;
+ Integrates with the existing transport systems;
+ Transforms the city and reshapes local travel;
+ Future proofs for long term growth and change in vehicle transit modes.

2.4 Funding

Funding for construction of the WestConnex proposal has not been determined. A mix of government and private sector investment is the likely final finance model.

A suggestion has been that new roads and upgraded roads be tolled, possibly on a distance toll basis.

The primary purpose of the route and motorway is to provide connection between the desired and required origin and destination points. If this is efficient and effective, tolling of roads may not be a significant influencing factor in people's decisions to use or seek alternative routes.

Therefore, the BBJV Team has endeavoured to find a route that:

+ Connects to the desired destination points such as Mascot Employment Lands, the Airport, and also permits access to the CBD periphery;
+ That provides another motorway route that will offer an alternate in emergency;
+ That offers significant lower construction costs by avoiding less suitable ground conditions.
+ Reduces land acquisition costs.

2.5 IPDT Process

The Baulderstone and Bouygues Construction Team, known as BBJV, was appointed by the Sydney Motorway Project Office (SMPO) to undertake investigations and studies for the Inner West Tunnel and Airport Access Link components of the WestConnex Motorway.

We bring the local knowledge of successfully constructing the existing M5 East and Cross City Tunnels as well as the international expertise of tunnel construction in the Northern Hemisphere

The primary objective of the Industry Development Team was to identify innovative solutions that provided the required connections and functionality for the Strategic Transport Network, but achieved them at a lower cost than had been identified as the Project Cost by by earlier studies.

3.0 PROJECT CONTEXT

3.1 Transport Context

3.1.1 Introduction

One of the first tasks undertaken by the BBJV implementation development team was a review of the WestConnex transport context, namely:

+ The role of the project in the Sydney context
+ Major network constraints within the Sydney network
+ Current travel patterns
+ Land Use forecasts

This analysis was considered crucial to the development of relevant and cost-effective WestConnex solutions for Sydney.

3.1.2 Overview

Sydney is the largest metropolitan city in Australia and is recognised as the fastest growing commercial hub in New South Wales.

To support this growth, a sustainable and economical transport network is required. Sydney's road network system consists of an extensive mix of freeways and toll roads. The most important trunk roads in the metropolitan area are the nine Metroads, including 110 km of connecting freeways as part of the Sydney Orbital Network. Within this Orbital network, the M5 East Freeway is a 10 km long freeway connecting the M5 South West Motorway at King Georges Road, Beverly Hills with General Holmes Drive, Kyeemagh.

The M5 East Freeway comprises of twin, 4 km long two lane tunnels between Bexley Road, Earlwood and Marsh Street, Arncliffe. It is currently owned by the NSW Government and operated and maintained by Leighton Contractors under a contract with the Roads and Maritime Services (RMS).

There are several proposed major developments within the metropolitan area that may impact positively or otherwise on the proposed M5 East Freeway duplication. These are outlined in the Infrastructure NSW's 20 year plan for Sydney.

A key recommendation of Infrastructure NSW's 20 year plan for Sydney is to build the WestConnex Motorway network. This project involves an extension of the M4 Freeway to Sydney Airport and the duplication of the M5 East Freeway. The new motorway is expected to contribute more than $15 billion to the NSW economy and is the highest priority project in the State Infrastructure Strategy.

WestConnex will relieve traffic congestion on the existing M4 Parramatta Road and M5 East and support more efficient freight movements to Port Botany. It will also improve orbital road connectivity to the south and west of the CBD and improve access to Sydney Airport.

The NSW government have identified various options for the M5 East Freeway extension that provide differing levels of congestion relief. The simplest solution involves expanding the existing tunnels from two lanes to three in each direction. All the other options include building a new tunnel to increase its current capacity.

The current traffic levels along the M5 East Freeway and the high proportion of heavy commercial vehicles using both the M5 South West Motorway and the M5 East Freeway are the catalyst for causing heavy congestion and long travel times along the corridor, which impact on Sydney's economy and productivity.

The M5 East Freeway is currently an un-tolled motorway. However, the NSW government's proposals for the expansion of the M5 East Freeway are contemplating charging tolls to cover all or part of the construction costs. As a result, the NSW government is now looking to the private sector to help with the provision of the M5 East Freeway expansion. Procurement options range from using a privately funded public private partnership (PPP) contract to a fully government funded alliance contract.

3.1.3 Major Network Constraints

The major network constraints identified by the BBJV team included:

+ The missing M4-east link between Strathfield and the Sydney CBD. The capacity of Parramatta Road, with its multiple sets of signals, is exceeded by the upstream feeders such as the M4 Motorway. This has created a bottleneck through Burwood which is not relieved until Wattle Street. The poor connectivity of the M4 Motorway to the airport and Port Botany has resulted in major truck transfer movements from the M4 Motorway to the M5 Motorway via the M3 ring road. The BBJV felt that it was essential to increase Parramatta Road capacity between Strathfield and Haberfield, as a minimum.
+ The Anzac bridge. This key arterial crossing is under a lot pressure and there are limited opportunities to increase its capacity. The BBJV sought to find a WestConnex solution that would release some of that pressure.
+ The Eastern Distributor provides a crucial north-south link around the CBD. There is little built-in redundancy in the current north-south network. The BBJV sought to find WestConnex options that could provide a back-up to the Eastern Distributor.
+ Whilst both M5 East tunnels are under a lot pressure, the westbound tunnel has major capacity issues due to the impact of slow moving trucks on a rising 8% grade up to the Bexley Road portal. The elimination of this grade was a major driver for the government's current WestConnex solutions.
+ The General Holmes Drive tunnel has a 4.4m height restriction. This prohibits access by over-height (4.6m) vehicles. Civil engineering and SACL constraints prohibit options to increase the clearance in the tunnel. It became clear that the BBJV needed to find a Port Connectivity solution for heavy vehicles that avoided use of the tunnel as much as possible.
+ The government proposal to reverse the direction of the existing M5-east westbound tunnel and the positioning of the new portals at Marsh Street was seen as creating major construction traffic issues. The site is constrained and access to the airport and existing M5-East must be maintained during WestConnex construction. The BBJV felt it was crucial to find a solution that moved the new portals away from the constraints at Marsh Street and to avoid the M&E complexities of reversing an existing tunnel.
+ Initial advice from RMS was that the patronage on the Airport Link Access was very sensitive to tolls. RMS was proposing no-toll on the Airport Access Link. This suggests the current solution is providing insufficient benefits to drivers to maintain demand under a toll.

3.1.4 Travel Patterns

The Household Travel Survey (HTS) undertaken each year by the Bureau of Transport Statistics (BTS) provides a useful source of information on travel in Sydney. This provides some guidance on the travel characteristics of potential WestConnex users.

Summary statistics for vehicle driver trips across Sydney are presented in Table 3.1. The survey data suggests the following:

+ Driver trips are generally short in length and duration
+ The average driver commute or work related trip is 14 to 15 km in length, or around 30 minutes duration
+ Driver commuting and work trips only account for 36% of total daily driver trips
+ 64% of daily driver trips are associated with non-work related purposes (e.g. shopping and social purposes) and are between 5 and 10km in distance, or 13 to 20 minutes in length.

Table 3.1: Average Daily Number, Distance, Duration & Purpose of Driver Trips in Sydney GMA (2009/10)

Purpose	Average Car Travel Distance (km)	Average Car Travel Time (Minutes)	Average Car Driver Trips Per Day (000's)
Commute	13.6	25.7	1582
Work related business	15.1	27.9	1134
Education/ childcare	14.4	27.1	70
Shopping	5.4	12.8	1318
Personal business	7.4	16.6	592
Social/ recreation	9.5	19.8	1295
Serve passenger	6.3	14.0	1609
TOTALS			7600

3.1.5 Modelled Travel Patterns

The BBJV also undertook origin/destination analysis of major routes in/out of the corridor using the calibrated and validated SMEC strategic transport model. A description of this model is presented in Appendix B.

The BBJV undertook 'select link' analysis along the M4, M5-East, Gladesville Bridge, Anzac Bridge and Captain Cook Bridge to determine the major destination of users travelling towards the city centre during the AM peak.

The results are summarised in the tables below and appear consistent with the patterns observed in the HTS data, namely:

+ The majority of destinations were located less than 5-10km from the point of assessment.
+ Most users exiting the end of the M4 had a local destination in the areas of Concord, Burwood, Drummoyne and Marrickville. These suburbs alone accounted for nearly half the M4 user destinations.
+ Most users exiting the end of the M5-East tunnel had a local destination in the areas of Botany Bay, Rockdale, Sydney (Sth) and Randwick. These four suburbs alone accounted for up 77% of all M5-East user destinations.
+ The importance of the CBD as a destination rises steadily the closer you move towards the city centre

Table 3.2: Destination of M5-East Users (inbound)

SLA	% Of trips
Botany Bay (C)	30%
Rockdale (C)	16%
Sydney (C) - South	16%
Randwick (C)	15%
Sydney (C) - Inner	6%
Sydney (C) - East	6%
Marrickville (A)	3%
North Sydney (A)	2%
Willoughby (C)	2%
Woollahra (A)	1%
Other	3%

Table 3.3: Destination of M4 Users (inbound)

SLA	% Of trips
Canada Bay (A) - Concord	21%
Burwood (A)	11%
Canada Bay (A) - Drummoyne	10%
Sydney (C) - West	8%
Marrickville (A)	7%
Leichhardt (A)	7%
Ashfield (A)	7%
Sydney (C) - South	6%
Sydney (C) - Inner	4%
Botany Bay (C)	4%
Other	17%

Table 3.4: Destination of Gladesville Bridge Users (inbound)

SLA	% Of trips
Canada Bay (A) - Drummoyne	22%
Leichhardt (A)	19%
Sydney (C) - Inner	13%
Sydney (C) - West	11%
Sydney (C) - South	4%
Marrickville (A)	4%
Strathfield (A)	3%
Sydney (C) - East	2%
Burwood (A)	2%
Ashfield (A)	2%
Other	17%

Table 3.5: Destination of Anzac Bridge Users (Inbound)

SLA	% Of trips
Sydney (C) - Inner	45%
Sydney (C) - West	16%
North Sydney (A)	9%
Sydney (C) - East	7%
Sydney (C) - South	5%
Randwick (C)	5%
Willoughby (C)	3%
Botany Bay (C)	3%
Woollahra (A)	2%
Warringah (A)	2%
Other	4%

Table 3.6: Destination of Captain Cook Bridge Users (Inbound)

SLA	% Of trips
Rockdale (C)	40%
Kogarah (A)	25%
Botany Bay (C)	6%
Marrickville (A)	3%
Sydney (C) - South	3%
Randwick (C)	3%
Sydney (C) - Inner	2%
Sydney (C) - East	1%
Gosford (C) - West	1%
Ryde (C)	1%
Other	15%

3.1.6 Lessons Learnt

The key lessons learnt by the BBJV from this analysis of survey and modelled data were:

+ Road users are making relatively short trips on a day-to-day basis and require frequent access points to join and depart motorways. This is the best way to maximise patronage on WestConnex
+ Botany Bay, Rockdale, Sydney (Sth) and Randwick are key destinations for M5 users. The WestConnex access strategy needs to reflect these key desire lines
+ The WestConnex will increase the reach of users for a given travel time. This will open additional employment opportunities and/or allow users to live further away from work without impacting their daily commute time. Over time, this network improvement may result in significant land use changes as user travel patterns settle back into the optimum or 'user-acceptable' travel patterns. It is interesting to note that the average Sydney travel time of 30 minutes, for the daily commute by car, has remained constant over the last 10 to 20 years, despite major network improvements such as the Westlink M7, Lane Cove Tunnel, Eastern Distributor and M5-East. Any patronage assessment of the WestConnex must, therefore, involve the full 4-step modelling process (trip generation, trip distribution, mode share and trip assignment) to ensure these land use shifts are captured

3.1.7 Population & Employment Forecasts

The BBJV undertook a review of BTS 2036 population and employment forecasts in the north-south corridor, to guide the development of WestConnex access arrangements.

The major employment centres identified in the corridor were:

+ The Mascot station precinct (22,290 jobs)
+ Sydney Domestic Airport (12,590 jobs)
+ Sydney International Airport (7,300 jobs)
+ Green Square (7,170 Jobs)
+ Alexandria Industrial Area (5,670 jobs)

The major population centres identified in the corridor were:

+ Green Square (19,660 people)
+ Mascot (6370 people)

The BBJV developed its WestConnex access strategies around these critical centres.

Table 3.7: 2036 Population Forecasts for Specified Travel Zones (BTS, 2010)

TZ	Location	Forecast 2036 Population
285	Zetland, Woolahra Council Works Depot	13,060
284	Zetland, Green Square North	6,600
406	Mascot, Coward and Botany Roads	3,530
404	Mascot, Qantas HO and Station	2,840
386	St Peters Station South	2,320
288	Rosebery, Southside Business Centre	1,830
287	Beaconsfield Industrial Area	1,140
378	Marrickville, Sydney Steel	810
393	Tempe, Salvation Army	700
291	Alexandria, Eastern Suburbs Mail Centre	430
385	Marrickville, Sydenham Station West	420
290	Alexandria, Industrial Area	200
289	Burrows Industrial Estate	120
411	Sydney Domestic Airport	-
581	Sydney International Airport	-

Table 3.8: 2036 Employment Forecasts for Specified Travel Zones (BTS, 2010)

TZ	Location	Forecast 2036 Employment
404	Mascot, Qantas HO and Station	22,290
411	Sydney Domestic Airport	12,590
581	Sydney International Airport	7,300
284	Zetland, Green Square North	7,170
290	Alexandria, Industrial Area	5,670
291	Alexandria, Eastern Suburbs Mail Centre	4,400
378	Marrickville, Sydney Steel	4,290
406	Mascot, Coward and Botany Roads	4,040
287	Beaconsfield Industrial Area	3,110
386	St Peters Station South	2,070
385	Marrickville, Sydenham Station West	1,590
288	Rosebery, Southside Business Centre	1,270
285	Zetland, Woolahra Council Works Depot	1,070
289	Burrows Industrial Estate	920
393	Tempe, Salvation Army	760

3.2 Urban Design Context

The project will need to be considered within the larger context of a number of other initiatives within Sydney. Urban development initiatives will be based on a developing response to local site conditions as well as an understanding of how they further the aims of strategic plans for Sydney.

Initiatives currently underway in Sydney include major strategic documents and local government area (LGA) plans. This report focuses on the major strategic plans with the understanding that a response to LGA plans will form part of a more detailed view of this project as it is further developed.

Strategic initiatives within the project study area include:

+ The Sustainable Sydney 2030 Plan
+ The Metropolitan Strategy
+ The Urban Activation Precinct (UAP) initiative by DoPI
+ Sydney Airport Master Plan - 2009
+ NSW Long Term Transport Master Plan
+ INSW State Infrastructure Strategy

A review of these initiatives is included here. Rather than reproduce sections of these initiatives in this report a summary of the major interfaces with WestConnex has been included. Where next steps or consultation is likely to be needed as the project proceeds it is noted in the text.

The above list is not intended to be exhaustive but to provide a reference point for understanding WestConnex and the urban issues that have been brought to bear on this study.

3.2.1 Sustainable Sydney 2030 Plan

The plan is focused on delivering a sustainable future for Sydney and identifies a number of project ideas for realising this vision. The WestConnex corridor can be a catalyst for the extension of the 'Main Green Corridors' toward the south and west. It has potential to foster an additional link in the 'Harbour to The Bay' link by acting as a catalyst to redevelopment along the Alexandra Canal. The Eora Journey also provides a framework for linking a series of significant Sydney elements which could conceivably be folded into an idea of linking public domain elements from the Cook's River to the harbour.

3.2.2 Metropolitan Strategy

The strategy provides for a vision of a multi-centered city with an extended and reinforced global arc for the city. WestConnex, as a link in the strategic motorway network, can help facilitate the extension of the global arc toward the south by providing a framework for redevelopment and intensification of creative business activity in and around the airport. By providing opportunity for removing through traffic from Parramatta Road and the Princes Highway, the project can also facilitate the strengthening of existing village centres.

3.2.3 Urban Activation Precinct (UAP) Initiative

The UAP initiative identifies several places within metropolitan Sydney as growth and activation centres. These have been identified as places for higher density living/working centres in order to facilitate urban consolidation, capitalise on transport availability and provide for legibility for infill development. WestConnex can provide strong links to the Mascot UAP and can foster like-minded thinking in terms of some areas of the Princes Highway and Parramatta Road where the benefits of ready access to transport can be exploited in order to provide improved legibility to village centres and to facilitate creative redevelopment of sites affected by the project.

3.2.4 Sydney Airport Masterplan 2009

The Sydney Airport Masterplan 2009 is a strategic document intended to highlight the operations directions for the future of the airport and to identify physical works needed to support these. WestConnex will interface with the airport in two ways. In terms of access it will provide improved access to surface roads around the airport from the motorway network and, should an enhanced design be implemented, will directly affect access roadways where roadway reconfigurations will be undertaken along the north and east sides of the airport. WestConnex is being developed with an understanding that close coordination with Sydney Airports Corporation will be needed as the project is further developed to ensure that a seamless interface is achieved.

A second area of interface of the project with the airport will occur in and around the 'Northern Lands Logistics Precinct'. WestConnex will provide greater access to these lands and the potential of redevelopment as part of an expended airport hub between the Alexandra Canal and the Princes Highway. This could be seen as an aspirational goal once the immediate masterplan areas for commercial development, earmarked for the northeast and north-west sectors, are completed. Redevelopment opportunities here will need to be carefully coordinated with the airport and Councils.

3.2.5 NSW Long Term Transport Master Plan

The Long Term Transport Plan put forth by Transport for NSW emphasises the links between a healthy economy and a robust transport system. The plan covers initiatives for all modes of transport including roadways, railways and ferries. It cites the development of Sydney as a multi-centered, connected city with a transport system that allows for flexibility and supports a sustainable and walkable collection of precincts.

WestConnex can be understood as a project that can relieve bottlenecks, provide a catalyst for redevelopment and serve as a vehicle for returning surface level streets to their surrounding communities to foster walkability and sustainability. The WestConex corridor is also well served by existing public transport options which can be leveraged for greater benefit as the project is implemented.

Truck movement considerations form a part of the WestConnex strategy and these are also noted as a concern of the transport master plan.

3.2.6 INSW State Infrastructure Strategy

The State Infrastructure Strategy 2012 – 2032 by Infrastructure NSW identifies key projects and timetables for delivering infrastructure across the state for the next two decades and beyond. It identifies project delivery as Now (0-5 Years), Next (5-10 years) and Later (10-20 years.) It cites the WestConnex project as a 'Next' stage project for a mid-term delivery and notes the importance of the project as part of an overall balanced approach to a public and private transport system.

3.2.7 WestConnex Project Context

To supplement the initiatives noted above the WestConnex team has provided a high level overview of the project context into which urban development issues have been placed. These include:

+ Strategic Connectivity
+ Legibility – Green Gateways
+ Strategic Transport Context
+ Development 'Hot Spots'
+ Environment / Natural Systems Issues

3.2.8 Strategic Connectivity

WestConnex can provide reinforcement for the strategic access corridors in and around key hubs of global Sydney. Whilst the project can be considered on a traffic study basis for the corridor demands itself, consideration should also be given to the need to provide alternate routes in case of emergency and/or disruption to any leg of the network. This built in redundancy, as a strategic objective of the project should not be overlooked.

This network needs to be easy to understand making the choice of alternate routes an easy decision to make and allowing users to adjust their travel patterns in response to perceived traffic conditions. This allows the network to be somewhat self-correcting on a daily basis.

3.2.9 Legibility, Wayfinding & Clear Hierarchy

+ A motorway network that is 'intuitive' and simple to understand and use
+ Avoid complex intersections that rely only on signage for legibility and navigation
+ Provide a common infrastructure architectural language and landscape design can reinforce legibility and provide important cues

3.2.10 Network Robustness & Flexibility

+ Build-in motorway network flexibility, leaving alternative routes to serve key nodes
  - City to airport
  - Airport to port
  - City to west
  - Airport/city to north

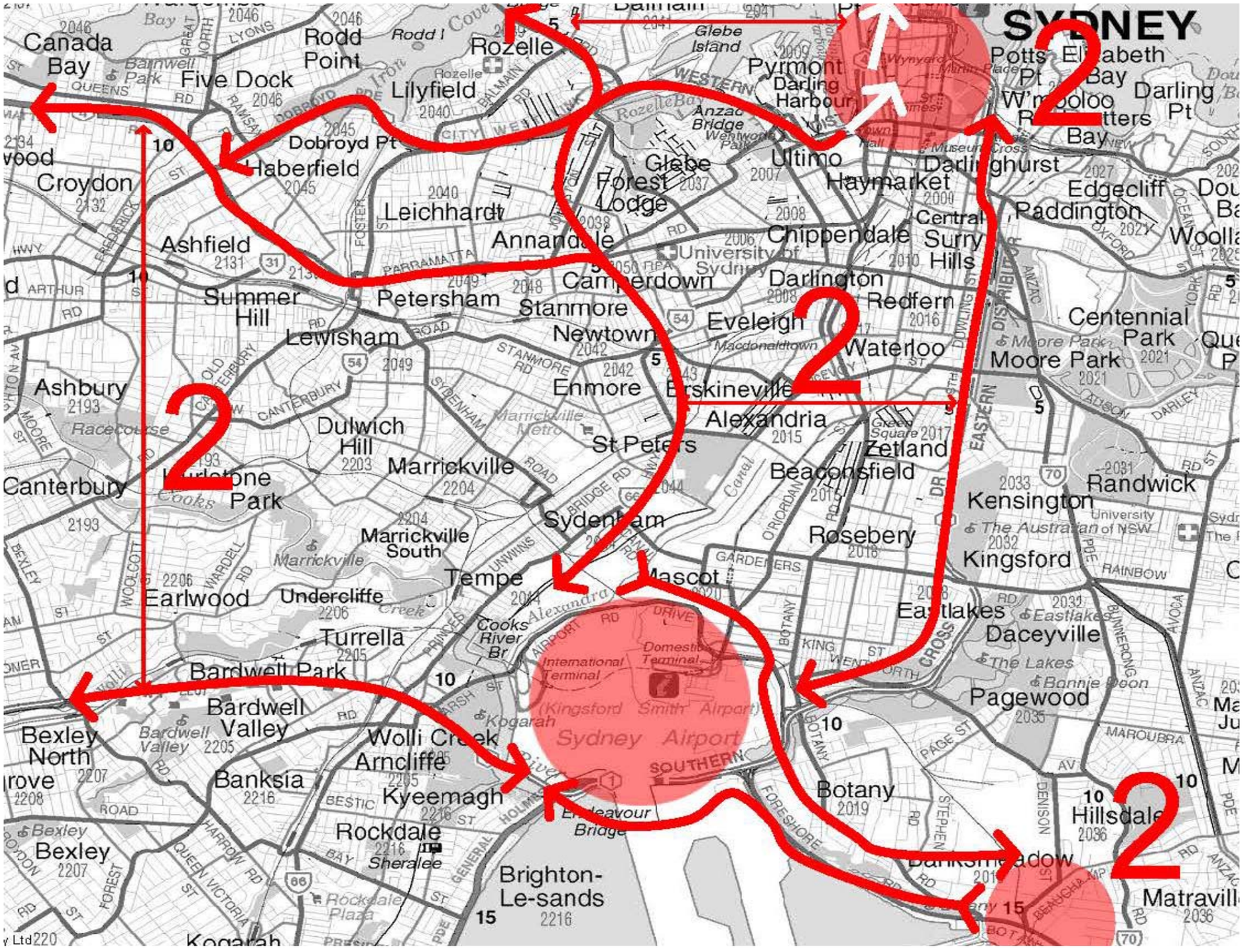


Figure 3.1: Strategic Connectivity

3.2.11 Airport Gateway

Legibility is a key component of a successful urban framework for any city. This extends to an understanding of open space structures, street patterns and connections and gateways to major precincts and transport nodes.

Legibility for transport nodes is particularly important as these nodes provide the link between a city and other sites served by the transport node. In the case of WestConnex, the key transport node is Sydney Airport and its connection to other global cities.

The present approaches to Sydney airport provide legibility in the form of Green Gateways. The approaches from motorway connections to the east and west of the airport provide legibility to the airport precinct. The current approach from the north toward the domestic terminal area does not provide this clarity. WestConnex offers an opportunity to create this legibility from the north and the M4.

+ West Gateway through Marsh Street with views over Kogarah Golf Course and Tempe Recreation Reserve.
+ East gateway through 'The Lakes' golf courses and other green reserves provide eastern approach to the airport.
+ WestConnex can provide a potential north green gateway.

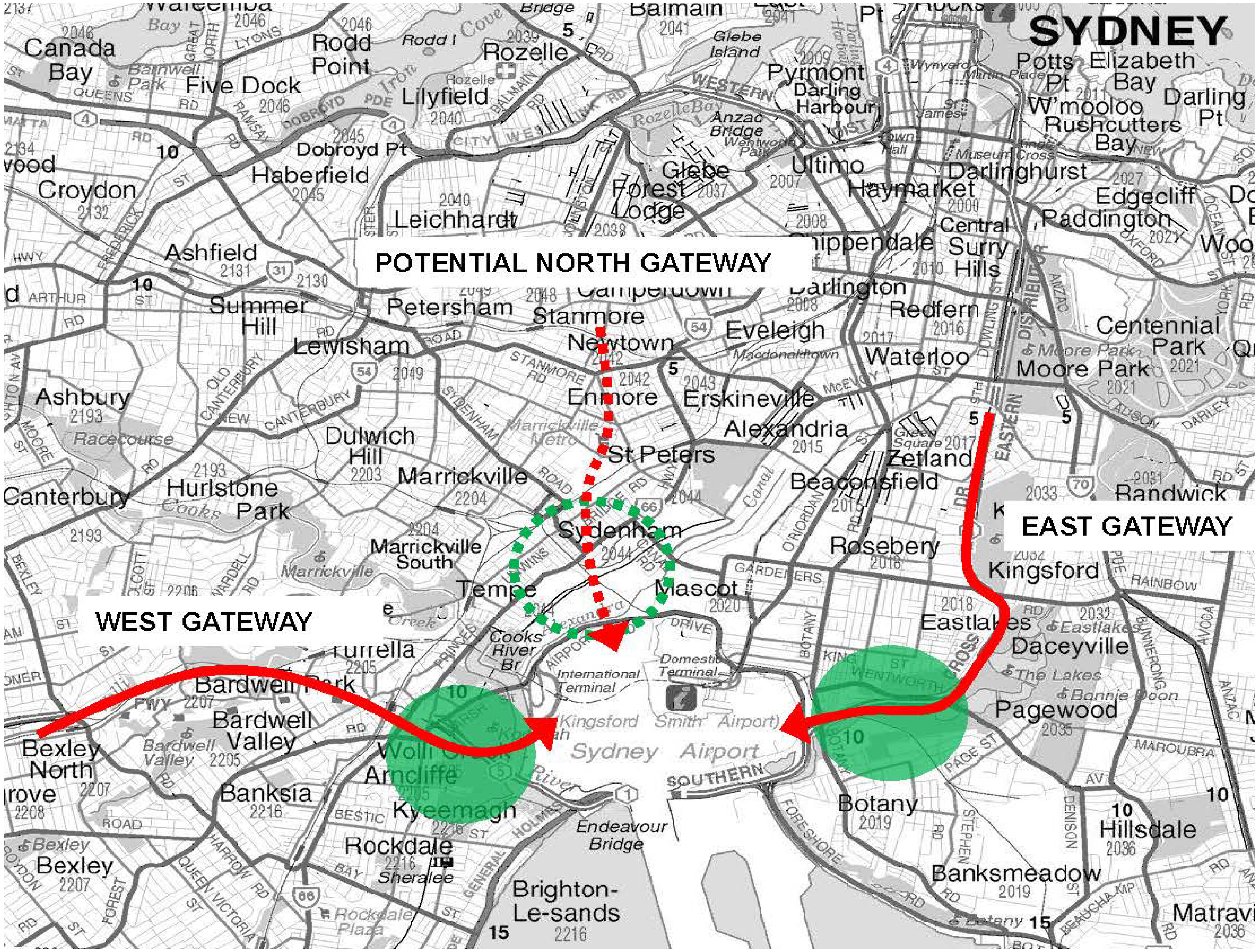


Figure 3.2: Legibility and Airport Gateways

3.2.12 Strategic Transport Context

The extent that the project can take through traffic off of the strategic roadways and free up space within these corridors for public domain improvements will determine the extent to which the project can act as a catalyst for regeneration along the corridors. This is also dependent on the extent to which alternate transit options exist to serve this corridor.

Both the Parramatta Road corridor and the Princes Highway corridor are well served by existing heavy rail lines and stations.

A review of the 10 minute catchment from heavy rail stations indicates that Parramatta Road is well served between Taverns Hill and Camperdown by Summer Hill, Lewisham, Petersham and Stanmore Stations. The corridor also connects points on the light rail as it traverses the inner west from Taverners Hill to Central station.

A review of the 10 minute catchment from heavy rail stations indicates that The Princes Highway is well served between Sydney Park and Tempe by Tempe, Sydenham and St Peters Stations. The corridor also connects points on the light rail system as it traverses the inner west from Taverners Hill to Central station.

A review of the 10 minute catchment from heavy rail stations indicates that Alexandra Canal Corridor is close to the catchments of Mascot, St Peters and Sydenham stations. Although not fully within these catchments, extending the catchments to approximately 12 minutes would yield effective coverage.

+ Corridor is well served by transport systems.
+ Catchments cover much of adjacent areas
+ Future transport plans will supplement coverage to other areas adjacent to the corridor.

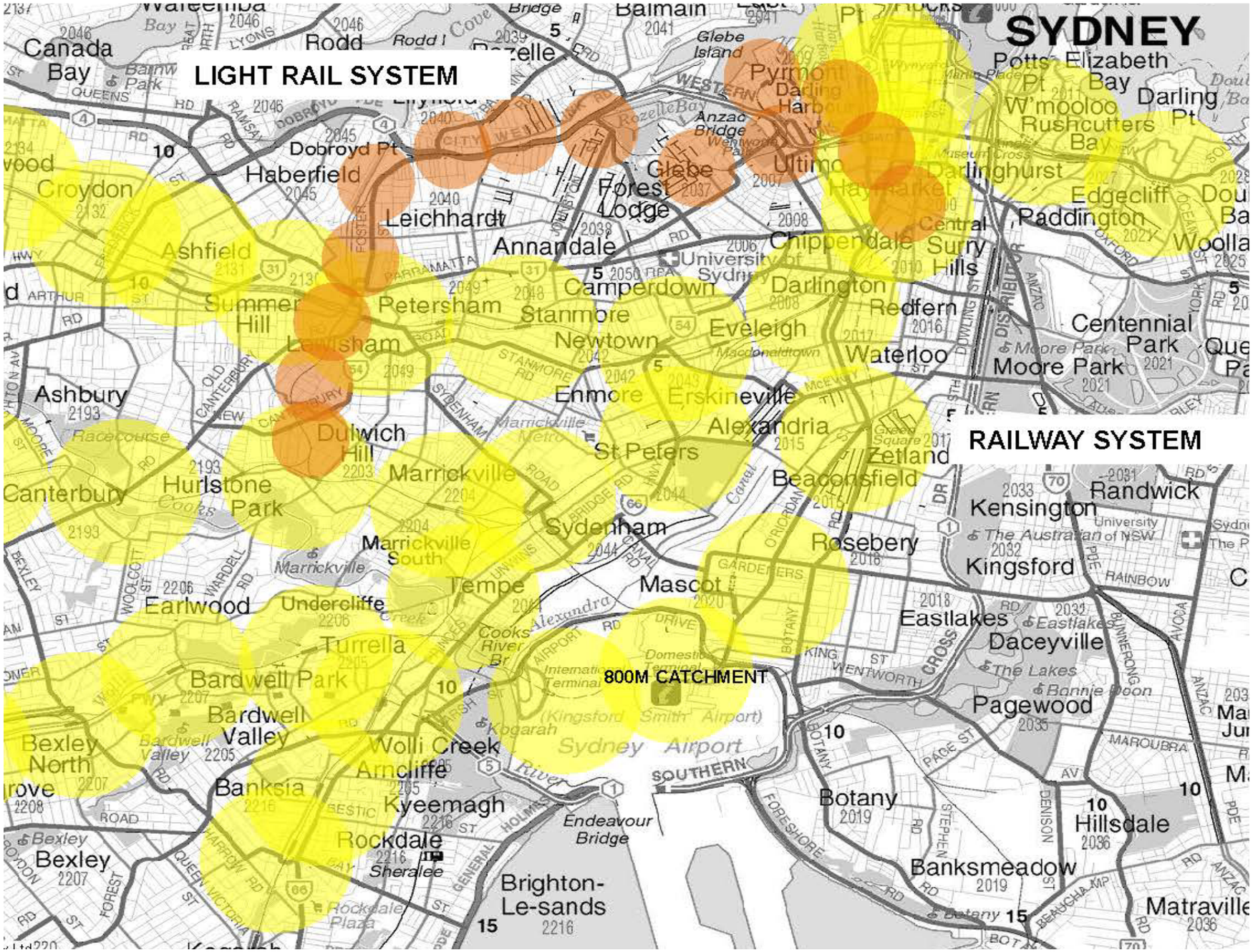


Figure 3.3: Strategic Transport Context

3.2.13 Development Hot Spots

The WestConnex corridor is situated near a number of significant development hot spots and development project areas in and around Sydney. These have been indicated to illustrate the strategic importance of WestConnex as a vehicle for providing better access to areas that are undergoing a significant increase in the density of residential and job concentration.

WestConnex will also provide direct and indirect regeneration opportunity in a number of urban corridors.

Proximity to major development areas in and around the western edge of the CBD and Airport includes:

+ Camperdown – Commercial, Residential and cultural development
+ White Bay – Mixed use development
+ Darling Harbour – Entertainment and special event uses
+ Central Park – Residential development
+ Waterloo – Residential development
+ Green Square – Residential development
+ Mascot – Residential and mixed use development
+ Airport – Potential development for airport related facilities
+ Wolli Creek – Residential development
+ Kogarah Golf Course Site - Previous Cook's Cove Development

Potential corridor regeneration possibilities of the project include:

+ Parramatta Road – Regeneration, potential uplift incentives, mixed use
+ Princes Highway – Regeneration, potential uplift incentives, mixed use
+ Alexandra Canal – Regeneration potential, creative industries

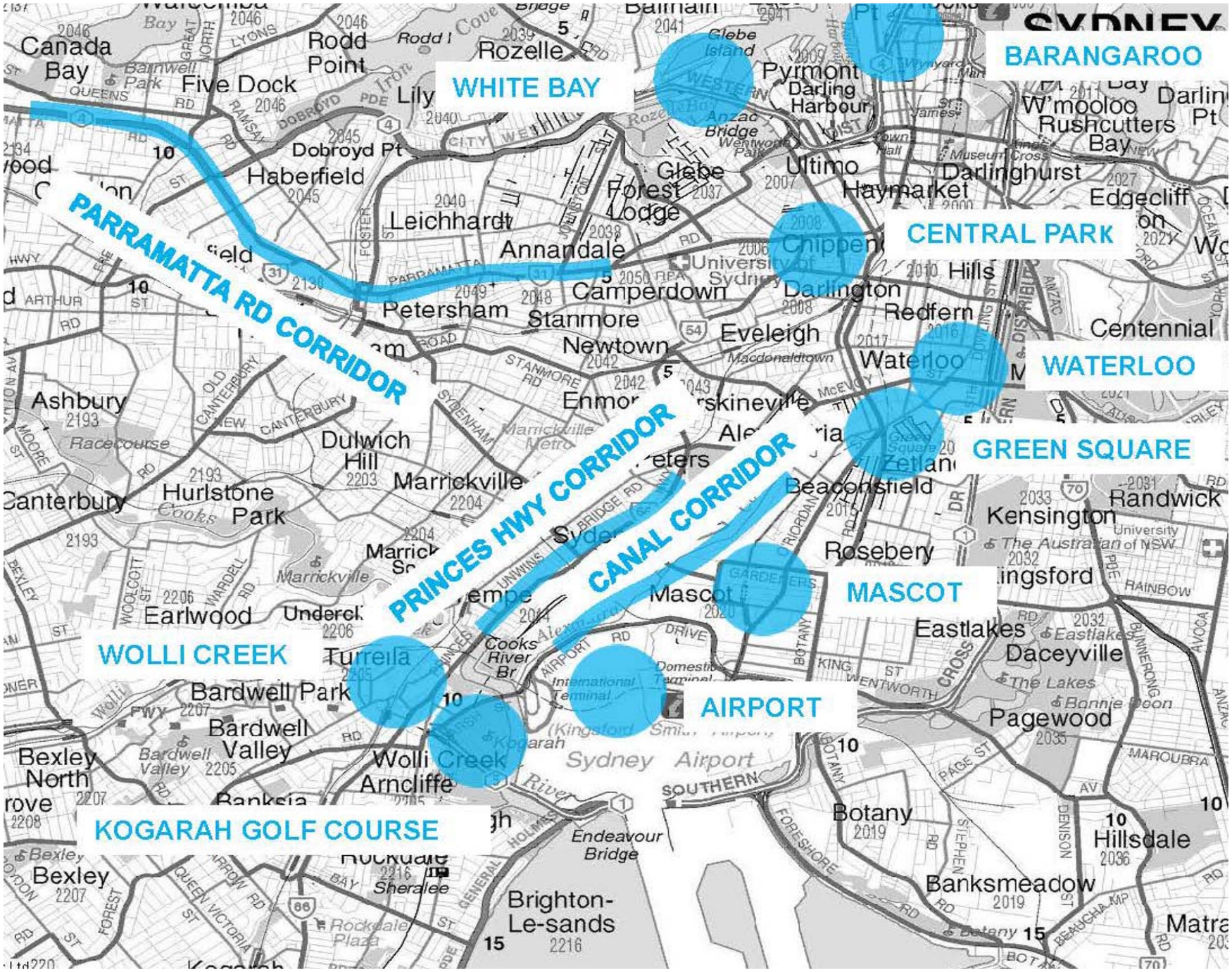


Figure 3.4: Development 'Hot Spots'

3.2.14 Environmental / Natural Systems

A series of green corridors have been identified in and around the project area. These include:

+ Cooks River corridor
+ Wolli Creek corridor
+ Sydney Harbour edge corridor
+ Eastern corridor

A notional corridor could potentially be developed / enhanced through the centre of the study area, which lacks a continuous open space system and narrative, with potential to link major open spaces into a system. This corridor could perhaps be an extension of the idea put for the in the Sustainable Sydney 2030 Plan of the Eora Journey and link the Cooks River (and Botany Bay) to the harbor at the Domain. Key elements linked could include:

+ Tempe Recreation Area
+ Alexandra Canal
+ Sydney Park
+ Perry Park
+ Alexandria Park
+ Erskinville Park
+ Vice Chancellor's Oval at ATP
+ Prince Alfred Park
+ Belmore Park
+ Harmony Park
+ Hyde Park
+ The Domain
+ Royal Botanic Garden

Other key considerations include:

+ Protect creek alignments/flow pattern and associated riparian landscape
+ Strengthen biodiversity corridors or reserves
+ Man-made canals – connectivity and restoration/regeneration opportunities
+ Existing wetlands, fauna and fauna areas to be protected

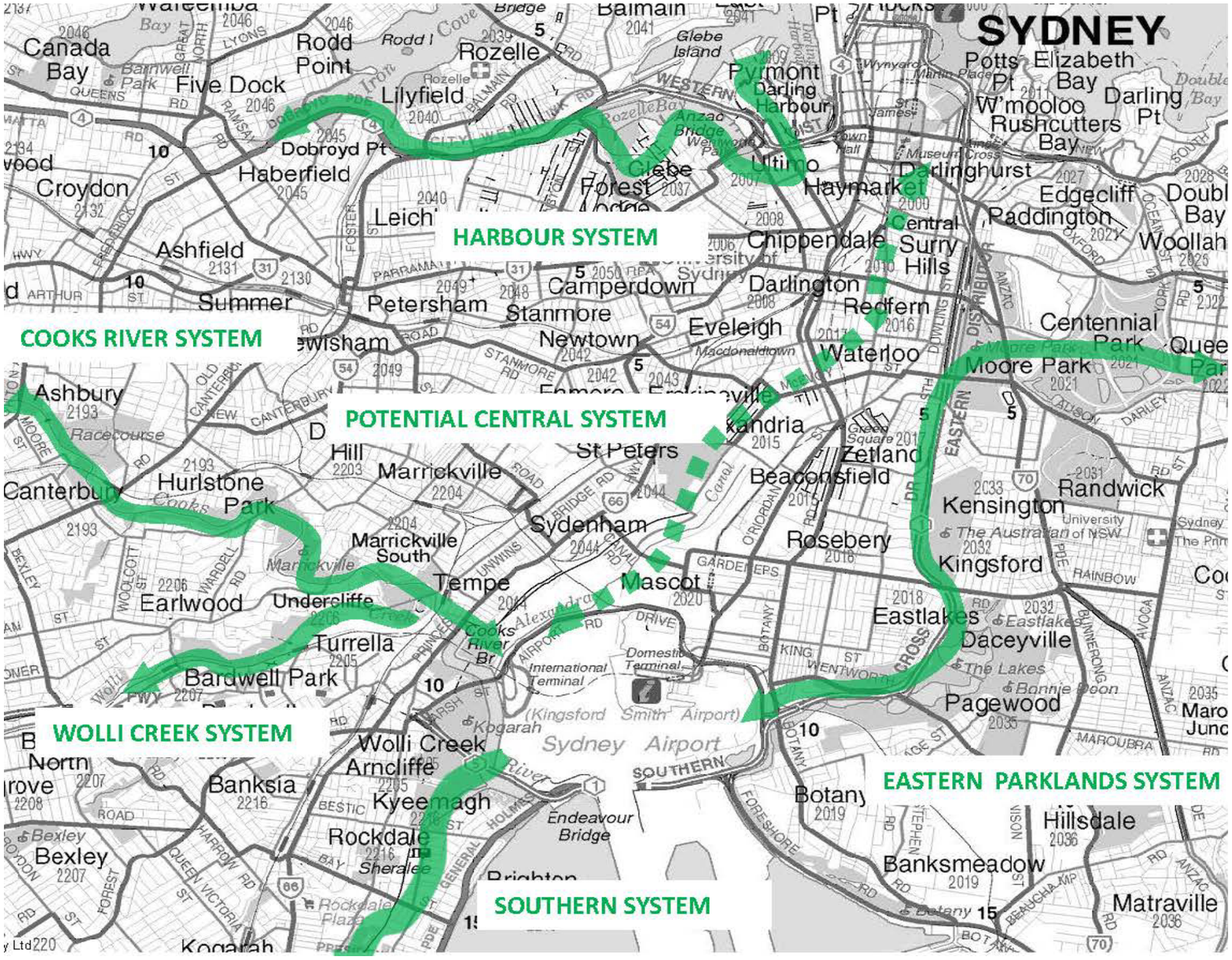


Figure 3.5: Environmental / Natural Systems

3.2.15 Corridor Review

Issues have been mapped at several scales and include opportunities as well as constraints. This mapping has been undertaken as a desktop exercise, including site visits, to ascertain key parameters that could help in determining issues. Each of the opportunities diagrams has a corresponding constraint diagram to complete the review of key issues determining the future development of the project.

An overall mapping of issues has been undertaken for the corridor and is included below. A second set of more detailed mappings have been undertaken where portal locations have been identified.

These issues have been grouped according to categories as noted below and used to guide general layout explorations for the alignment.

A detailed analysis of the opportunities and constraints within the WestConnex corridors is presented in Appendix D.

Constraints

Constraints have been mapped to ascertain key parameters that could limit placement of infrastructure result in increased costs, impact on the community and potentially require mitigating measures to overcome some unacceptable outcomes.

Opportunities

Urban Design opportunities have been mapped to identify outcomes that could be achieved with the implementation of the project.

These include improvements to the public domain, opportunities for urban regeneration and opportunities for strengthening the legibility and cohesion of communities along the corridor.

Figure 3.6: Princes Highway Study Area

3.3 Geology

3.3.1 Available Information

Assessment of the geology along the road corridor associated with IWT, AAL and M5 East Duplication has been based on the geotechnical information provided by RMS, as described in "WestConnex existing geotechnical information overview" and relevant borehole information from our own geotechnical database including the Inner West Light Rail and Transgrid Cable Tunnel projects.

To assist in the development of the geotechnical models, a combined geotechnical database has been established using the computer program gINT. Information collected from all the boreholes and test pits excavated have been captured in gINT with a total of 810 test locations. However approximately 70 test locations have been disregarded due to inaccuracies or errors e.g. borehole coordinate errors etc.

Other relevant information or publications have been referenced in interpreting the geology and ground conditions along the alignment, including:

+ Geological maps published by the NSW Geological Survey providing information regarding regional geology, and regional geological structure;
+ Geological Survey of NSW (1963) "Bulletin 18 – the Botany Basin"
+ K Jones (1996) "Planning and Development of Infrastructure: The New Southern Railway Airport Link Project"
+ E Nye (1999) "The soft ground bored tunnel under Sydney Airport"
+ Rickwood (1985) "Mapping of Dykes in Sydney"

This section of the report will firstly provide a description of the regional geology and hydrogeology for the WestConnex corridor between Taverners Hills and the M5 Bayview alignment commencing at Gough Whitlam Park (approximate CH 3900), followed by a geotechnical assessment for the BB preferred alignment, i.e. the Princes Highway Alignment. The alignment drawings are shown in Appendix L.

The geology along the section of the alignment to the West of Tempe Street is not covered in the study however from the geological map it would appear that this section of the alignment is located within Hawkesbury Sandstone bed rock.

3.3.2 Geology

The proposed WestConnex route for the section between Taverners Hills to M5 East Bayview alignment at Tempe Street extends eastwards from Taverners Hills along Parramatta Road to Pyrmont Bridge Road, and then southwards to Sydney Airport and westward to Bexley Rd following the Bayview ridge line. The elevation of the topography within the corridor ranges from about RL38m in Leichardt and Newtown area to RL2.0m within Sydney Airport and R.L.40m towards Bexley Road.

The geological map at scale 1:100,000 which covers the alignment (Geological Series Sheet 9130 (Edition 1) 1983) is shown in Figure 3.6.

The geological map indicates that most of the corridor in the north of Wolli Creek is underlain by the Wianamatta Shale and the underlying Hawkesbury Sandstone. Both rock formations are from the Triassic period. The bedrocks are covered by a layer of man-made fill, residual soils and alluvial soils. The area between Alexandra Canal and St Peters including Sydney Park and St Peters is underlain by a thick shale sequence to approximately -30mAHD where brick pits have been developed in the past both in Sydney Park and in the St Peters area. Regionally, the Ashfield shale is divided into four units, namely:

+ Mulgoa Laminite
+ Regentville Siltstone
+ Kellyville Laminite
+ Rouse Hill Siltstone

The boundary between the Sandstone and Shale units varies in elevation but rises from St Peters to the North and South. In the north at the junction of Parramatta Road and Pyrmont Bridge Street, the boundary is at approximately R.L.+5m AHD and further rises up to over R.L. +20m AHD at Leichhardt. In the south the boundary is at R.L.-10mAHD in Tempe container area before rising further up resulting in sandstone outcrops in View Street adjacent to the Cooks River. This generalised stratigraphy was confirmed by a number of existing boreholes available to this project.

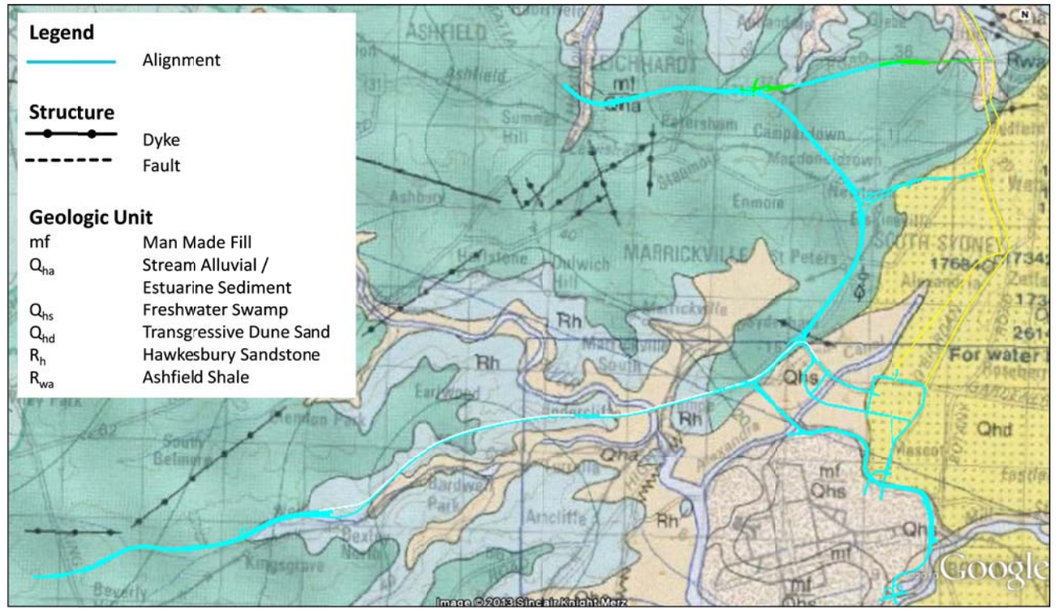


Figure 3.6: Regional Geology (Sydney 9130)

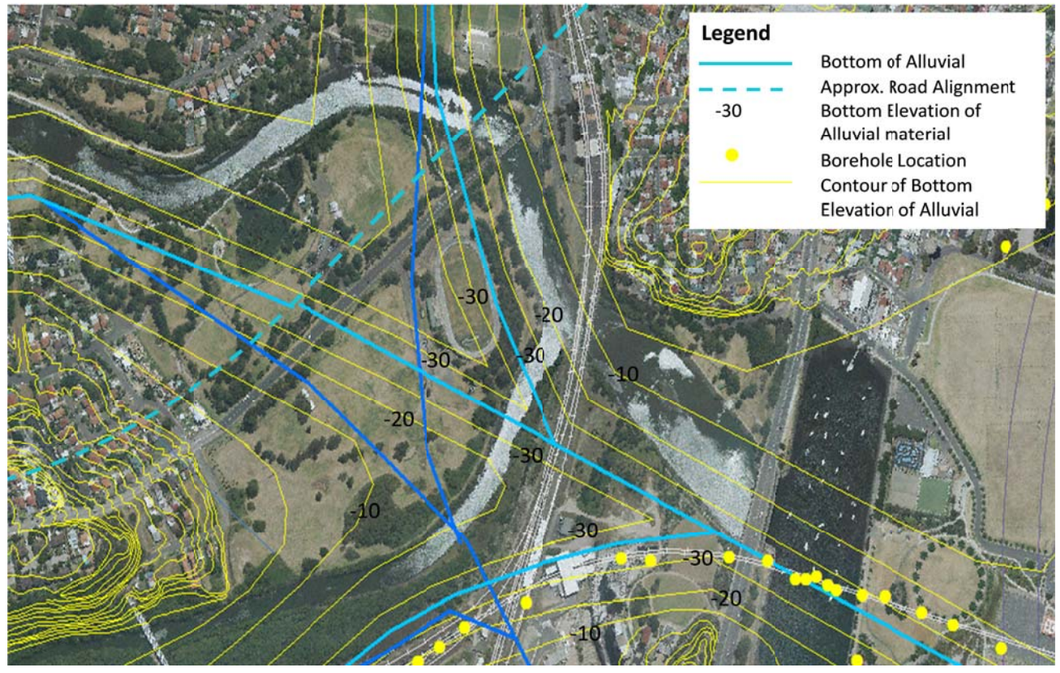


Figure 3.7: Palaeovally Channel Around Wolli Creek

The typical stratigraphy of the Triassic rocks in the Sydney Basin includes a transition formation between the Ashfield Shale and the underlying Hawkesbury Sandstone. This formation is referred to as Mittagong Formation and considered to be two to five metres thick comprising beds of shale or laminite, similar to the Ashfield shale, and beds of sandstone similar to the Hawkesbury Sandstone. There is no evidence of this formation in the section south to Parramatta Road from existing information. This implies that where the crown of the tunnel is close to the shale/sandstone interface there could well be interbeds of shale and sandstone immediately above the tunnel.

The proposed WestConnex Road corridor from Sydney Park to the Airport and Bayview Street area is drained by Alexandra Canal, Cooks River and Wolli Creek. All three watercourses are underlain by significant depths of sediments. It is understood Alexandra Canal was constructed in the latter part of last century within what was formerly a "ditch type" creek known as Sheas Creek. As part of the airport redevelopment following World War II, the Cook's River was redirected southward from the confluence with Shea's Creek, and the area filled as the present Sydney Airport. At both sides of Alexandra Canal and Cooks River, a 5 to 15m estuarine sediments (Qhs and Qha as shown in Figure 3.6) containing an extensive peat and sandy silt and to a less extent muddy sand layer which is generally very soft to soft and is characteristics of normally consolidated soils. They are believed to be formed when the sea level rose steadily to its present level, submerging the eroded land surface, then after the sea level stabilised, the area were filled with tidal flat mud.

At both sides of Wolli Creek between View Street and Tempe Street, a deep Palaeochannel consisting of alluvial sediment (Qha as shown in Figure 3.6) is present, overlying directly on weathered sandstone. The bottom of the alluvial material has been interpreted between R.L. -30 to -40 m AHD based on primarily information recorded in Airport Link project at the confluence of Cook's River and Alexandra Canal where the sediment beneath the Cooks River is up to 37m thick. The infill channel is approximately 300m wide. The inferred Palaeovalley channel at this location is shown in Figure 3.7. The depth of alluvial material sitting in the Palaeochannel at both sides of Wolli Creek remains a key constraint to tunnelling and the design of the portal locations. However considering that the Paleochannel is a significant constraint to tunnelling, the depth of the channel would need to be confirmed by future geotechnical investigation campaigns.

3.3.3 Rock Contour

On the basis of the previous drilling information combined with the regional gravity data the reduced level of the top of Hawkesbury Sandstone has been contoured at 10m intervals are presented in Figure 3.8. It is however noted that the rock contours represent interpolation between widely spaced borehole data and therefore are only accurate at the borehole locations. Overall accuracy has been interpreted as ±5m.

Rounded elevated ridges of shale occur north and west of the road route while steeper sandstone ridges are evident in the Wolli Creek area which includes three sandstone rock exposures as described on the Sydney Geological Map. The outcrops at Tempe Street, on the Princes Highway at Arncliffe and in View Street in Tempe (see Figure 3.9 Photos) may represent former rocky peaks.

3.3.4 Rock Weathering Profile

The extent of weathering in the shale along the road route varies from the north to the south and may reflect the amount of weathering and erosion the rock surface experienced. Boreholes along Parramatta Road typically encountered up to 5m of extremely and highly weathered shale above the slightly weathered to fresh rock.

The shale contains sandy interlaminations in some beds which classifies the beds as laminites.

The underlying Hawkesbury Sandstone is typically fresh if protected by a shale capping or highly weathered for probably 5m to 10m if directly overlain by alluvial sediments as recorded by the boreholes around adjacent to Wolli Creek. A well-developed sub-vertical joint system at joint spacing of 1m to 10m is often evident in the Hawkesbury Sandstone. Orthogonal joint sets within the Sydney area are typically north-northeast and west-northwest.

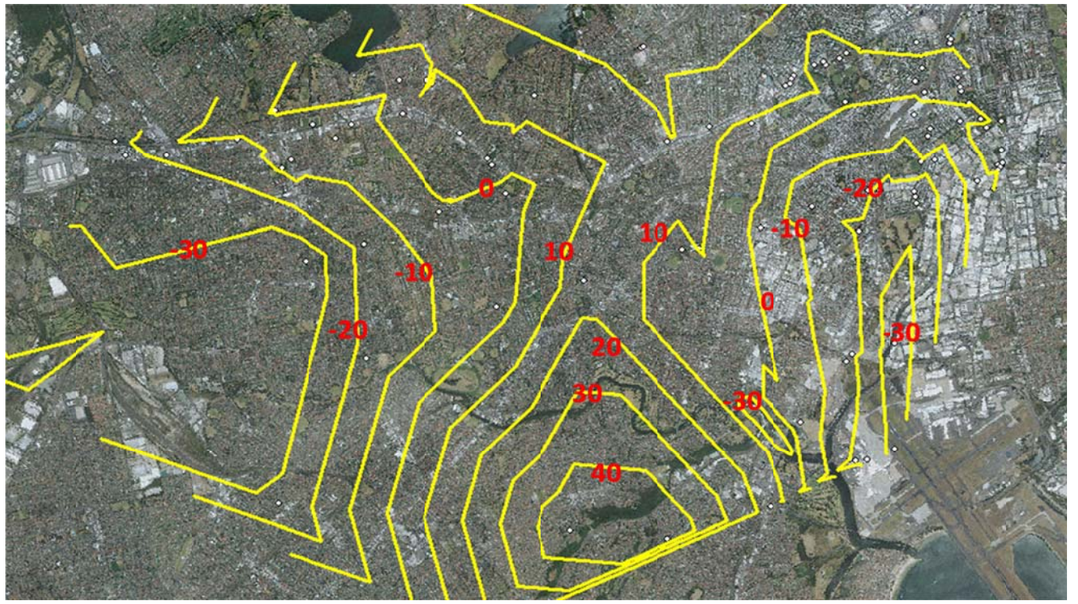


Figure 3.8: Rock Head Contour

Figure 3.9: Sandstone Outcrops Around Cooks River and Wolli Creek

3.3.5 Major Bedrock Discontinuities

The Triassic bedrock of the Sydney area contains major discontinuities in the form of volcanic dykes or faulted shear zones. Volcanic dykes have been mapped in rock exposures along the Sydney coastline and in building excavations and have been documented in various publications including the geological maps.

Dyke rocks are either hard, tightly jointed basalt of significantly higher strength than Shale and Sandstone or are extremely weathered with soil like properties. Dykes are typically 1m to 3m wide, occur as vertical features and may extend laterally for several kilometres within a swarm or terminate within several tens of metres. The major dyke orientation is west-northwest with a small number oriented north.

The boreholes within the corridor have not appeared to intersect dykes. However, one dyke has been recorded in the brick pits to the east of the road corridor, and also two in Parramatta Road. It is hence postulated that about 3 dykes may cross the proposed road route and they may be to a depth of 15m or more. This suggests that the Inner Western Tunnel will intersect such dykes.

During the excavation of the Green Square Station on the Airport Links, three dykes were identified and hence it is likely that more dykes will be found along the alignment in particular between Newtown and St Peters Area.

The dyke intrusions may have a significant impact on groundwater levels, water ingress, rock mass permeability and water quality surrounding the intrusion. Dykes often form vertical hydraulic connectivity between permeable horizontal bedding and shear planes within Hawkesbury Sandstone.

Faulted shear zones are more difficult to locate. Shear zones typically involve rock displacements of several metres, contain weathered brecciated material, and are more permeable. They are typically oriented approximately similar to the regional joint pattern. Based on existing geological information, the Luna Park Fault will intersect the road corridor at approximately the corner of Pyrmont Bridge Stress and Parramatta Road.

Photos typical faults and dykes in Sydney are shown in Figure 3.10.

Bedding in the lowermost unit of the Ashfield Shale is usually not well developed because it is largely massive claystone/siltstone. However, there are laminite bands and other bedding horizons along which preferential weathering occurs leading to sub-horizontal seams. It is expected that significant bedding discontinuities may occur at about 1m to 2m intervals

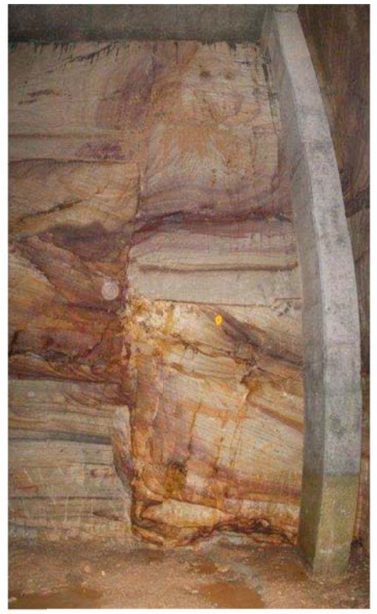
3.3.6 Hydrogeology

The shale and sandstone generally have low intergranular permeability and the most productive zones of the aquifer occur where the rock is fractured and jointed.

Along Parramatta Road section of the alignment corridor, the road tunnel is expected to situate within Hawkesbury Sandstone. Currently available packer test data (from the West Metro project) indicates relatively minor inflow Lugeon values ranging up to 7 uL. Again from borehole data recorded from the West Metro Project, two groundwater levels may exist along the Parramatta Road section of the alignment with one possibly a perched water table at shallow depth in residual soil (approximately 1.5m deep as recorded in Borehole No. WM1/BH226), and another within the sandstone rock at approximately 6 m depth (RL 16.4 m AHD as recorded in WM1/BH17.

No groundwater data is available for the alignment section between Parramatta Road and Princes Highway however it is expected that similar to the Parramatta Road section of the alignment, two groundwater tables may present with one water table which is within a few metres of ground surface in the shale or residual soil and, another one beneath the shale, within sandstone which is saturated but at a porewater pressure lower than hydrostatic pressure. In areas at either side of Wolli Creek where sandstone is exposed at the surface, the profile is expected to be hydrostatic.

Between Alexandra Canal and St Peters area where the brick pits were excavated, groundwater was recorded to encounter in fill and alluvial soils at depths ranging from 0.5m AHD and 2.5m AHD. Similar groundwater levels are expected within the Paelaeochannel adjacent to Wolli Creek.



Luna Park Fault Exposed in City Basement

Typical dyke in Ashfield Shale (Lane Cove Tunnel)

Figure 3.10: Typical Faults and Dykes in Sydney

3.3.7 In-situ stress

A significant characteristic of the Sydney region geology is the high horizontal locked in in situ stress. The effect of this high stress is to cause stress relief during tunnel excavation, which can manifest itself in shearing along bedding planes and opening of discontinuities. Along with increased ground movements, this dilation can result in increased joint aperture leading to increased groundwater inflow.

There is a wealth of data on the regional stress field in the Hawkesbury Sandstone but less so for the shales. In the upper 50m of the Hawkesbury Sandstone Pells (2002) has recommended north-south horizontal stress be taken as 1.5Mpa + 1.2 to 2 times of the vertical stress and the west-east horizontal stress be taken as 0.5 to 0.7 times of the vertical stress. However it is noted that local variations from the stress field are likely in the following cases:

+ Increases in stress adjacent to geological features such as dykes or faults
+ Stress concentrations in relatively stiff / stronger massive beds, with corresponding lower stresses in weathered, less stiff interbeds
+ Relaxation of the rock mass due to joint opening / weathering
+ Concentrations is stress beneath incised valleys and paleo-valleys resulted in valley closure (valley bulging) or buckling in the valley floor

3.3.8 Compressible deposits

Compressible deposits are primarily present between Alexander Canal and the St Peters area (shown as Qhs in Figure 3.6). The alignment has been optimised to the west of this area. In Bayview area between approximate Chainages 4000 to 4300, superficial deposits (shown as Qha in Figure 3.6) are present. These sediments are usually of low strength. Soil compressibility and induced settlement in the event of groundwater drawdown (or at least porewater pressure reduction) can be severe and needs to be controlled in order to prevent damage to structures and services in the vicinity.

Tunnelling can cause significant changes to the pore water pressure around the tunnel and in addition, cause groundwater drawdown.

Due to the soft nature of the compressible material and the accompanying high groundwater table, cut and cover tunnelling method, if adopted, may involve sheet piling, diaphragm walls together with strutting. Pile foundations to either support the foundation loads or prevent buoyancy of tunnel box also must be considered.

Tunnel linings should also be designed to limit long-term leakage to low levels in areas where compressible deposits are present such that long term groundwater drawdown does not occur.

From Figure 3.6, the presence of Botany Sand (shown as Qhd) is evident in the Henderson Road Portal location. Botany sand covers the incised bedrock surface of the Botany Basin and was deposited during the fluctuations in sea levels during the Quaternary Period with various units of clay, clean sand and peat. Previous investigations associated with Airport Link in this area have indicated significant variability laterally within the quaternary sediments and further investigation may be required in this area to provide delineation of the sedimentary sequence.

3.3.9 Nature of Fill materials

From the geological profile, the thickness of fill material along the proposed alignment, outside the apparent landfill area, appears to be generally less than three metres, The fill encountered is variable in nature, ranging from a gravely clay, sandy clay, clayey sand and sand, with isolated occurrences of asphalt and concrete debris. The nature of the fill material outside the apparent landfill area along the present alignment does not appear to pose significant hazards to construction.

The extent of landfill, in the brick pits west to the Alexandra Canal, is shown in Figure 3.11, the brick pits are primarily in three areas and they are 1) the Sydney Park Brick Pits where the bottom of the brick pits have been recorded as at approximately -30mAHD; 2) St Peters Brick pits whose bottom level has also been recorded as at approximately -30mAHD; and 3) Tempe Brick Pits where the bottom level has been recoded as at -18mAHD. The bottom of these brick pits may represent the bottom of the natural Shale level.

There is limited information on the nature of the fill material on both Sydney Park and St Peters Brick pits however it is understood that the landfill contains significant amount of putrescible materials.

Figure 3.11: Extent of the Brick Pits

In the Tempe brick pits area, investigations were carried out for the development of the light-weighted container area and it was found that the landfill was carried out in two stages. Stage 1 Landfill is associated with the general tipping likely to be pre 1972. The material is highly variable in nature and includes putrescible material such as rotting vegetation and domestic waste, and solid waste such as paper, fabric, metal, wood, concrete, plastic, rubber etc. Stage 2 landfill is associated with Council tipping likely to be post 1972. Material is typically described as gravelly sand, clayey sand, sandy clay, silty clay with between 10% to 50% bricks, concrete, metal and wood fragments. Stage 2 fill is typically 3 to 4m thick.

Although the preferred road corridor does not pass through these brick pits, the excavation of tunnel in Hawkesbury Sandstone which has a high horizontal stress may open joints/bedding, and leading to potential ingress of the leachate water into the tunnel zone. This is a potential hazard and may have to be further assessed.

The ground treatment of landfill to support highway loads was earlier contemplated in this study when comparing different alignment options. The successful use of ground improvement methods such as dynamic compaction and stone column to improve the foundation capacity and stiffness at putrescible landfill site has been reported such as those documented by McIntosh and Barthelmess (2002), Charles and Watts (2001) and Raju et al (2004). However for cases where stone column is used, the sealing off the water passage to the fill layer at depth by grouting or using an impermeable capping layer may be necessary so that the risk of water ingress induced further creep or collapse settlements risk can be minimised.

3.3.10 Interface with Adjacent Structures

Interface with adjacent buildings/structures has not been investigated in detail in this study. Ground settlement due to the proposed tunnelling works may result from any one or combination of the following:

+ Volume loss due to relaxation of the ground during tunnel advance;
+ Settlement due to groundwater drawdown.

The adopted values for volume loss are normally based on local case histories in similar ground conditions and using similar construction techniques. Based on previous tunnelling experiences in Sydney, volume loss for tunnelling in sandstone and shale may be taken as 0.1 to 0.5% with a trough parameter of 0.6. It is however noted that for tunnelling under the Palaeovalley channel, larger volume loss may be expected due to the thick and highly weather zone below the alluvial material where the soil and water ingress may be difficult to control.

3.4 Constraints

GIS constraints mapping for the area traversed by the alignment was done and is shown in Appendix H. The major constraints identified along the general route of the AAL and IWT alignments include:

+ Obstacle Limitation Surface (OLS) for the North South airport runway;
+ Port Botany rail line;
+ Cooks River rail terminal;
+ Tempe tip site (potential area of contamination);
+ Tempe reserve;
+ Airport rail link tunnel;
+ St Peters brick pits (potential area of contamination);
+ Sydney Park and brick pits; and
+ Various heritage and conservation areas.

3.5 Utilities

The major utilities present within the general route corridor were identified and are mapped in Appendix H. These include:

+ Sewer trunk lines (SWOOS);
+ Desalination pipeline; and
+ Two major water main tunnels crossing the IWT alignment near the Henderson Road connection.

4.0 OPTION DEVELOPMENT

4.1 Option Scope

Early in the design process the BBJV Team coined the concept of Strategic and Tactical options. The initial focus of the team was on Tactical options designed at reducing costs and improving functionality through:

+ improved construction methodologies
+ revised interchange layouts
+ reduced land acquisition
+ modified alignments

However, the team realised that the opportunities to reduce project costs with tactical refinements were limited. In order to make truly significant project savings, a more strategic review of options needed to be undertaken in tandem with the tactical reviews.

The strategic reviews focused on reducing costs and improving functionality through:

+ major redirection of the WestConnex alignments
+ elimination of significant lengths of tunnel
+ challenging the future strategic network requirements in Sydney

Most of this strategic analysis was undertaken over a four week period ending mid-February 2013 using the SMEC strategic model. The model testing was based on 2021 AM peak trip tables and did not include any tolling regimes. The models were used as a planning tool to assist in the design process. The purpose of the modelling was to:

+ Identify the worse-case un-tolled demand levels for the various WestConnex options being tested
+ Identify likely lane requirements and optimum lane configurations based on the comparative size of flows
+ Identify likely demand for various ramp options
+ Identify possible traffic reassignments resulting from the various network upgrade options

4.1.1 Strategic Design Options

(Refer to Figure 4.1 and Appendices as noted)

In early phase of the strategic assessment the team considered a large range of options. These were quickly refined down to the following two options:

+ Roselle Option (Option A)
+ Bayview Lyons (Options B and B1)

Descriptions of these options and findings of the modelling work undertaken are provided in the Appendices.

A third strategic option was also considered. This option involved the construction of the M4-East and M5-East duplication as separate projects with grade-separation of the major interchanges along M3 ring-road (Option C). However, due to timing constraints, this strategic option was not modelled. Sample outputs from Options A, B and B1 are presented in Appendix C.

4.1.2 Tactical Design Options

Following the review of strategic options, the BBJV began focusing on the development of tactical options. The tactical options generally follow the same alignment as the SMPO Base Case alignment. The dominant drivers were cost, connectivity and functionality and to find an optimum between these drivers. Tactical options investigated included the following:

+ Refinement of SMPO Base Case
  - Base Case Enhancement 1
  - Base Case Enhancement 2
  - IWT refinement and optimisation
+ Canal Options
  - Canal short option
  - Canal long option
  - BBJV Canal option (refer to drawings in Appendix N5)
+ Alternative M5 tunnel alignment and alternative eastern tunnel portal locations
  - BBJV Optimised Base Case (refer to drawings in Appendix N6)
  - BBJV Princess Highway Option (refer to drawings in Appendix L)
  - Two variations to the Princess Highway Option were investigated:
    - Alternative next to canal
    - Alternative midway between

Traffic modelling was used to develop and refine these tactical options. Strategic modelling (TransCAD) was used to identify overall traffic demands, whilst micro-simulation modelling (Aimsun) was undertaken for the interchanges to test lane allocations and link capacities.

The main tactical options assessed were:

+ The At-grade Arterial Airport Access Link
+ The Princes Highway Airport Access Link (Loops)
+ The Princes Highway Airport Access Link (Tunnels)

These three options all had a number of components in common, these included:

+ M5-East duplication along the Bayview Ridge Alignment
+ One-way pairs system through Mascot featuring Bourke, O'Riordan Street, Gardeners Road, Ricketty Street and Coward Street
+ Inner West Tunnel
+ Parramatta Road Tunnel/slot upgrade between Strathfield and Camperdown

In addition, the following optional access strategies were considered

+ The Henderson Street Ramp connection
+ The Sydney University Ramps to Parramatta Road at Arundel Street

4.2 Design Process

4.2.1 Sharing a common understanding

Access to the SMPO Information Documents was provided to the Team through a common server to enable all the contributors the chance of gaining an understanding of the WestConnex Project, the extent of the associated studies already carried out and information available. The Team first came together in late January and exchanged information, challenged the conclusions of some of the studies and set out on a new path feeding off the information documents and the combined experience and knowledge of the Team.

4.2.2 Spreading the Search Wide

The initial investigations were free flowing with different groups working separately, testing assumptions contained in the information documents and exploring new ideas. Every 3 to 5 days a Team meeting was held to share information, prioritise and channel investigations, while eliminating concepts which failed to satisfy.

4.2.3 Setting Early Priorities

The early priority was clear: find innovations which reduce cost without compromising functionality or future connections.

4.2.4 Eliminating Options which do not satisfy the core requirements

Concepts which failed to satisfy the core requirements were reviewed and culled at every meeting with those concepts with merit being included in the Ideas Register for use at a later date in part or in full.

4.2.5 Breakthrough Ideas

Breakthrough ideas came in various forms. The "Bayview Ave" alignment was seen by most of the Team as a "light-bulb" moment while the AAL Interchange location on the Princes Hwy needed more testing and development before it was seen as a viable Option.

4.2.6 Building on an accumulated understanding of the constraints and the requirements

Looking back over the progress of the Options development, some early ideas were necessarily simplistic as the Teams understanding of the Project grew. With such a large Project time was necessary to fully understand the constraints adequately prioritise them and develop a concept that satisfies them all.

4.2.7 Minimising Impacts and building for the future

The understanding of the working environment, current and future around the airport, the OLS, the land-fills, the arterial connections, the future freeway connections and the effects of future growth on traffic and transport were all elements which were regularly tested against the Options as they were developed.

4.2.8 Achieving a Team Result

The result achieved was a Team result with all members making significant contributions. The absence of any one of the Team members would have diminished the outcome.

Figure 4.1 shows the development of options during the design process, with references to the relevant Appendices where sketches and drawings of the various options are shown.

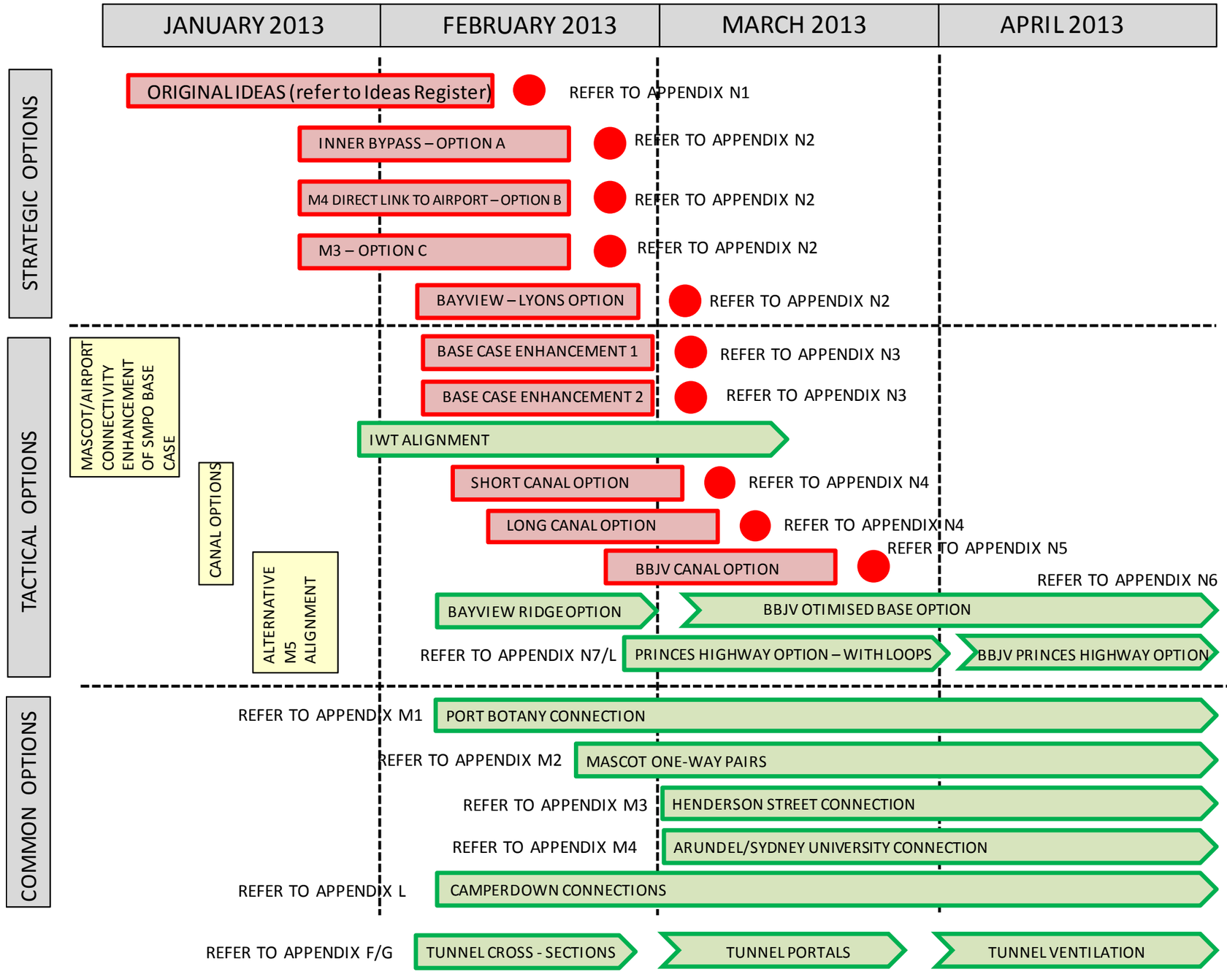


Fig 4.1: Options Development Process

4.3 Option Analysis

The BBJV has undertaken a comparative assessment of the urban design and engineering attributes of the three main options against the SMPO Base Case.

Below is a summary of the key opportunities identified in each option. Figure 4.3 compared the performance of each option against a set of urban design criteria. Figure 4.2 compares the performance of each option against a set of engineering design criteria.

4.3.1 Optimised Base Case

(Refer to Appendix N6)

+ Simplified interchanges to connect to International and Domestic Terminals
+ Simplified initiation of operations
+ Reduced land acquisition providing significant cost savings
+ Connections to Mascot 'Employment Lands' maximises existing road capacities by using 'one-way traffic pairs'
+ Allows for additional open space links
+ Allows for potential connections to Camperdown, Redfern and Glebe
+ Reduced construction cost by avoiding poor alluvial areas at Cooks River to Marsh St M5 portals
+ Driven Tunnel portals located in sound rock, cut + cover construction provides opportunities for tunnel M+E plant.
+ Use simple construction methods to build bridges and above grade structures
+ Full interchanged functionality and network connections provided
+ Future F6 corridor can be future proofed

4.3.2 Princes Highway Option

(Refer to Appendix L)

+ Simplified interchanges to connect to International and Domestic Terminals
+ Simplified initiation of operations
+ Minimised land acquisition providing major cost savings
+ Connections to Mascot 'Employment Lands' maximises existing road capacities by using 'one-way traffic pairs'
+ Allows for potential connections to Camperdown, Redfern and Glebe
+ Reduced construction risk by choosing tunnel route with better geology
+ Driven Tunnel portals located in sound rock, cut + cover construction provides opportunities for tunnel M+E plant.
+ Avoids construction in landfill and brick pits
+ Provides 'urban regeneration' to opportunity Princes Highway
+ Reduced impact on community
+ Allows for additional open space links
+ Provides for potential future opportunities to enhance other modes of freight transport in this area
+ Potential to optimise future land developments unimpeded by bisecting motorways
+ Minimum OLS impacts
+ Preferred tunnel gradients achieved
+ Extent of costly structure over landfill is minimised
+ Full interchanged functionality and network connections provided
+ No significant impact on future F6 Freeway corridor

4.3.3 Canal Option

(Refer to Appendix N5)

+ Reduced construction risk by choosing route with better geology
+ Reduced construction in landfill and brick pits
+ Full interchanged functionality and network connections provided
+ Reduced land acquisition by selecting canal route

Route	Uses Favourable Geology	Ease of Construction and Phasing of Opening	Minimises Landtake	Minimises Roadway on Structures	Allows Good Construction Set-up Area	Reduce Cost	Reduce Risk	Increases Certainty	Connectivity to Local Road Network
Base Case	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Poor	Average
Optimised Base	Good	Average	Average	Good	Good	Average	Average	Average	Good
Princes Highway	Good	Good	Good	Good	Good	Good	Good	Good	Good
Canal Option	Poor	Poor	Average	Poor	Average	Average	Average	Average	Good

Good Outcome
Average Outcome
Poor Outcome

Figure 4.2: Technical Assessment of Options

Route	Preserves Heritage	Protects Existing Open Space	Preserves Visual Amenity	Allows Additional Open Space Links	Parramatta Corridor Development Potential	Princes Hwy Corridor Development Potential	Canal Corridor Development Potential	Airport Area Development Potential	Kogarah Golf Course Development
Base Case	Good	Average	Average	Good	Good	Good	Good	Good	Average
Optimised Base	Good	Average	Average	Good	Good	Good	Good	Good	Good
Princes Highway	Good	Good	Good	Good	Good	Good	Good	Good	Good
Canal Option	Poor	Average	Poor	Poor	Good	Good	Poor	Good	Good

Good Outcome
Average Outcome
Poor Outcome

Figure 4.3 Urban Design Assessments of Options

5.0 RECOMMENDED OPTION

Following the options development and analysis process , the Princes Highway Option was selected as the BBJV team's preferred option.

5.1 Outline of Scheme

5.1.1 Overview

The "Princes Highway Option" alignment is formed by:

+ A new M5 East "Bayview" Tunnel Route from the existing Bexley Rd portals location to Tempe, following the alignment of Bayview Ave
+ Airport Access Link –Princes Hwy Option located adjacent to the Princes Hwy between Canal Rd and the Port Botany rail line
+ An optimised Inner West Tunnel with some changes which come from the choice of access/egress ramp locations that are adopted

Free flow access from the M5 tunnels and IWT are provided through the Princes Highway Interchange to:

+ Port Botany along the upgrade of Qantas Drive;
+ To both the International and Domestic Airport terminals;
+ To the industrial areas north of the airport in Mascot, Green Square and areas west of Princes Highway in the vicinity of Sydenham;

5.1.2 M5 "Bayview" Tunnel Route

It was identified at an early stage during our concept development that the proposed location of the new M5 tunnel portals would create significant problems in requiring construction to be carried out in an area of high traffic flows and similarly the already heavily congested M5 traffic would be impacted.

By moving the tunnel portals from Marsh St to the Tempe area it became obvious that:

+ constructability and traffic flows would be improved
+ the constructed length of the motorway would be reduced
+ Acquisition and environmental impacts on the land area around Kogarah Golf Course would be eliminated
+ Bridges over the SWOOS, Marsh St and the Cooks river would be eliminated

With the BBJV Recommended Option, the new M5 tunnels will follow an alternative route from the Bexley Road end, to the north of Wolli creek and generally under Bayview Avenue. The tunnels will extend under Gough Whitlam Park, under Tempe and along the Princes Highway, to exit in new portals in the area to the south-east of Princes Highway, between the Port Botany Railway line and Canal Road. The new tunnels will carry both eastbound and westbound traffic and the existing M5 tunnels will remain as is. None of the current traffic flows will be reversed. The proposed alignment is shown in Appendix L

The proposed new M5 tunnels will have the following geometry:

+ 2 traffic lanes in each direction. The typical section is shown in Appendix F
+ The eastbound tunnel starts at the portal location next to the existing tunnel portal at Bexley Road, at approximately km 0+100 and ends at the portal at km 5+880. It is approximately 5780m in length;
+ The westbound tunnel starts at km 0+140 and ends at km 5+880 and is approximately 5740m in length;
+ The horizontal geometry for the tunnel is as follows:
  - Horisontal curve radii of 500m and 440m respectively for the westbound and eastbound tunnels at the western portal ends. It is however proposed to improve these radii to comply with a higher design speed;
  - Curves of 2000m, 3000m and 2000m in the tunnel;
  - A curve of 900m at the eastern tunnel portals.
+ The vertical geometry for the new tunnel is as follows:
  - Maximum grades of 4% are achieved throughout and minimum grades of 0.5%
+ The vertical and horizontal geometry is shown in Appendix L

5.1.3 Airport Access Link (AAL) – Princes Highway Option

The Princes Highway Option was developed following a global review of the Risks and constructability obstacles in the area of the RMS Base Case Option, and in the proposed are of the Airport Access Link (AAL) in general.

The most significant risk and constructability issues were identified as:

+ Impact of the airport Object Limitation Surface (OLS) on construction productivity possible limiting working hours to as little as 5 hours per night
+ The existence of several brick pit excavations along the alignment filled with a mixture of hard and putrescible waste posing constructability and environmental problems
+ Acid Sulphate Soil (ASS) deposits in cut and cover locations requiring removal and treatment
+ The significant extent of land acquisition representing a substantial cost to the project, reducing the available land in the area and limiting the accessibility to the remaining areas
+ The Base proposal proposed that a high 87% (by cost) of AAL be built on structure due to the motorway route passing over pits/tips

With the above drivers identified, the Team looked for routes which would minimise the risks and the associated costs.

The location adjacent to the Princes Hwy bounded by Canal Rd, the Port Botany Rail Line and the Cooks River Rail Depot was identified as a location which would reduce many of the above risks. The location offers the following benefits:

+ Construction can be carried out with minimal impact on the use of heavy cranage due to the OLS
+ Both the M5 tunnel and the M4 tunnel can break ground in this location while avoiding tunnelling / cut and cover in the brick pits and land fill areas
+ It is anticipated that the incidence of ASS will be reduced by moving the tunnel portals towards the ridge line and out of the marine deposits and alluvium adjacent to the Cooks River and Alexandria Canal.
+ A significant reduction in land acquisition area of around 70% compared to the RMS Base Case
+ Urban regeneration of a key section of Princes Hwy which could flow on to further improvements to the north and south.

The layout of this interchange is shown in Appendix L. Directional ramps connect the M5 and Inner West tunnels to proposed access roads to Qantas Drive and to Mascot Industrial area, via Canal Road. The proposed layout provides full free flow access to and from the M5 and IWT tunnels to both Qantas Drive and Mascot. The proposed geometry of the directional ramps is as follows:

+ Horizontal geometry:
  - Minimum curve radius from M5 tunnel to/from Mascot access via Canal Road is 100m;
  - Minimum curve radius from IWT to/from Qantas Drive is 100m;
  - Minimum curve radius from M5 tunnel to Qantas Drive via directional tunnel ramps is 250m;
  - Minimum curve radius from IWT to/from Mascot is 150m.
+ Vertical geometry:
  - The maximum vertical grades achieved at the tunnel entry/exit portals are 4%;
  - Minimum crest K-value for the curve between tunnel portals is 50 and the resultant stopping sight distance is approximately 150m (eye height 1.1m and object height 0.2m). This can be improved by increasing the vertical curve length and lowering the road between the tunnel portals.

5.1.4 Optimised Inner West Tunnel (IWT)

The IWT route adopted is similar to the RMS Base Case. Modifications to the Base case route will depend on the connections finally adopted which will result in the combined tunnel and ramp alignment being optimised. Should ramps in the South Sydney/Redfern area not be required a more direct tunnel route between St Peters and Camperdown would be adopted. Consideration has also been given to 2 x 3 lane tunnels to allow for a later connection to Victoria Rd.

The proposed IWT tunnels will have the following geometry:

+ 2 traffic lanes in each direction. The typical section is shown in Appendix F. It is however strongly recommended that the IWT be constructed as 3 traffic lanes each way to allow for future extension to the north, as well as to allow for anticipated increase in traffic if additional connections such as the Henderson street connection is completed.
+ The horizontal geometry for the tunnel is as follows:
  - Horisontal curves of 1100m; 450m and 1500m in the tunnels. It is proposed to improve the 450m curve radius;
+ The vertical geometry for the new tunnel is as follows:
  - Maximum grades of 4% are achieved throughout.

5.2 Comparison with SMPO Base Option

The SMPO objectives for the IWT and AAL sections of the WestConnex base option are stated for comparative purposes.

5.2.1 Inner West Tunnel (Taverner's Hill to St Peters)

The Inner West Tunnel (excluding Taverners Hill connection and portal)

The Inner West Tunnel ("IWT") is a six kilometre underground link between the M4/Parramatta Road corridor and the Sydney Airport precinct. The design for the IWT must include the following features:

+ South facing tunnel portal in the vicinity of Campbell Road, St Peters, connecting to Airport Access Link
+ Intermediate access to the legacy road network to the south-west of the CBD for traffic from both the M4 and M5 corridors
+ Minimum two lanes in each direction, with a desirable option for three lanes in each direction
+ Posted speed of at least 70km/h
+ Intermediate access should be provided in the Camperdown area, but may also be considered at other locations in order to improve connectivity. SMPO believes that identifying the optimal approach for linking WestConnex with the legacy road network is the critical success factor for this package.

Sites of interest include:

+ Parramatta Road between Johnston Street, Annandale and Pyrmont Bridge Road
+ Parramatta Road in the vicinity of Arundel Street, Glebe
+ City Road near Cleveland Street, Chippendale
+ Eveleigh, in the vicinity of the Australian Technology Park

The target cost for the IWT is $2.0 - $2.5 billion (2012$) at a P50 level including the net cost of land.

5.2.2 Airport Access Link (St Peters to M5 East Duplication)

The Airport Access Link (AAL) will comprise 3-4 kilometres of new road, predominantly at grade, to the north-west of Sydney Airport. It will accommodate through traffic from the M5 East portals to the portal of the Inner West Tunnel (IWT) at St Peters, as well as access to surrounding precincts.

The design for the AAL must include:

+ Connection to the IWT at St Peters
+ Connection to the new M5 East duplication tunnels at an appropriate location
+ High quality access to both the International and Domestic Airport terminals, having regard to traffic growth forecasts
+ Appropriate access for WestConnex traffic to/from industrial areas north of the airport, Green Square and areas west of Princes Highway in the vicinity of Sydenham
+ Connections to and from the AAL may be at-grade and signalised if feasible.
+ Through lanes should have a posted speed limit of at least 70 km/h.

The Industry Partner must define a strategy for managing truck movements between Port Botany and WestConnex, having regard to growth forecasts and existing height restrictions. The strategy may include concepts for future road upgrades as traffic increases.

It is desirable that construction impacts on the Tempe Recreation Reserve and the Tempe wetlands be avoided or minimised if part of a demonstrated better value for money solution.

The Port Botany rail line must be able to operate continuously through construction. Realignment of the existing line may be considered.

Designs for AAL must show how future augmentation of north-south motorway capacity in the area (ie F6 extension and Inner West Bypass to Victoria Road) can be provided.

The area traversed by AAL is constrained by a number of factors, including Sydney Airport's OLS restrictions, Port Botany rail line, Cooks River, Alexandra Canal, community facilities and ground conditions. SMPO believes that identification of an innovative solution that minimises the cost impact of site constraints is the most important factor for this component of the Project.

The BBJV recommended option achieves these stated objectives.

In addition to the base scheme, the Industry Partner must prepare an option for the AAL that follows, to the extent feasible, the course of the Alexandra Canal.

The target cost for the AAL is $1.5 billion (2012$) at a P50 level including the net cost of land, and excluding any design impacts on the M5 East and its duplication as part of WestConnex.

5.2.3 M5 East Extension

The BBJV preferred option deviates from the SMPO Base Option and a new tunnel alignment following the Bayview Ridge is proposed. The existing M5 tunnels will remain unchanged, carrying both eastbound and westbound traffic as is currently the case. The advantages of this arrangement are discussed in section 5.1.2 of this report.

5.3 Cost Summary

5.3.1 Start Up Kit Estimates

SMPO provided high level cost summaries of their WestConnes Base Option and their Option 13.

The high level costing showed that the project construction costs included Assumed Contractors Design and Construct (D&C) Selling Price, Project Development and Finalisation costs of $37M and $12M respectively. It also identified Client Project Contingencies and Land Acquisition values which when added together gave an overall Project Element Cost.

Cost planning estimates provided breakdowns of the Project Development and Project Finalisation costs. Estimates showed that there was a detailed cost plan prepared for the Airport Access Link (AAL) section of the project. These cost plans developed a Direct Cost D&C price.

To convert the Direct Cost price to a selling price SMPO adopted a multiplier of 1.6 for Surface Works to cover project indirect costs, contractor's assumed contingencies, overhead and profit for surface works. This multiplier was seen as reasonable for cost planning purposes and comparing IPDT cost plans. It is noted that when final scope and project timing is known this multiplier may vary.

There was not a similar detailed cost plan for the Inner West Tunnel (IWT) however guidance on tunnelling was provided in a detailed cost plan for the M5 duplication. The cost build up adopted by SMPO for the Tunnel was similar to AAL except that a multiplier of 1.75 was adopted to convert Direct Cost Estimates to Selling Prices, again this multiplier was seen as appropriate for cost planning and comparison purposes and may vary when final scope and project timing is known.

5.3.2 Approach to developing BBJV estimates

With Guidance from SMPO it was agreed that BBJV would review the estimates included in the Start Up Kit to satisfy themselves that the cost build up was appropriate for cost planning purposes. BBJV would then adopt appropriate rates from these estimates to build up cost plans for the solutions being developed.

BBJV adopted this approach for the AAL options we developed. For our IWT options we used historical data from completed projects and escalated these rates. The cost plan developed was then compared to rates developed for the M5 Duplication estimate as a check.

5.3.3 Changes in Cost Estimates

During the Cost planning phase there is minimal detail relating to items such as Geology, Services, etc. Where possible we have made provision for interpreted data to allow us to develop concept designs.

We have made no provision for services works where the tunnel, or its ramps surface and have assumed that part of the Client's contingency will cover surface relocations. For the Recommended Option we have made provision for terminating services at the site boundaries we have identified.

The BBJV recommended Option Cost Summary is shown in Table 5.1 and refers to the elements in Figure 5.1.

Legend

1. AAL
2. IWT
3. Additional length of M5 East Duplication to portal at Tempe Park
4. Arundel Street Connection
5. Henderson Street Connection
6. Princes Highway Connection
7. Flood Street Ramps
8. Taverners Hill Portal
9. SMPO Estimate for M5 East Duplication (shown as 10 in figure 12.7f)
10. SMPO Base Option P90 for AAL, IWT & M5 East Duplication with Portal at Marsh Street

Table 5.1: BBJV Recommended Option Cost Summary Compared with SMPO Base Option P90

	Values taken from SMPO documents & BBJV Cost Planning from ISCART meeting 27/03/13	D&C Selling Price	Property	Selling Price + Property	Clients PD & PF	Clients Contingency	TOTAL
1	**Princes Highway Option - IWT**		23	23	49		72
	IWT 2x2 (less Flood Street Ramps & Taverners Hill Portal)	951		951		683	1,634
	Additional Length	102		102			102
	IWT extra for 2x3 - considered as mandatory for futureproofing	274		274		137	411
	M4 (IWT) SB Ramp	23		23			23
	M4 (IWT) NB Ramp	60		60			60
	M5E Ramp SB	36		36			36
	M5E Ramp NB	55		55			55
	Spoil Allowance	20		20			20
	subtotal	1,522	23	1,545	49	820	2,414
2	**Airport Access Link**		195	195	49		244
	Princes Highway Interchange	243		243		130	373
	One way pairs	8		8		0	8
	Urban Design Allowance	100		100		0	100
	subtotal	351	195	546	49	130	725
3	**M5E Duplication**						0
	Additional Cost to Princes Highway Interchange	232		232		120	352
	subtotal	232	0	232	0	120	352
	TOTAL BEFORE CONNECTION OPTIONS	**2,104**	**218**	**2,322**	**98**	**1,070**	**3,490**
4	Arundel Street Connection	338		338		164	502
5	Henderson Street Connection	313	4	317		157	474
6	Princes Highway Connection	37		37		19	56
7	Flood Street Ramps	46		46		0	46
8	Taverners Hill Portal	46		46		0	46
	subtotal	781	4	785	0	340	1,125
	D&C Contractor Total for AAL, IWT and Connection Options	**2,885**	**222**	**3,107**	**98**	**1,410**	**4,615**
9	**Estimate by Others**						
	King Georges Road to Bexley	308	0	308	12	128	448
	Bexley to Marsh Street	1,157	5	1,162	37	477	1,676
	subtotal	1,465	5	1,470	49	605	2,124
	TOTAL for AAL, IWT & M5 East combined	**4,350**	227	4,577	147	2,015	**6,739**
10	**SMPO Base Option P90 - High Level Estimate for :-**						
	Airport Access Link - **BY BBJV**						
	- Build with M5 East duplication	941	405	1,346	37	538	1,921
	- Build with Inner West Bypass	277	252	529	12	159	700
	Inner West Tunnel - 2 x 2 lanes - **BY BBJV**						
	- Taverners Hill to Camperdown	694	56	750	12	353	1,115
	- Camperdown to St Peters	727	0	727	37	382	1,146
	Inner West Tunnel - Extra Option 13 for 2 x 3 lanes	441	0	441	0	221	662
	TOTAL - AAL & IWT	3,080	713	3,793	98	1,653	**5,544**
	M5 East Duplication - **BY OTHERS**						
	- King Georges Road to Bexley Road	308	0	308	12	128	448
	- Bexley Road to Marsh Street	1,157	5	1,162	37	477	1,676
	TOTAL including M5 East Duplication	**4,545**	718	5,263	147	2,258	**7,668**

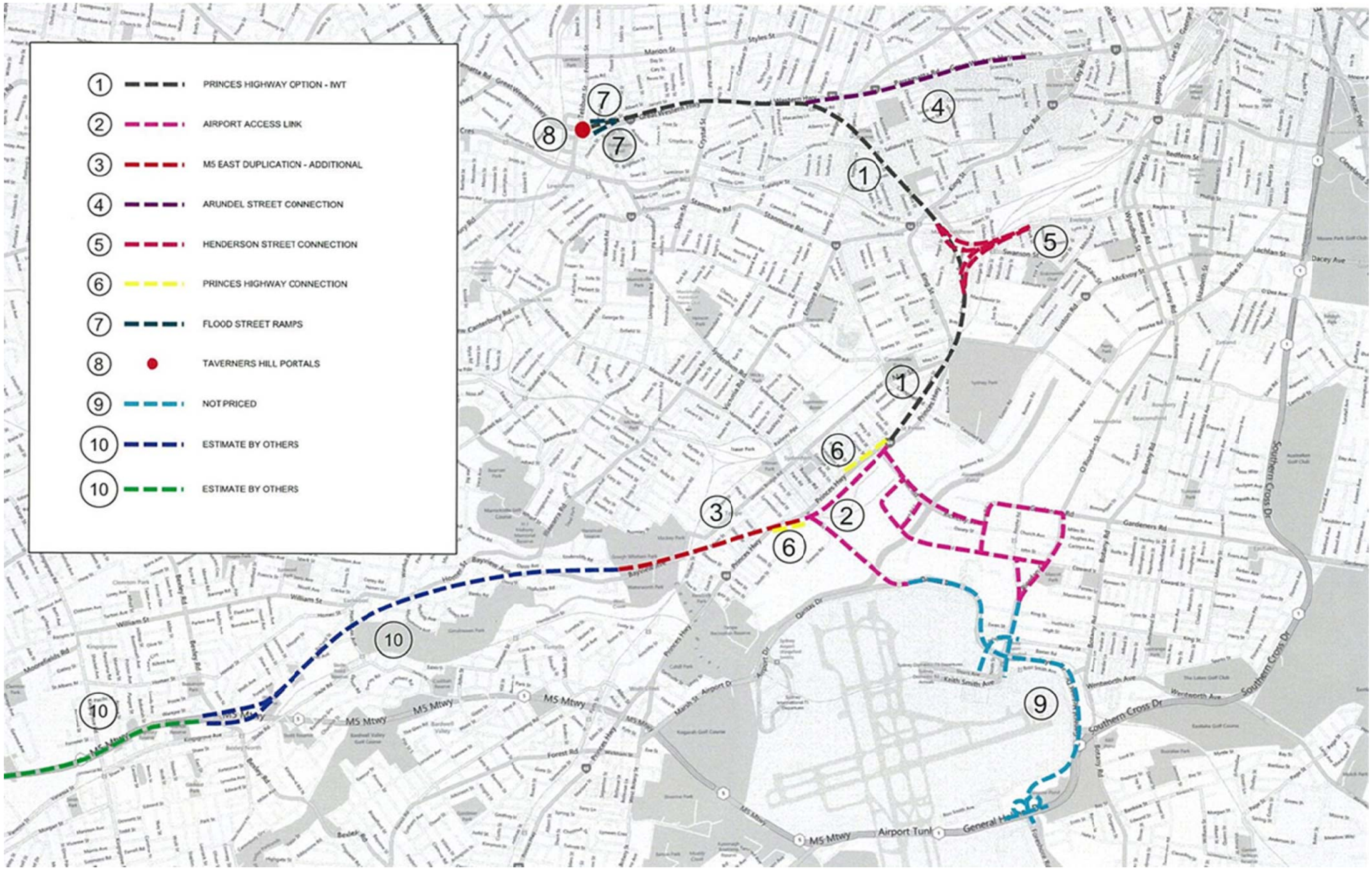


Figure 5.1: Elements identified by BBJV as part of the recommended AAL & IWT solution

5.4 Geotechnical Constraints

5.4.1 Stratigraphy and Structure

The geological longitudinal section for the Princes Highway Alignment is reproduced here Figure 5.2, which indicates the following broad classification of geology along the road route.

A section by section assessment of the geology along the Princes Highway Alignment is given in Table 5.2 below.

5.4.2 Methods of Excavation

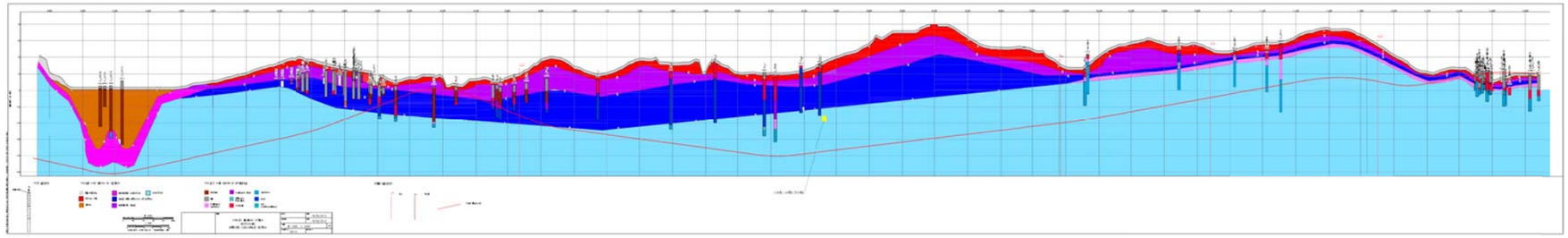
The shales could be readily excavated by road header, or by hydraulic impact breaker. Because the shale has low abrasivity, wear rates should be low. Machine productions may well be governed by the requirements to install primary support.

The sandstone could be able to be excavated by the same equipment. However, because of the highly abrasive nature of these rocks, pick wear would be high. Actual consumption will depend on the type of equipment adopted.

Table 5.2: Geotechnical Assessment of the Princes Highway Alignment

Section	Tunnel Type	Geology	Key Risks & Constraints	Remarks
Ch 3700 to 4050	Driven	Crown of tunnel over 10m below top of fresh Hawkesbury Sandstone		
Ch4050 to Ch4350	Driven	Crown of tunnel is overlain by approximately 15m Hawkesbury Sandstone including possibly a 10m deep weathered zone which is underlain by approximately 25 to 35m Alluvial deposit	+ Presence of Palaeovalley Channel; + Possibility of water / soil ingress	A cut and cover option may be adopted with the possible lifting up of the vertical alignment which would be beneficial to ventilation during operation
Ch4350 to Ch5600	Driven	Crown of the tunnel is 5 to 30m below fresh Hawkesbury sandstone		
Ch5600 to Ch5900	Driven	Crown of tunnel in fresh shale		
Ch5900 to Ch6100	Driven	Crow of tunnel in weather shale	Heavy supporting may be required	
Ch6100 to Ch6400	Open Slot, Cut and Cover	Tunnel in residual soil and extremely weathered shale		
Ch6400 to Ch6500	Driven	Crow of tunnel likely in weather shale		
Ch6500 to Ch7300	Driven	Crown of tunnel in fresh shale	Presence of dyke in this area	
Ch7300 to Ch12000	Driven	Crown of tunnel in fresh sandstone	Intersecting at least 2 dykes at approximate Chainages 10,900 and 11,900, the Luna Park Fault at approximate Ch 9,950, and Sydney Water tunnel at approximately Ch8,500	
Ch12000 to 12200	Open Slot, Cut and Cover	Tunnel in a mix of residual soil, shale and sandstone		

Figure 5.2: Geological Section Along the Princes Highway Alignment



5.5 Portals and Structures

A variety of typical portal cut and cover structures have been considered for the tunnel alignments under consideration. At large the ground conditions dictate the construction methodology and type of structure required at each location. The following sections describe key considerations and constraints in relation to the typical structures considered for this study. A summary of portal parameters is given in Figure 5.3.

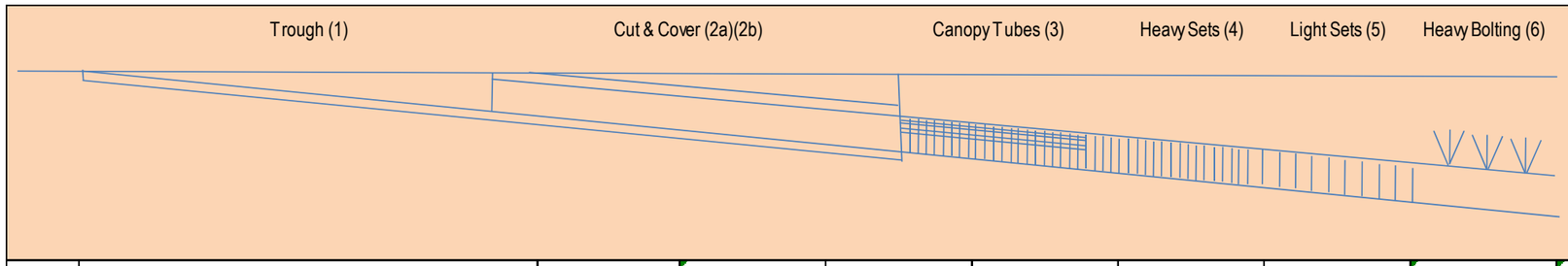
5.5.1 M5 Bayview - Western Portals at Bexley Road

The Western Portal for the M5 Bayview alignment follows the RMS proposal of the M5 East Duplication except that the M5 Bayview Eastbound tunnel portal is located to the North of the existing M5 East. Both Portals are located immediately West of Bexley Road.

5.5.2 The Cut & Cover structures and portals between the M5 Bayview and the IWT

The ground conditions for the cut and cover structures between the M5 Bayview eastern tunnel portals and the Inner Wester Tunnel southern portals is expected to consist of alluvium and fill that can be up to about five metre deep overlying residual clay and underlain by Ashfiled Shale.

The significant depth of permeable or soft alluvial deposits places construction with a pile wall at a disadvantage when compared with diaphragm wall construction except for the shallow trough structures for which the top of the traffic barrier in the trough is not lower than the typical ground water level. This is because diaphragm walls automatically achieve ground water cut off where supplementary measures i.e. grouting behind the wall will be required to effectively seal contiguous pile walls.



	Construction / Support Type →		(1)	(2a)	(2b)	(1)+(2a)+(2b)	(3)&(4)	(5)	(6)
Item	Portal Location	Relevant Options	Trough Length (m)	Propped Trough Length (m)	Cut & Cover Length (m)	Total Length of C&C + Trough	Canopy Tube Heavy sets Length (m)	Spiling bars light Sets Length (m)	Heavy Bolting Length (m)
1	M5 - Bexley Rd Portal	Recc,OBC, Canal	140	0	340	480	20	20	20
2	Bayview Option - Tempe Reserve Portal	OBC, Canal	140	0	220	360	20	20	40
3	Bayview Option - Princes Hwy Portals - M5 Bayview	Recommended	240	90	60	390	60	40	20
4	Bayview Option - Princes Hwy Portals - IWT	Recommended	140	100	60	300	60	40	20
5	IWT - St Peters Tip Portal	Opt. Base Case	0	250	60	310	75	75	50
6	IWT - Camperdown, Arundel St Ramps	Recc,OBC, Canal	60	20	40	120	25	25	20
7	IWT - Camperdown, Pyrmont Bridge Rd Ramp A	Recc,OBC, Canal	140	0	80	220	20	20	20
8	IWT - Camperdown, Pyrmont Bridge Rd Ramp B	Recc,OBC, Canal	160	0	100	260	20	20	20
9	IWT - Taverners Hill Portal	Recc,OBC, Canal	320	0	60	380	25	25	20
10	IWT - Taverners Hill, Flood St Ramps	Recc,OBC, Canal	80	0	40	120	25	25	20
11	IWT - City Rd Portals - Exit @ 6% - Fr.Shale @ 18m	Recc, OBC	60	50	220	330	40	TBC	TBC
12	IWT - City Rd Portals - Entry @8% - Fr.Shale @ 9m	Recc, OBC	50	40	100	190	30	TBC	TBC
13	IWT - Henderson Rd - Exit @ 6% - Fr.Shale @ 15m	Recc, OBC	60	50	230	340	40	TBC	TBC
14	IWT - Henderson Rd - Entry @ 8% - Fr.Shale @ 15m	Recc, OBC	50	40	170	260	30	TBC	TBC

Fig 5.3: Summary of Portal Structures and Portal Support

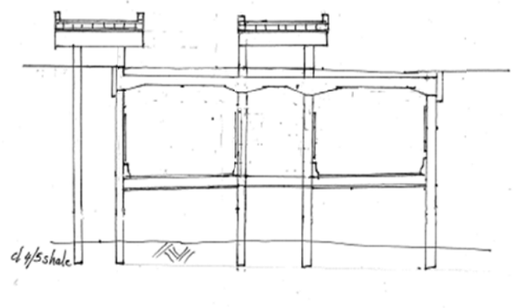


Fig 5.4: M5 Bayview Typical C&C Structure with elevated ramp connections

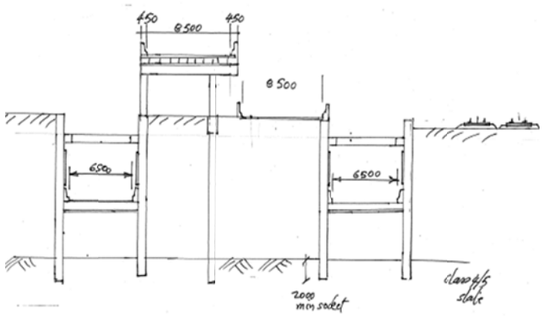


Fig 5.5: IWT Typical Cut Structure Bellevue Street with elevated ramp connections

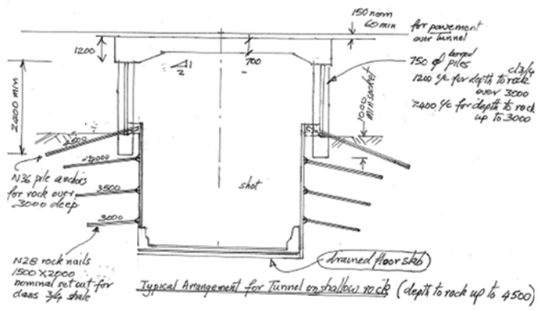


Fig 5.6: IWT Typical C&C Structure

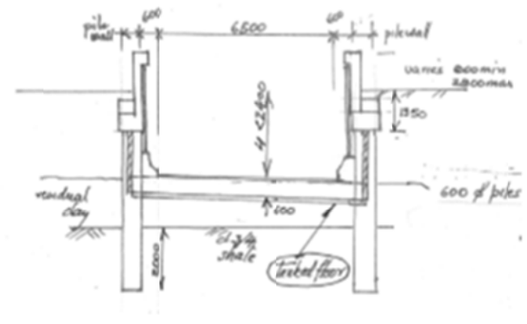


Fig 5.7: IWT Typical Open Cut Structure

However, the shallow part of the trough structures could be configured with pile walls, where the pavement in the trough is supported on concrete slabs that also act to prop the pile walls.

It is proposed to configure the deeper trough structures with diaphragm walls that extend down to a socket in the residual clay and shale where they achieve a ground water cut-off. This allows the adoption of a drained floor structure, which then saves on the cost of a heavier floor slab to resist the uplift groundwater pressure, and also avoids the need to provide anchorage against the uplift force that is in addition to the weight of the walls and floor slab.

Where the depth to the top of the slab in the trough structures exceeds about three but is less than five metres it will be necessary to prop the walls during construction , either using temporary props at capping beam level that are installed once excavation has reached a depth of about three metres, or using temporary ground anchors.

Where the trough structures are deeper than approximately five metres, and therefore deeper than the vehicle clearance permanent props should be considered comprising of precast concrete struts and cast in place waler beams that are constructed top down. Alternatively, the deep trough structures could be propped with precast struts at capping beam level that are installed once excavation is about three and a half metres deep.

An alternative method is to constructing the deeper part of the approach to the tunnel portal as a trough is to configure the section as a cut and cover tunnel, which is a feasible alternative but does not appear to present obvious advantages, but instead there are operational costs associated with an increased tunnel length.

Therefore it is proposed to extend the trough structures up to the ventilation plant rooms that are in front of the driven tunnel portal, propping the walls with precast struts that are incorporated in the composite floor slab structure to the plant room.

5.5.3 IWT Northern Portals at Taverners Hill, Flood Street and Camperdown

The expected ground conditions for the portals and trough structures at the northern end of the IWT are expected to comprise shallow fill and residual clay over a thin layer of Ashfield Shale (typically ≤3m) followed by Hawkesbury Sandstone.

Where the depth to the competent rock does not exceed about four metres it is advantageous to construct the cutting with a collar structure of retaining wall that supports the ground above rock level, with the rock face below retained on a vertical sawn cut face that has a pattern of rock nails and a facing of reinforced sprayed concrete.

Where the retaining wall is to be constructed next to a road a piled retaining wall is required to provide support to the ground under the road during construction. The retaining walls on both footing foundation and on bored pile foundation have to be anchored into the rock against sliding using passive anchors. A typical section is shown in Fig 5.6 below

The excavation below the retaining wall collar is then carried out into the shale, with a vertical cut face, a pattern of rock nails and a reinforced sprayed concrete facing, which is drained with strip drains on the rear face and weepholes. The rock nails are set out on a standard pattern, typically 1.5m x 2m, and additional nails added where the rock is locally found to have inclined joints or to be weathered to class V.

The pavement in the cutting is then a drained construction as is the rock face on each side. The retaining walls retain ground water in the soil above the rock, the level of which will have seasonal variation.

A similar construction methodology has been adopted on several previous projects , including the underpass of Victoria Road at Devlin St [in Shale], the approach cutting of the Cross City Tunnel at Kings Cross [in Sandstone] and also the deep cutting for the rail underpass at Sefton [in Shale also].

A pile wall for the full depth of the trough is however required where the depth to rock in a cutting exceeds about four metres or where the construction requires a roof over the cutting to support a plant room or existing surface road pavement. This proposed arrangement is based on the understanding that there is only a shallow cover of fill or alluvium that is at least mainly retained by the pile wall capping beam, leaving the wall of spaced piles to retain the clay and weathered rock, which have a low permeability.

The floor slab to the cuttings would be water retaining in the short section that is above the residual clay and shale, and would be drained below that.

5.6 Traffic

5.6.1 Demand

The 2021 AM peak hour link flow plots generated for the Princes Highway Interchange option (based on a no-toll scenario) are presented below. The modelling identified the following issues:

+ The AM & PM peak movements between the M4 and M5 may be accommodated by a single lane. The lane arrangements in the interchange were subsequently simplified to a lane drop and lane pick-up in between the ramps (i.e. 2-1-2)
+ A micro-simulation model of the interchange was developed using 2021 AM and PM peak flows. Whilst the interchange operated satisfactorily, the low-speed loops represent a potential capacity constraint. The heaviest demands for the loops are in the PM peak. Under 2021 PM peak flows, demands exceeded 1500 vph.
+ Demand for the Canal Road ramps (7300vph) is significantly heavier than for the Qantas Drive ramps (4,900vph)

A comparison of link flow forecasts under both the OBC and PHO schemes are presented in Table 5.3.

Table 5.3: Comparison of OBC and PHO 2021 AM peak Hour link Flow Forecasts

Description	OBC	PHO
New M5 Tunnel WB	1540	1450
New M5 Tunnel EB	3310	3450
Old M5 Tunnel WB	2520	2680
Old M5 Tunnel EB	3450	3330
IWT NB (North of Henderson Rd)	2760	2400
IWT SB (North of Henderson Rd)	3380	3090
IWT NB (South of Henderson Rd)	2760	2400
IWT SB (South of Henderson Rd)	3380	3090
EB Off-ramp @ Camperdown	3340	3210
WB On-ramp @ Camperdown	2100	1850

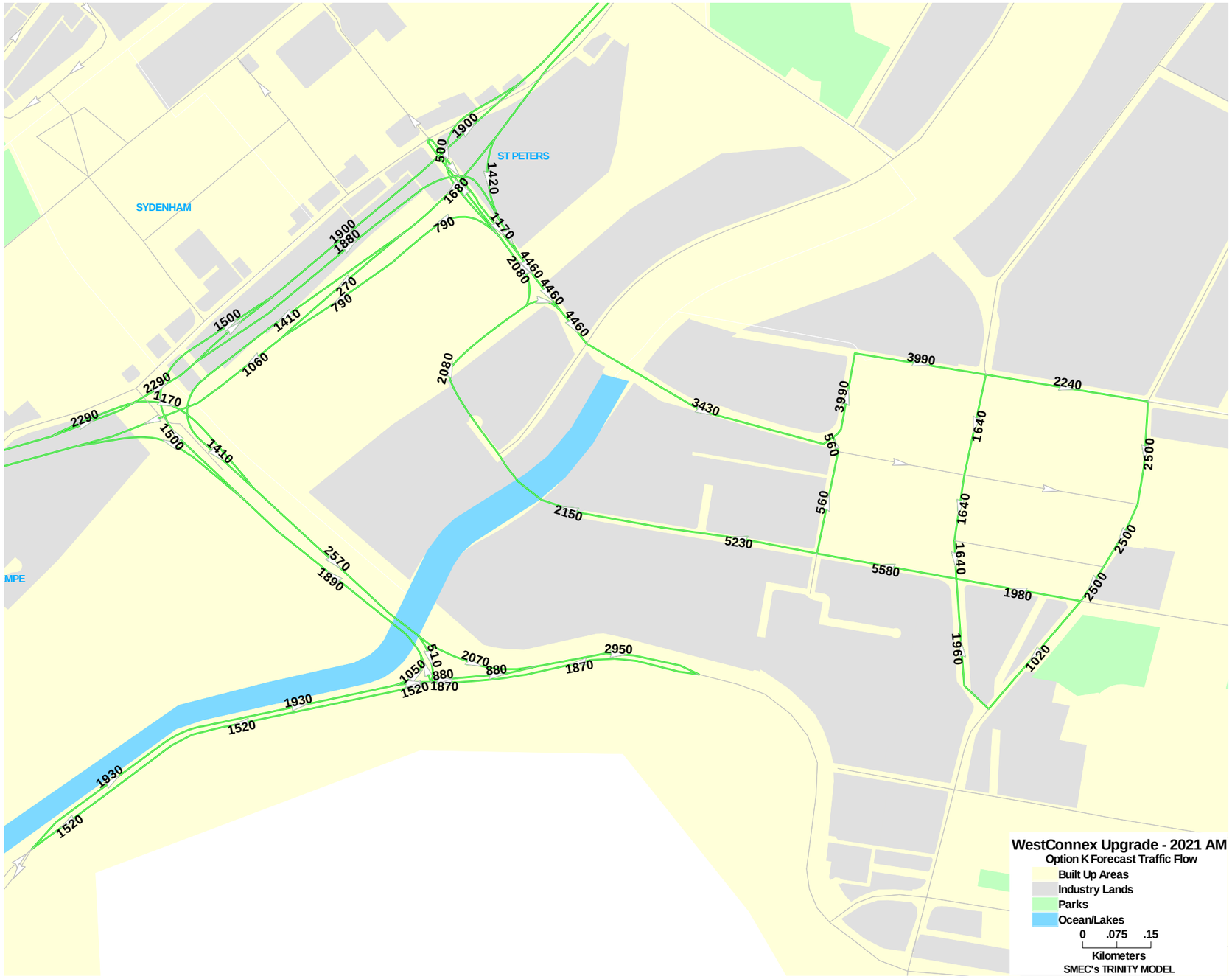


Figure 5.8: Princes Highway Option (Tunnels) 2021 AM Peak Hour Forecast Link Flows

5.6.2 Truck Connectivity

A key feature of the PHO functionality for the road freight movements, include:

+ Provision of a single primary corridor for all truck movements (up to and including 4.6m high vehicles) between Port Botany and the WestConnex.
+ Improved legibility of the freight network and easier navigation freight vehicles
+ Provision of an easily accessible alternative to the existing M5-East westbound tunnel which is plagued by steep grades at its western end
+ Increased returns on any investment in freight network upgrades along the Airport, Qantas and Joyce Drive connection around the airport
+ Maintains some redundancy in the system with secondary access opportunities should the primary route be blocked

This arrangement does not preclude existing access arrangements for Dangerous Goods vehicles which are prohibited from using road tunnels in Sydney.

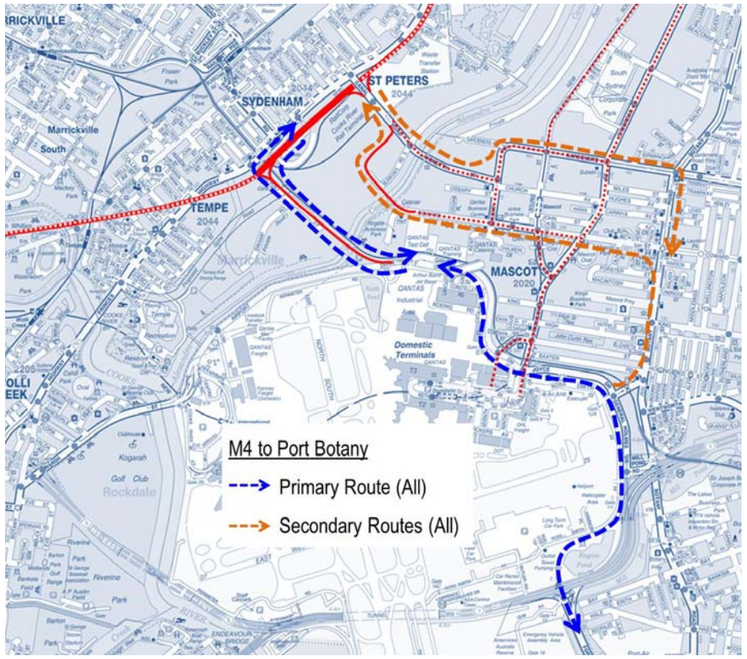


Figure 5.9: PHO Truck Access Routes Between Port Botany and M4

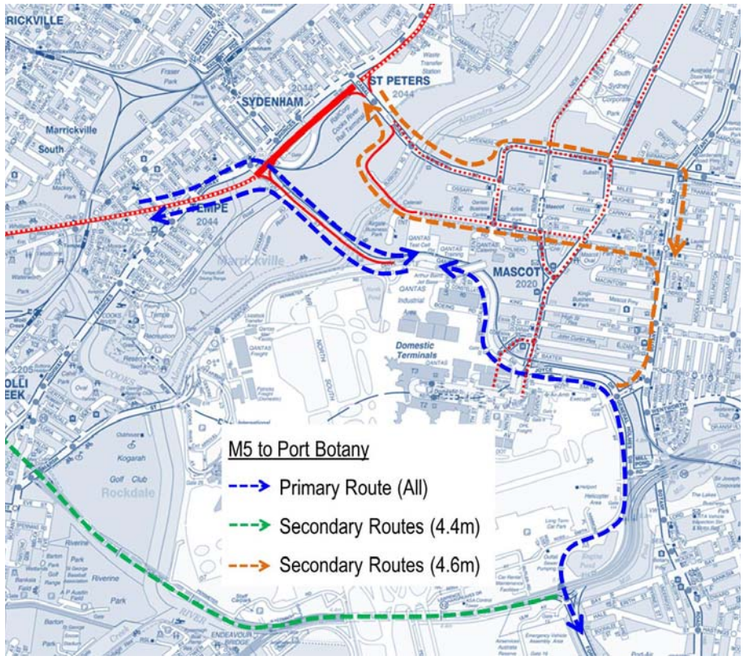


Figure 5.10: PHO Truck Access Routes Between Port Botany and M5

5.6.3 Cooks River Terminal Access

Under the PHO, access to the Cooks River terminal would be via:

+ Left-in-left-out access to Coward Street (Access 'A'). This replaces the current access onto Canal Road which cannot be maintained under the PHO. Fortunately, the replacement access onto Coward Street provides terminal users with full access to the M4, M5, Mascot and Princes Highway

+ Left-in-left-out access to the Princes Highway via Talbot Street (Access 'B'). This will become a secondary access to the site. The right turn into the site has been sacrificed to improve the overall capacity of Princes Highway.

These access arrangements will require some modifications to the internal road system in the south-west corner of the site.

Figure 5.11: PHO Truck Access to the Cooks river rail terminal

5.7 Urban Development Opportunities

5.7.1 Urban Renewal

This Project catalyses urban renewal through project activities in respect of enabling commercial/ residential redevelopment or contributing to liveable communities.

5.7.2 Description of Corridor

The study area of WestConnex traverses several differing areas of urban fabric to the west of central Sydney. These include the Parramatta Road Corridor, Inner West Suburbs, Southern Sydney Areas and Airport Environs.

Parramatta Road Corridor can generally be understood as a series of segments with the eastern segment, within this study area, as the most urban. It is characterized as a tight corridor with generally good building stock, smaller parcels and strong orientation to the street front of Parramatta Road. Buildings generally range from 2 – 4 stories.

The corridor passes through the Inner West suburbs of Camperdown, Newtown, and Erskinville. These areas are characterised by dense low-rise residential development of terraces and semi-detached dwellings on smaller lots. Within this mix are some smaller residential flat buildings. Several 'main street'spines cross these areas providing commercial and retail activities. The Eveleigh Rail Yards with Australia Technology Park essentially form the eastern edge of this area.

The Southern Sydney area is includes St Peters, Alexandria and Tempe and contains a mix of smaller scaled residential communities of semi-detached and free standing dwellings along with larger blocks of industrial land. The Princes Highway generally separates existing residential communities on the north from larger scaled industrial/transport related facilities to the south. The Area includes some of the Alexandra Canal environs and reaches into western Mascot.

The Airport Environs section of the study area includes Tempe, Cook's River parkland and a portion of Kogarah. This area has a number of major facilities such as the Tempe Recreational Reserve, Cook's River, the Kogarah Golf Course and small scaled residential fabric of semi-detached and free standing dwellings. The Princes Highway forms the main spine for this area.

5.7.3 Local Government Areas

The corridor passes through several local government areas (LGAs) and their zoning and built form controls have informed the development assessment of this study. These include Leichhardt, Marrickville, Sydney and Rockdale.

The Parramatta Road portion of the corridor, between Flood Street at Taverners Hill and City Road at Chippendale, sits on the border of Leichhardt and Marrickville LGAs.

The Inner West Tunnel portion of the Corridor passes through Marrickville and Sydney LGAs. It travels under Marrickville before following the border between these two LGAs near Newtown. The potential Henderson Road portal is within the Sydney LGA.

The Southern Sydney portion of the corridor passes through Sydney and into Marrickville at a location close to the Botany Bay LGA.

The Airport Environs portion of the corridor passes through the Marrickville LGA and into the Rockdale LGA

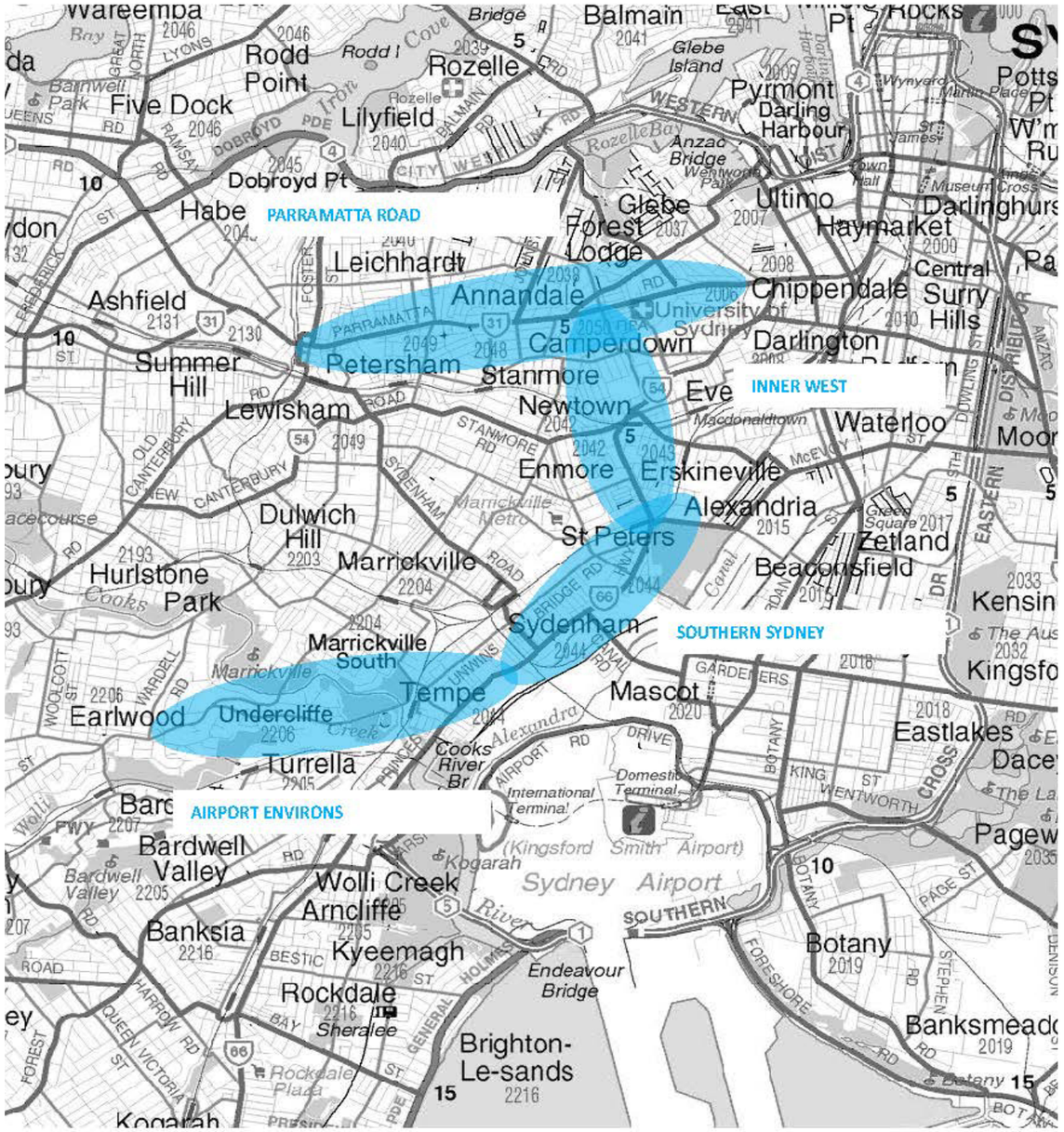


Figure 5.12: Corridor Areas

5.7.4 Current Controls and Development Situation

Parramatta Road

+ Leichhardt
  - Zoning Use – Business / Industrial
  - FSR – Residential 0.5 / 0.6 / 0.7
  - Height Controls (Varies)
+ Marrickville
  - Zoning Use – B2 Local Centre
  - Zoning Use – B4 Mixed Use
  - FSR – S1- 1.5
  - Height Controls – N- 14m

Current Development Capacity

Sites along Parramatta Road are for the most part developed along the portion of the corridor between Taverners Hill and Camperdown. The corridor has sites that generally range from 40 to 50 in depth with established residential areas immediately adjacent. The corridor sites fronting onto Parramatta Road generally have rear lane access although the rear accessways consist primarily of lanes.

Inner West

+ Marrickville
  - Zoning Use – B2 Local Centre
  - Zoning Use – R2 Low Density Residential
  - FSR – S1:1.5 / F:0.6
  - Height Controls – N:14m / J:9.5m
+ Sydney
  - Zoning Use – R1 Residential
  - Zoning Use - B2 Local Centre
  - FSR – R1 - 0.6 / B2 – 1.5
  - Height Controls – 6 – 15m

Current Development Capacity

These suburbs have essentially reached their full development potential with few open lots and limited scope for parcel assembly. Parcels related to the rail yards, should they be deemed surplus to railway operations, would offer the best opportunity for new development. Sites in and around the Mitchell Industrial Estate in Erskinville are currently being converted to high density residential flat uses and this is likely to continue.

South Sydney Area

+ Marrickville
  - Zoning Use – B6 Enterprise Corridor
  - Zoning Use – IN1 General Industrial
  - FSR – M:0.95
  - Height Controls – Deferred / J:9.5m
+ Sydney
  - Zoning Use – R1 Residential
  - Zoning Use - B2 Local Centre
  - Zoning Use – 4 Industrial
  - Zoning Use – 10 Mixed Use
  - FSR – R1 - 0.6 / B2 – 1..5
  - Height Controls – 1 – 6 Storeys

Current Development Capacity

The primary sites offering development potential within this area are the larger industrial sites south of Sydney Park and near the Alexandra Canal. Some regeneration is currently taking place at the north end of the Alexandra Canal whereby former industrial sites are being converted in to entertainment/creative industries hubs. This trend is likely to continue and move southward along the canal towards the airport. The Mascot Urban Activation Precinct, recently identified by DPI, will also accelerate the transformation of this area into a more active living and working centre.

Airport Environs

+ Marrickville
  - Zoning Use – B6 Enterprise Corridor
  - Zoning Use – IN1 General Industrial
  - FSR – M:0.95
  - Height Controls – Deferred / J:9.5m
+ Rockdale
  - Zoning Use – B4 – Mixed Use
  - Zoning Use – R4 High Density Residential
  - Zoning Use R2 – Low Density Residential
  - FSR – D:0.5 / U2– 2.85
  - Height Controls – 8.5 – 28m

Current Development Capacity

Development opportunity in this area occurs largely on two places. The Kogarah Golf course, which has been previously proposed for development with the Cooks' Cove development proposal, and the industrial/container areas adjacent to the airport lands are the major areas that could be further developed pending consideration of airport constraints.

5.7.5 Direct Intervention of WestConnex

Parramatta Road

New Sites – New development sites will be opened us with the direct intervention of West Connex at the Taverners Hill Portal and the Camperdown Portal. A Glebe/Arundel Road Portal will likely require little or no resumption of private land and will not offer substantial opportunity for redevelopment / regeneration at that location.

Taverners Hill sites would yield approximately 8,800 sqm of development land. A development scenario follows later in this section.

Camperdown Portals would yield approximately 8,300 sqm of development land. A development scenario follows later in this section.

Potential Uses – These could include commercial and residential buffer buildings. It would be important that any new construction provide parking and offer a continuous edge along Parramatta Road to support retail/entertainment uses and pedestrian activity.

Inner West

New development sites could be opened up with the direct intervention of WestConnex at the any tunnel ventilation building location. Although locations for this facility have not been identified in detail yet, it is likely that this facility may occur at the Camperdown Portal area or further to the south along the tunnel alignment. These facilities have a small footprint and would not offer any major opportunity for redevelopment although, in urban areas such as these, any residual land that can be used to integrate the facility with the surrounding urban fabric should be developed to do so.

Potential Uses – Depending on the final location for any ventilation building potential uses could include retail/community/or small scale commercial uses.

South Sydney Area

New development sites will be opened us with the direct intervention of WestConnex are centered along the Princes Highway between Canal Street and the Port Botany Freight Line. Other portions of WestConnex located in this area would require some further land acquisition however efforts would be made to minimise this in order to allow indirect redevelopment by others to take place at a later date if it is deemed appropriate by individual landowners.

The Princes Highway sites would yield approximately 36,400 sqm of development land. A development scenario follows later in this section.

Potential Uses – These could include commercial and airport related uses. It would be important that any new construction provide parking and offer a continuous edge along the Princes Highway to support pedestrian activity and to encourage further regeneration of this corridor.

Airport Environs

Under the preferred Option no new development sites will are expected to be opened up through direct intervention of WestConnex at this location. The roadway is in tunnel at this location and bypasses most of the area of the airport environs. Should alternate options be pursued at a later time, some sites closer to the airport, such as the Kogarah Golf Course, could be opened up for development as they are acquired for the project.

Potential Uses – Should any sites be identified uses could include commercial and airport related uses. Expansion of landside facilities such as parking, check-in and retail could be accommodated on lands adjacent to the airport and linked to the airside facilities through any number of means.

5.7.6 WestConnex as a Catalyst

Parramatta Road

New Sites – Development sites will be opened us as a result of upgrades and reconfiguration of the public domain. With additional space available for improving pedestrian amenity, parking and landscaping adjacent landowners will be encouraged to upgrade properties to higher-end uses and potentially greater rental returns.

This would likely occur on a gradual basis with some early upgrades occurring in and around village hubs such as Annandale and Leichhardt. This will accelerate the already occurring upgrading of larger parcels along the corridor.

Potential Uses – These could include higher end retail and restaurant/entertainment uses which could support greater pedestrian activity and foster a greater sense of night-time security in the area.

Inner West

New Sites – Opportunity for new development as a result of WestConnex is limited. Whilst WestConnex may take some traffic off of local streets, there are few parcels available for development and current demand for housing and retail venues is strong in the area and appears unlikely to change as a result of WestConnex.

Potential Uses – Uses for any development triggered by WestConnex would largely be infill developments and uses would conform to the prevailing residential/retail mix in the area.

South Sydney Area

New Sites - Development triggered as a result of WestConnex could occur along the Alexandra Canal and in and around industrial sites between the Princes Highway and the airport.

Regeneration is already occurring along the northern end of the canal as a nascent creative industries area combining office / entrainment and retail emerges. With improved access to the metropolitan motorway network and the airport, this area could see a further demand for high-value creative industries and just-in-time delivery of goods and services.

Sites to the north of the Princes Highway could also be prime candidates for regeneration should there be improvements to the traffic conditions or public domain configuration along the Princes Highway. Redevelopment of sites directly impacted by WestConnex will further encourage the regeneration of adjacent sites.

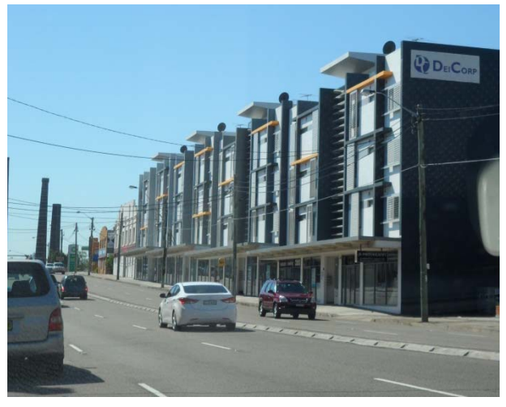
The industrial/transport logistics sites provide large unencumbered site areas. With improved access to the motorway network and airport these sites could be attractive for large scale airport related development.

Potential Uses – ‘Next generation’ sky cities of logistics, airport support, fly-in / fly –out business centres and accommodation areas could be developed. Examples of this type of development are already up and running at various airports around the world. Creative industries precincts can attract any number of media, information and research enterprises for whom proximity to international air gateways is a plus.

Airport Environs

New Sites - Development triggered as a result of WestConnex could include the Kogarah Golf course, site of the former Cook’s Cove development proposal.

Potential Uses – ‘Next generation’ sky cities of logistics, airport support, fly-in / fly –out business centres and accommodation areas could be developed. Examples of this type of development are already up and running at various airports around the world.



5.7.7 Camperdown Redevelopment

The proposed portal at Camperdown would require the resumption of approximately 12,500 sqm of parcels along the south side of the highway.

The portal layout would require approximately 25% of the footprint of this resumed land. The resulting residual parcels would leave a development zone of between 20m and 40m wide adjacent to Parramatta Road for divestment and redevelopment. Given the parcel depth, excellent road frontage, and improved motorway access, it is felt that the residual parcels could be attractive redevelopment opportunities. This could be further facilitated if they were to be rezoned with an FSR uplift.

The current FSR is S1 1.5 for these parcels. A net neutral GFA would be approximately 2.0 FSR for the residual parcels and could yield for up to 16,000sm GFA with good floor plate configurations and below grade parking. The current height limit is 14m.

The redevelopment of these parcels into 4 storey mixed use/residential buildings would also provide a buffer to the residential areas to the south, enhance the immediate streetscape and act as a catalyst for the regeneration of adjacent heritage conservation areas.

The redevelopment sites should provide a continuous street scape of retail/commercial space. Sensitive modulation of the built form will be needed to ensure that the development is compatible with the adjacent residential area. Recent developments in this area suggest that a residential typology, perhaps with some live/work units could be successful here.

The redeveloped parcels could perhaps benefit from some incentive zooming as they will be redeveloped as parcels with better access to Sydney's motorway network than they presently have.

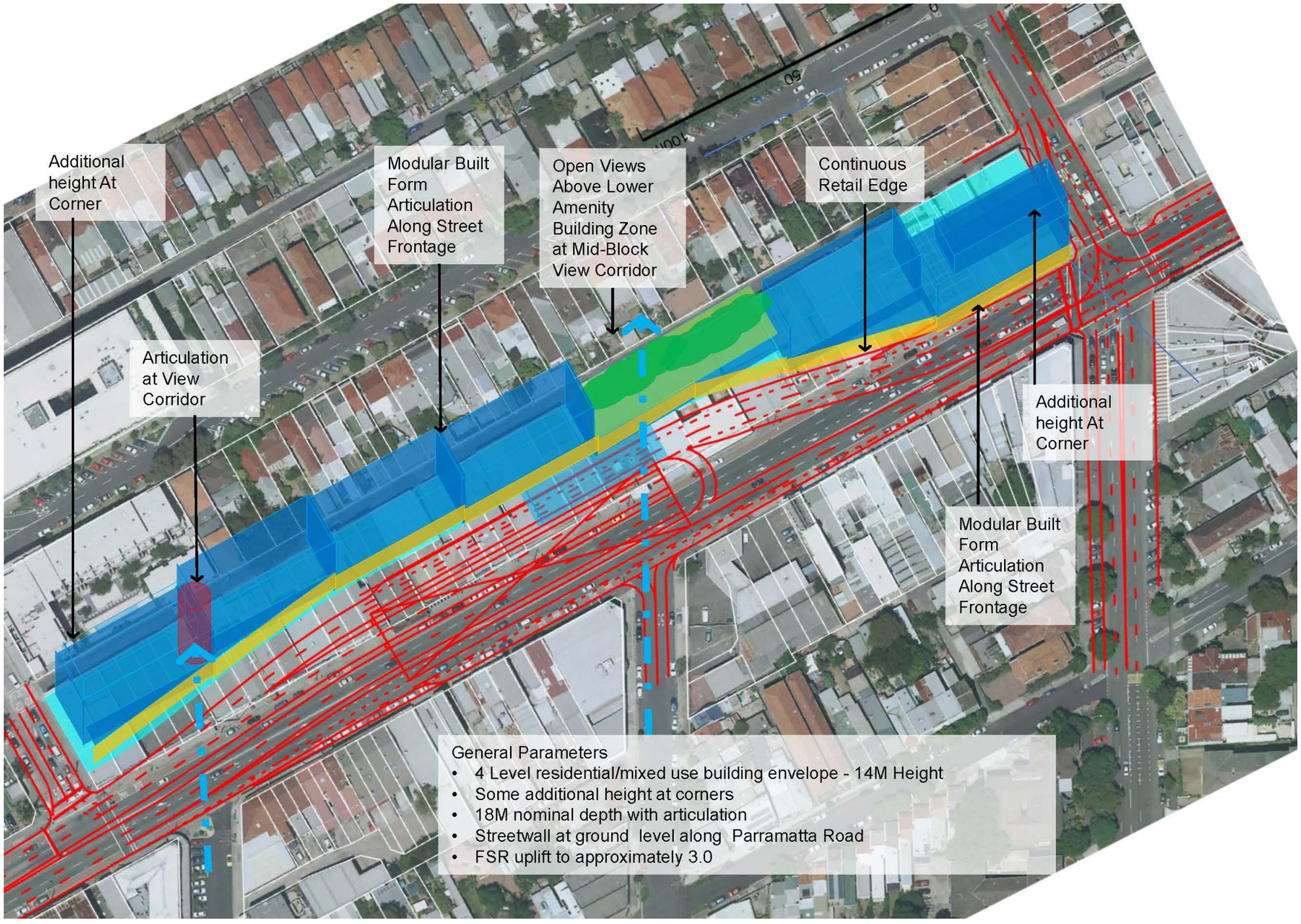


Figure 5.13: Camperdown Portal Development Scenario

5.7.8 Taverners Hill Redevelopment

Provision of a portal at Taverners Hill would require resumption of approximately 22,400 sqm of properties along the north side of Parramatta Road. The portal layout, as provided in the reference design, would require approximately 50% of the footprint of the resumed land.

The resulting residual parcels would leave a development zone of between 20m and 40m wide adjacent to the north side of Parramatta Road for divestment and redevelopment. Given the parcel depth, excellent road frontage, and improved motorway access, these parcels could be attractive redevelopment opportunities. This could be further facilitated with an FSR uplift.

The current FSR is 0.5 residential for these parcels. A net neutral GFA would be approximately 0.7 FSR for the residual parcels of 5800sm yielding 4000sm. The residual commercial sites with a footprint of 3000sm could yield an uplift of up to 4000sm.

The redevelopment of these parcels into mixed use/residential buildings would also provide a buffer to the residential areas to the north, enhance the immediate streetscape and act as a catalyst for the upgrade/regeneration of adjacent areas

It would be envisioned that the redevelopment sites would be largely residential with a continuous street scape of retail/commercial space. Sensitive modulation of the built form will be needed to ensure that the development is compatible with the adjacent residential area. Properties along Albert Street would need to be redeveloped with a residential frontage to that street to maintain continuity with the scale and use of the existing area.

The area between the surface carriage ways could be envisioned as a green gateway to this part of the corridor and provide additional open space that enhances the green link to the Petersham Oval.

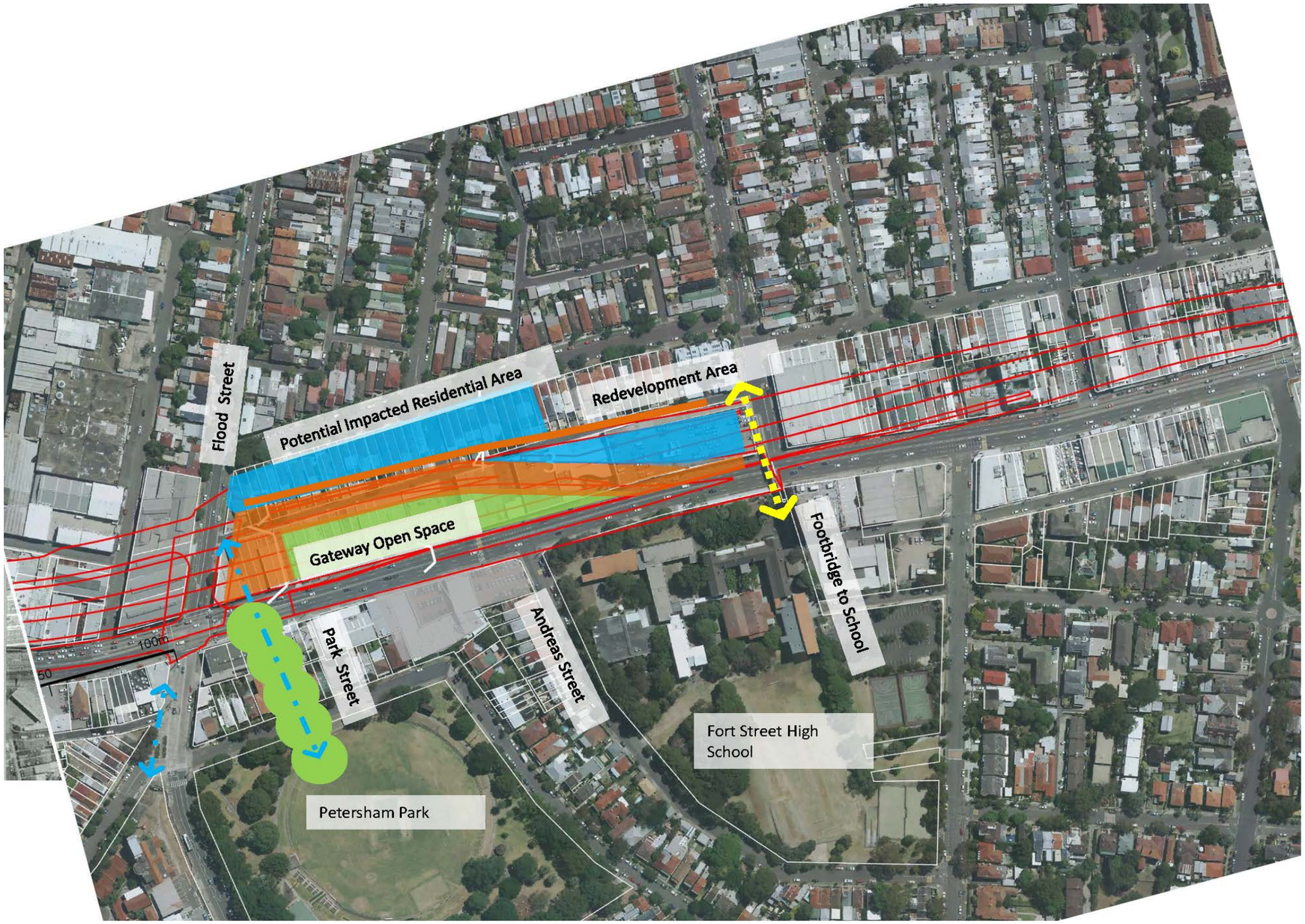


Figure 5.14: Taverners Hill Development Sites

5.7.9 Princes Highway Redevelopment

The proposed interchange of WestConnex at the Princes Highway would require the resumption of approximately 85,700 sqm of parcels along the south side of the highway.

The interchange itself would require approximately 50% of the footprint of this resumed land and, given the existing Princes Highway configuration, the residual parcels would yield a zone of approximately 40m wide adjacent to the highway for divestment and redevelopment. Should the Princes Highway be widened further study would be required to optimise the widening to ensure sufficient width is available in the residual parcels to allow redevelopment. The study illustrated here is based on the existing configuration for the Princes Highway.

Given the parcel depth, excellent road frontage, improved motorway access and proximity to Sydenham Station, the residual parcels could be attractive redevelopment opportunities. This could be further facilitated if they were to be rezoned with an FSR uplift.

The current FSR is 0.95 for these parcels. A net neutral GFA would be approximately 2.0 FSR for the residual parcels and an uplift could yield for up to 70,000sm GFA with good floor plate configurations and below grade parking. The improved access to Sydney Airport provided by WestConnex would further enhance redevelopment opportunities as airport related commercial /accommodation space.

The redevelopment of these parcels into 4 – 6 storey buildings would also provide a buffer to the residential areas to the west from the interchange, enhance the immediate streetscape and act as a catalyst for the redevelopment of narrower blocks on the western side of the Princes Highway at this location.

It would be envisioned that any redevelopment of the edge blocks on the northern side could be mixed residential to provide for more activity on the street as well a transition to the existing residential neighbourhoods. WestConnex could act as a catalyst for .this redevelopment as a result of improved access to the motorway network and airport.

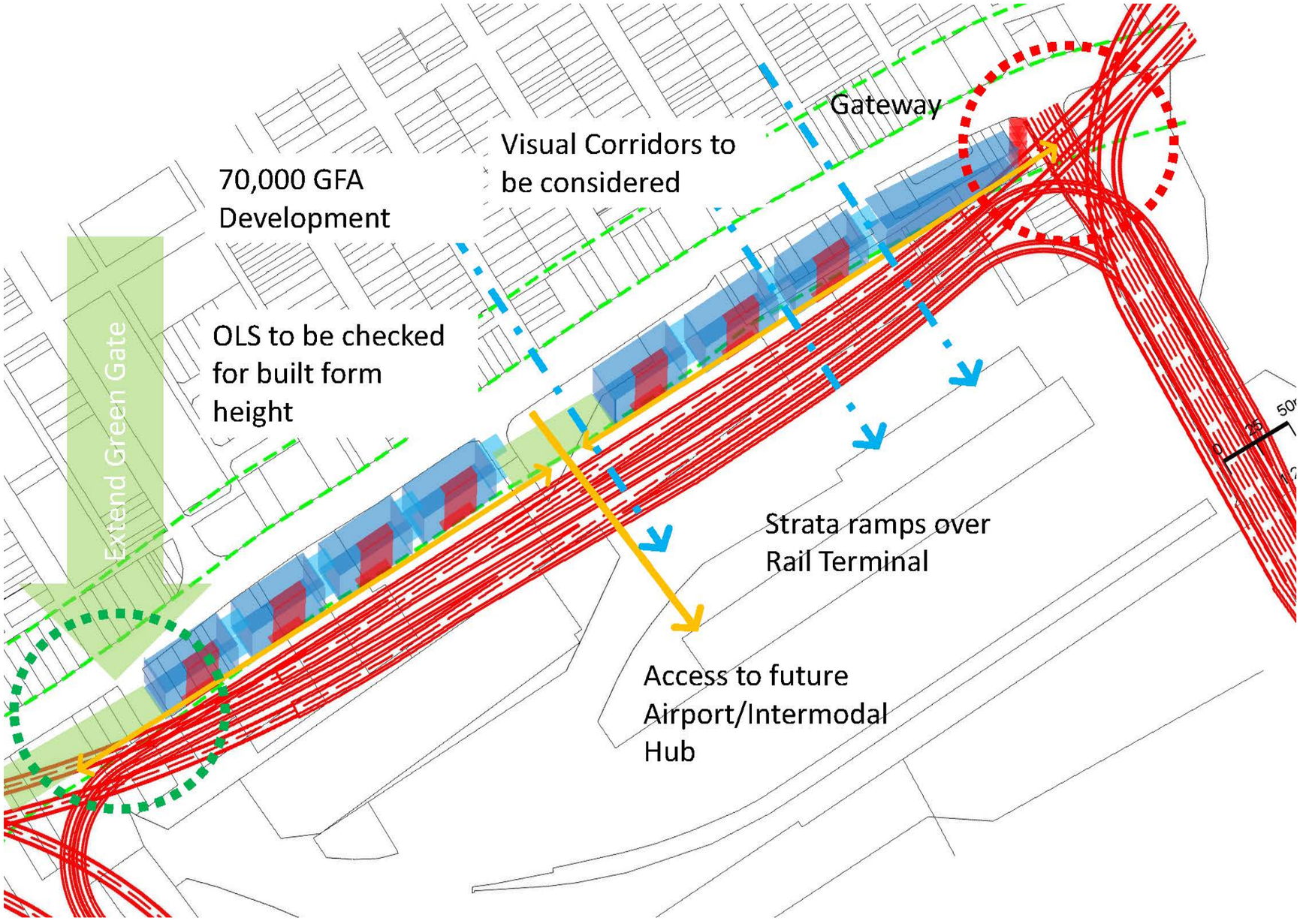


Figure 5.15: Princes highway Development Scenario

5.7.10 Overall Vision

“A renewed ‘Arc of Urbanism’ that supports Inner West Village Centres and fosters the creation of ‘Gateway Hubs’ of creative industry and air related support for Sydney Airport “

The overall development Vision for WestConnex envisions a revitalised Parramatta Road corridor with renewed local centres and relatively a continuous zone of activity along the street.

Larger hubs will be fostered at Camperdown and, potentially at Taverners Hill, where portals will provide new sites for development. These hubs can contain new residential centres with space for public parking facilities within their development footprints.

Further to the south along the Princes Highway WestConnex will play a larger role in the ultimate redevelopment of transport and logistics areas near the airport. Adjacent to the Princes Highway Interchange, the project could unlock the potential of large sites for an eventual redevelopment as an air hub which could provide needed expansion of landside facilities for Sydney Airport.

This concept is already in place at airports such as Hong Kong where remote terminals have been built to expand capacity of the main terminal. These have been located adjacent to the main terminal itself and along key transport routes around the city. This redevelopment would be seen as a long term possibility when either the rail terminal can be relocated or capacity constraints at the airport dictate that the air-rights above the rail terminal be pressed into service to expand the airport’s competitiveness.

Initial redevelopment along the Princes Highway can be undertaken as part of the WestConnex project and can set that stage for further airport related development to follow.

Connections from this major air hub to the Mascot UAP will be strengthened. These two hubs will, with renewed connectivity between them, work in synergy to provide for a strengthening of Sydney Airport's global position as the centre of an emerging group of 'air‘cities’ around the world. Seoul’s Songdo City and Incheon Airport is a recent example of this type of development.

Between these two hubs the ongoing regeneration of the Alexandra Canal is envisioned to continue to create the spine of a mixed residential and creative industry precinct. The attractions for this regeneration will be its identity as a link in Sydney’s metropolitan open space network and with its unique access to both the airport and the new hub at Mascot.

Further to the south a revitalised Princes Highway corridor with a renewed local centre and relatively a continuous zone of activity along the street is envisioned.

An image of this development vision is provided on the following page.

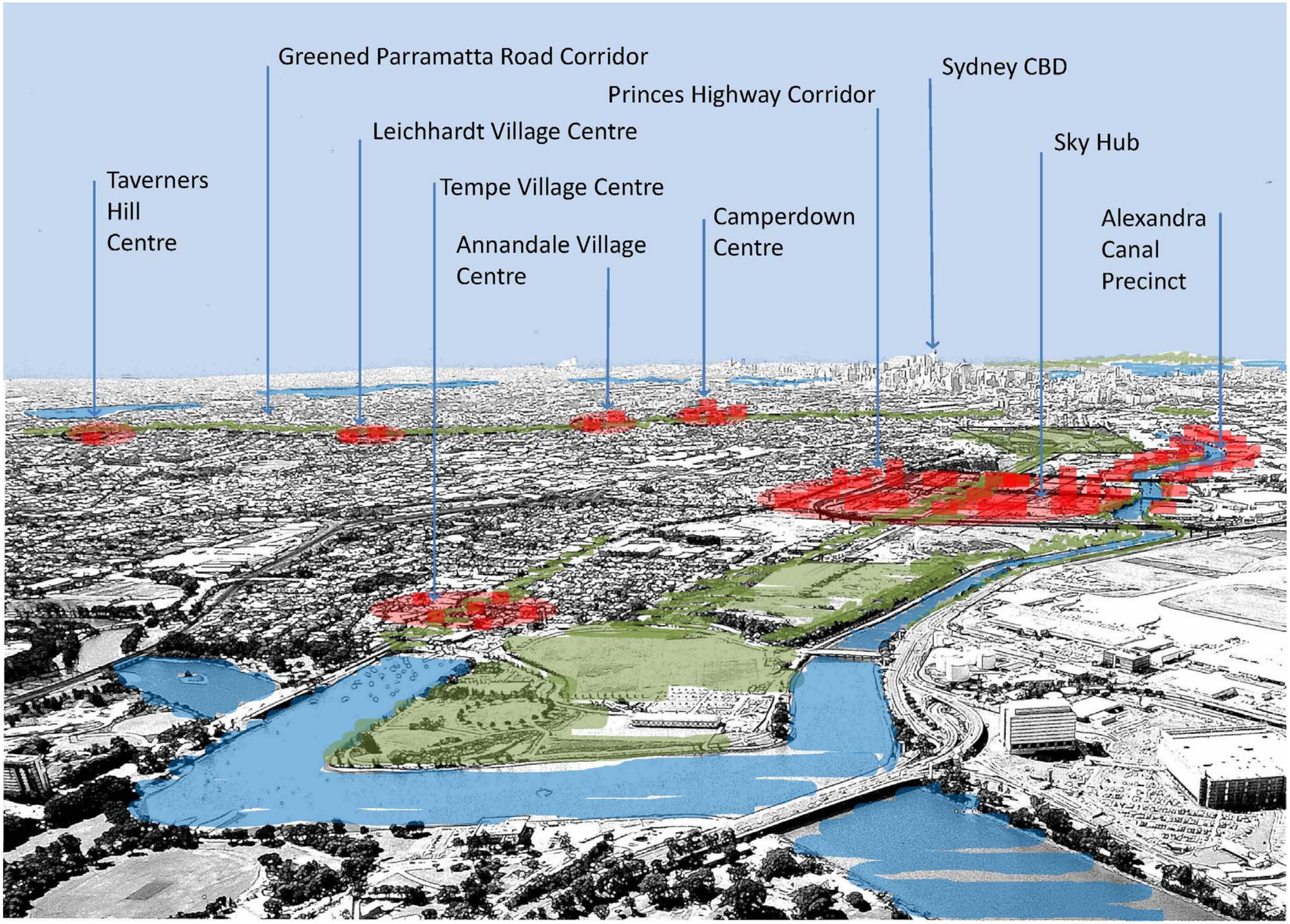


Figure 5.16: Urban Design Vision

5.8 Construction Methodology

5.8.1 Inner West Tunnel Cross Section Review

For the Inner West Tunnel, a review of possible design / construction tunnel options has been undertaken in focusing on costs, programme and work organisation / risks.

We have investigated, for both the 2x2 and 2x3 lanes configurations, the following options:

+ Conventional mined twin-tunnel, excavated with roadheader machines (most common tunnel types in Sydney area)
+ Mined stacked tunnel, with one carriageway above the other, similar to the Eastern Distributor tunnel in Sydney
+ Twin-tunnel built with Tunnel Boring Machines (TBM), of following types:
  - Open mode gripper-TBM, with permanent supports made of rockbolts and shotcrete, drilled and placed through dedicated machines behind the cutting wheel within the TBM back-up
  - Open mode TBM with segmental lining
+ TBM single tube with stacked carriageways, similar to the Alaskan Way tunnel project currently under construction in Seattle (USA)

The results of this review, together with its assumptions with regard to scope and costs on one side and on programme on the other side, are presented in Table 5.4 on the following page.

They can be summarized as follows:

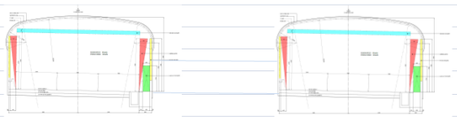
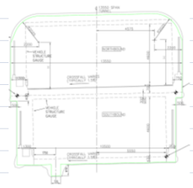
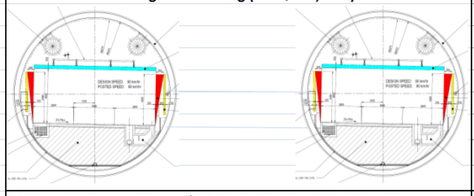
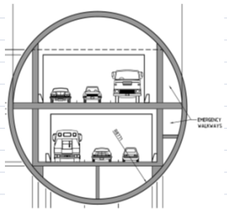
+ The wide single tube option with stacked carriageways (Seattle type) can be excluded since it is highly penalised by
  - the overall programme duration (mainly due to the procurement time for such 18m diameter TBM, and to the average advance rate, which is in any case limited by the speed of the outside rock cutting tool)
  - The cost, mainly due to the internal civil fit-out structures, which is not balanced by the saving on the cross-passages. The Seattle conditions (softer ground, EPB machine) must have been more appropriate to that design/construction mode than the Sydney sandstone ones.
+ The mined stacked option will not be retained as well, as, while it appears to be at quasi the same cost, it's still slightly longer (+4 months), and doesn't present the same flexibility in the work organisation than the twin-tube (the excavation is done from 2 areas, with roadheaders working on staggered locations, compared to 4 separate faces in the twin tube option)
+ In terms of delivery time, the roadheader twin-tunnels option is shorter, for both the 2x2 and 2x3 lanes configurations, with respectively 49 and 52 months, but with a difference to the other options of only 2 months (TBM) to 4 months (RH, stacked). Considering that, particularly for the TBM, an improvement of both the procurement time (trough further insight with TBM manufacturers) and the advance rate (through better knowledge of geology) should be possible, that delivery time criteria cannot be a decisive one.
+ In terms of costs, the gripper-TBM option appears slightly more favourable for the 2x2 lanes configuration (-2% to the roadheader one), what should be promising since a number of issues have still not been considered (e.g. the positive effect of the larger cross-section on the ventilation design, and therefore on both the related Capex and Opex).
+ The gripper-TBM has not been considered for the 2x3 lanes configuration, since, due to the size (Ø 14.5m), the increased quantities of rockbolts and shotcrete within the construction cycle is deemed to compromise the overall advance rate. However, this aspect would need to be further reviewed, on one side, together with the TBM manufacturers, in order to develop/improve the necessary tools, and on the other side, further to a more in-depth analysis of the geology and the subsequent refinement of the necessary permanent supports.
+ As a "consequence", the TBM option for the 2x3 lanes configuration, envisaged with a full segmental lining, appears to be 17% more expensive than the roadheader option (that difference is slightly reduced to 13% for the 2x2 lanes, since the ciruclar excavated cross-section is more adapted to the 2-lane 10m wide reactangular clearance than the 3-lanes 12.2m one) .
+ In terms of overall risks, the main pros and cons can be summarized as follows:
  - The roadheader options offer more flexibility in the work organisation, since further mining faces can be opened from additional shafts (at some costs), in case the construction programme is running late for any reason. In addition, the connections with the ramps are somewhat simpler than in the TBM with segmental lining, in which either the segments must be dismantled at those locations and some rebolting undertaken, or the main tunnel connection areas must be excavated beforehand, together with the ramps, so that the TBM can then cross the resulting caverns, like the stations on a railway tunnel.
  - The TBM options offer a more environmentally friendly construction mode, since the management of spoil, despite the bigger volume, is done from the tunnel portals, which are deemed to be located in more convenient and remote locations than the intermediate access ramps or shafts which are located in critical urban areas (inner connections to city).
  - In the long term, the TBM drive with segmental lining, which is not required in most of the areas located in the Sydney sandstone, offers the advantages of a fully lined undrained tunnel, in terms of durability and maintenance.

In the current scheme (IWT length of around 5km in both the Optimized Base Case and Recommended "Princess Higwhay" Option alignments), the construction of the IWT is proposed, and included as cost in the cost plan, by roadheader equipment. Considering the likelihood of a future link from the IWT to Victoria Rd at White Bay, a twin 3 lane tunnels solution is most likely for this section of WestConnex to satisfy the future traffic load due to that connection.

We consider a drained unlined tunnel to be an appropriate solution for the bulk of the tunnel length with additional support and waterproofing being applied at sections where permeable strata is encountered, typically at the location of soft ground portals, dykes, weathered rock and under old river valleys. Our experience in Sydney Sandstone indicates that if an alignment can be maintained at suitable depth in sound rock the tunnel bore will generally be stable and have minimal water inflow.

The TBM options, either with a gripper TBM and rockbolts/shotcrete, or a TBM with concrete segmental lining, should be considered as viable alternatives for tunnel excavation and final design. Those options could be proven to be more efficient with regard to both the delivery time and the cost aspects, should the IWT scheme be altered to become a longer tunnel. In that case, a deeper insight of the geology constraints and machine procurement should be undertaken, together with a proper analysis of the positive impacts of the resulting larger cross-sections on the ventilation design and costs.

Table 5.4: Inner West Tunnel Option Cost Comparison

2x3 lanes						
Tunneling option	Cost (M$)	Rate/km (M$)	Possible programme		Pros	Cons
			Duration	Details		
Conventional mined twin-tunnel (roadheader)				section: 2x77m2		
	1 292	0,195	52 months	4 mining faces	tunneling option well adapted to geology (sandstone)	moderate progress rate
				4 roadheaders for main tunnels + 4 for the ramps and miscellaneous excavations (cross-passages, ventilation & substations caverns)	construction flexibility	
					duration	
				mobilisation time: 9 months	less costly	
				average progress rate: 95m/month/tube (excavation: 28 months)		
Mined stacked tunnel (roadheader) - *Eastern Distributor type*						
	1 286	0,194	56 months	section: 153m2	tunneling option well adapted to geology (sandstone)	longer duration than twin-tube
	-1%			2x2 mining faces (staggered)		
				4 roadheaders for main tunnels + 4 for the ramps and miscellaneous excavations (cross-passages, ventilation & substations caverns)	less landtake impact in portal areas	doesn't save cross-passages (vertical)
				mobilisation time: 9 months		less flexibility in excavtion organisation than twin-tube
				average progress rate: 90m/month/side (excavation: 30 months)		
TBM twin-tunnel - segmental lining (out. Ø 14,50m)						
				section: 2x165m2	final product is a fully lined undrained tunnel	excavation section (circular) not well adapted to functional one (rectangular); more spoil
	1 510	0,228	54 months	2 TBMs + 4 roadheaders (misc. excavations)		
	17%			mobilisation time (TBM): 18 months (contract, fabrication, transport, assembly)	thanks to larger cross-section, benefits on E&M Capex and Opex (ventilation) - *still not considered in current high level cost estimate*	more costly than roadheader option, but to be refined at later stage (cost & procurement of TBMs, positive impact on E&M...)
				average progress rate: 390m/month		
				excavation: 16 months		
TBM stacked-tunnel (out. Ø 18,8m) - *Alaskan Way (Seatle) type*						
				section: 278m2		
	1 719	0,260	58 months	1 TBM + 3 roadheaders	excavation section (circular) well adapted to functional one (square)	duration (progress rate + mob. time)
	33%			mobilisation time: 20 months		
				average progress rate: 250m/month		cost of internal structures
				excavation: 22 months (section: 275m2)	saves cross-passages	most costly option

2x2 lanes						
Tunneling option	Cost (M$)	Rate/km (M$)	Possible programme		Pros	Cons
			Duration	Details		
Conventional mined twin-tunnel (roadheader)	1 043	0,158	49 months	section: 2x62m2; 4+4 roadheaders		
				av. progress rate: 110m/month/tube		
Mined stacked tunnel (roadheader) - *Eastern Distributor type*	1 031	0,156	53 months	section: 124m2		
	-1,2%					
TBM twin-tunnel / gripper - bolts+shotcrete (out. Ø 11,30m)	1 022	0,154	52 months	section: 2x100m2; 2 TBM + 4 roadheaders	cheapest option, to be refined at later stage (cost & procurement of TBMs, positive impact on E&M...)	
	-2%			progress: 400m/month (excavation: 17 months)		
TBM twin-tunnel - segmental lining (out. Ø 11,80m)	1 176	0,178	48 months	section: 2x109m2; 2 TBM + 4 roadheaders		
	13%			progress: 530m/month (excavation: 13 months)		

Scope & costs assumptions:	Programme assumptions:
Length = 5120m (Optimized Base Case alignment); 80% of length in sandstone, 20% in shale	Start month 1 = Notice to proceed (NTP), lands available, Preliminary Design completed, no critical administrative process (EIA...)
Includes: excavation, temporary & permanent supports/lining, cross passages & other miscellaneous excavations (ventilation and substations caverns), civil fit-out, M&E equipments, ventilation (1 intermediate shaft + buildings), portal structures (cut& cover and open troughs) + connection ramps (at Camperdown & Flood Str, *M4 faced* only) for a total of 1500m of *equivalent twin-tube length*	Programme duration: from NTP to opening to traffic; mobilisation time: from NTP to effective construction start
Construction costs only (with 1,75 mark-up, ditto RMS/M5 estimate), but excl. PD, property, I&D, finalisation	Includes 2 months for internal finishes + 8 months for M&E equipment (incl. testing & commissioning) + 6 months contractor's contingency

5.8.2 Portal areas

With the “Princes Hwy Option” the IWT southern portals are constructed away from the brick pit and tip locations in areas of natural ground and possibly away from the Acid Sulphate Soils which are predominantly found along the Cooks River and Alexandra Canal. The trough and “cut and cover” tunnel entry ramps will be constructed by contiguous pile or diaphragm wall method from the surface down with propping and the base slabs being constructed as the excavation progresses. Section 5.5 contains a summary sheet showing the likely extent of trough and “cut and cover” structures at all the proposed portal locations.

Construction in the St Peters area is problematic, with brick pits and refuse tips dotted along the Princes Hwy. The geology is alluvium overlying shale and sandstone with sound rock as deep as 40m. The RMS Base Case located the IWT portal in the St Peters land fill with the tunnel commencing its drive into the northern face of an old brick pit. The Princes Highway Option positions the portal in natural ground however, because of the depth to sound rock, extensive work will be required in trough, cut and cover and soft ground tunnel before a drive can be commenced in sound rock.

At Taverner’s Hill where rock is close to the surface the portal structure will be less complex due to the ability to bring the tunnels closer to the surface and minimise the extent of the portal structures. The interface between the IWT and the Parramatta Rd tunnel is covered extensively by others in the Parramatta Rd tunnel report as a part of the WestConnex review process, and is not further covered in this scope.

5.8.3 Camperdown

We anticipate that the Camperdown ramp off the main IWT drive will be excavated by road header, regardless of the method adopted for the main tunnel drive, and will be constructed from the Parramatta Rd site enclosure towards the main tunnel drive. Spoil will be disposed of via Parramatta Rd. As the Parramatta Rd location for the cut and cover structure, portal and construction site is constrained and land acquisition will be necessary to facilitate the construction, and to some extent can be repackaged for development at the end of the Project. It is anticipated that the ground water table will be deep in this area and contiguous piling and shotcreting will be suitable for the cut and cover portal construction.

5.8.4 Airport Access Link (AAL)

In this Section of the project there are a number of cost drivers which have been identified and addressed in our selection of motorway route and our selection of construction methodologies within the route.

Object Limitation Surface (OLS) will have a big impact on the construction cost in the airport area. Much of the AAL is affected by the OLS limiting equipment heights (carnage, excavators, piling rigs etc) in areas adjacent to the runways. In some areas work will be limited to the airport curfew hours with the additional deduction of airport shut-down and start-up periods, bringing the working hours down to as little as five night-shift hours per day. Our approach has been to select routes and construction methods which minimise the construction interface with the OLS and maximise the available working hours.

The existence of Brick Pits and Tips in the area is a major unknown which will never be adequately identified by investigation due to the likely existence of car bodies, concrete obstructions, asbestos and other unknowns within the pits/tips. Again our approach has been to avoid these areas, mapping areas of undisturbed ground where ground conditions can be predicted with a reasonable level of confidence.

Potential Acid Sulphate Soils (PASS) are also known to be a hazard in the area. The construction of the M5 East encountered PASS in the areas adjacent to the Cooks River tunnel and again at Turella adjacent to the M5 Ventilation Outlet. It is highly likely that soils adjacent to Alexandra Canal and the Cooks River at Tempe will contain sulphides. By selecting a location for the AAL away from the waterways and well above the water table we have aimed to minimised the costs associated the treatment, handling and transportation of PASS.

Land acquisition is related to the footprint of the motorway and interchanges. We have addressed this by focusing on simplifying and bringing together the Airport and Mascot interchange and feeding both the M4 and M5 tunnels directly into this interchange using tunnelled ramps to distribute the traffic before it reaches the surface.

Land reuse at the end of construction is limited by the way the freeway carriageways and ramps cut the landscape into portions, and can effectively deny or severely limit effective access to those portions and their value. Our approach has been to bring the tunnel portals closer to the identified primary destinations of the Airport and Mascot Industrial Area, offsetting tunnel cost against land acquisition, structure and an enhanced residual land value while still satisfying the secondary goals.

Structure is a large component of any motorway cost. The RMS Base Case budget indicated that 87% of the cost of the AAL was structure. A significant reduction in the proportion of the motorway being built on structure has been achieved by avoiding the pits, tips, river and road crossings where structure is required.

5.8.5 M5 Bayview Tunnel

The Bayview Avenue alignment for the duplication of the M5 Tunnel has been chosen primarily to take the construction activities away from the existing high traffic areas around Marsh St and the existing tunnel portals. For the same reason the prospect of modifying the existing tunnels is seen as an expensive re-construction requiring the existing traffic to be re-routed, or an extensive program of work to be carried out on night shift with consequential low levels of production.

By following the Bayview Avenue ridge a more direct route to the Airport and Mascot Industrial Area destinations is achieved while reducing land acquisition around the Marsh St and Kogarah Golf Course, avoiding the construction of bridge crossings of the SWOOS, Marsh St and the Cooks River, and avoiding environmentally sensitive habitat areas for the Green and Golden Bell Frog near Marsh St. Land areas south of the Cooks River are unaffected for further development.

The Bayview Ave tunnel route travels under Whitlam Park and crosses under the Cooks River near the Bayview Ave Bridge. There is a deep alluvium filled paleochannel in this area, the depth of which is currently not thoroughly investigated. Although we believe that there will be around 10m of rock cover above the tunnel in this area further investigation may indicate that a cut and cover structure across Whitlam Park and the Cooks River would be a lower risk solution providing a flatter tunnel grade with additional benefits of reduced tunnel exhaust emissions and lower ventilation and pumping operations cost. These options would be refined during the detailed design when additional information becomes available.

The M5 Bayview tunnel is fundamental to bringing the traffic closer to the Airport / Mascot destination by tunnel, reducing land acquisition and maximising the available development land in the area. It is also fundamental to achieving the benefits of the Princes Hwy Option by bringing M5 traffic to the Interchange location by the shortest and most cost effective route, while avoiding those risks that have been identified.

5.8.6 Alexandra Canal

The impacts on Alexandria Canal are limited with most options apart for the “Canal” options which are covered separately. The remaining options require additional or widened bridge crossings which are further detailed in the option descriptions, leaving open the possibility of further urban regeneration along the waterway.

5.8.7 Port Botany Rail Line

Our approach with all option development has been to minimise the impacts on the Port Botany Rail Line and the Cooks River Rail Depot to minimise impacts and due to the potential delays that can result in agreeing and managing occupations and switches with the rail authorities. All options, both by BBJV and by RMS, require crossings of the rail line either over by viaduct or under by cut and cover. All options developed have aimed to avoid Cooks River Depot land acquisition and minimise the construction interface with the Port Botany Rail Line.

5.9 Spoil Reuse and Spoil Disposal Opportunities

5.9.1 Assumptions

It is envisaged that the project would generate approximately 1,000,000 m3 of surplus spoil. The majority of spoil would be generated from excavation of tunnels. Relatively, smaller quantities would be generated by site preparation activities, excavation of vertical access shafts, cut and fill activities for the above ground components of the Project.

The majority of excavated spoil material would be uncontaminated crushed sandstone and shale material, classified as VENM.

The Tunnel Spoil is assumed to be removed from the two sites, the St Peters portal and the Taverners Hill portal. If additional connections are provided, such as Camperdown Parramatta Rd, these locations would also permit spoil removal.

The main tunnels, cross passages and caverns will be excavated utilising road headers. The spoil generated will be transported to the two previously mentioned portals for transportation offsite.

We assume the portal locations have the capacity to store four days continuous production from the road headers.

An important note is if the spoil is to be removed from site, then the Project will have the potential exposure to the New South Wales (NSW) Government Waste Levy. The levy applies to material that is tipped at a waste disposal / land fill facility. The applicable levy rate currently is $95.20 per tonne. However, if sites are available with DA approval to accept pre-determined quantities of fill, then the waste levy is not applicable resulting in a substantial cost saving for the project.

5.9.2 Reuse opportunities

There are limited reuse sites within the Sydney Basin area. These reuse sites availability are dependent upon project timeframes, and other potential large infrastructure projects commencing before the WestConnex project.

Reuse of spoil within the project boundaries is limited due to the majority of the works being underground, and a relatively minor portion being surface works.

In relation to the BBJV Recommended Option it is consider that all spoil will be removed from site, due to the area within the project boundaries being unable to accommodate spoil.

5.9.3 Current disposal opportunities

There are currently limited spoil disposal opportunities within the metropolitan area. In southern Sydney at Holts Kurnell there currently operates a facility for spoil disposal. The location is within close proximity to the St Peters portal, which provides economical transport costs for the project.

Other spoil disposal sites located in western Sydney exist, such as the Kemps Creek tip, the SITA facility at Wallgrove Rd, however they currently attract the NSW waste levy.

5.9.4 Potential Future Opportunities

Due to the extended timeframes for the project, identifying spoil reuses sites in the future is extremely difficult. Other potentially large infrastructure project such as the M5 East duplication may impact upon availability of spoil reuses sites in the future.

Potential opportunities in the future for spoil reuse may develop in south western Sydney at Moorebank, with the re-development of the inter-modal project.

5.10 Work packages and sequence

5.10.1 General

Although the WestConnex Project is being investigated as a single entity it is obvious that many of the elements that make up the whole can function and provide community benefits either individually or in groups. While focusing on maximising road-user and community benefits and progressing the project in steps which provide a viable tolling income return the Team has looked at breaking the WestConnex project into standalone packages which can be executed independently by a single contractor or JV and will provide a significant benefit when completed.

5.10.2 Route: M5 to City

This Route is recommended to be constructed in four parts. The proposed construction and opening sequence must not only deliver traffic into but also distributes traffic in the destination area.

The Mascot One-Way Pair system (Map Ref [1]) needs to be opened before the AAL and M5 Duplication directs more traffic into the Mascot Industrial Area, potentially overloading the existing arterial road network. Further traffic analysis may also indicate that similar improvements may be needed to the airport road system, particularly with an over-height vehicle route using Qantas Drive and Airport Drive to access the adopted AAL Interchange location.

The Airport Access Link (AAL) (Map Ref [2]) is essential to provide the tunnel launch locations for both the M5 tunnel drives, and also the IWT drives, and can be viewed as an early works package for the tunnel construction. The AAL, in the temporary case, acts as a launch pit for the tunnelling machines and needs to be in place to allow the M5 tunnel drives to commence from the tunnel eastern portals. As tunnel excavation progresses spoil will be removed and tunnel fit-out will proceed via the AAL launch pit. Finally, in line with the completion of the M5 tunnel the AAL trench will be benched, paved and completed ready to receive the tunnel traffic.

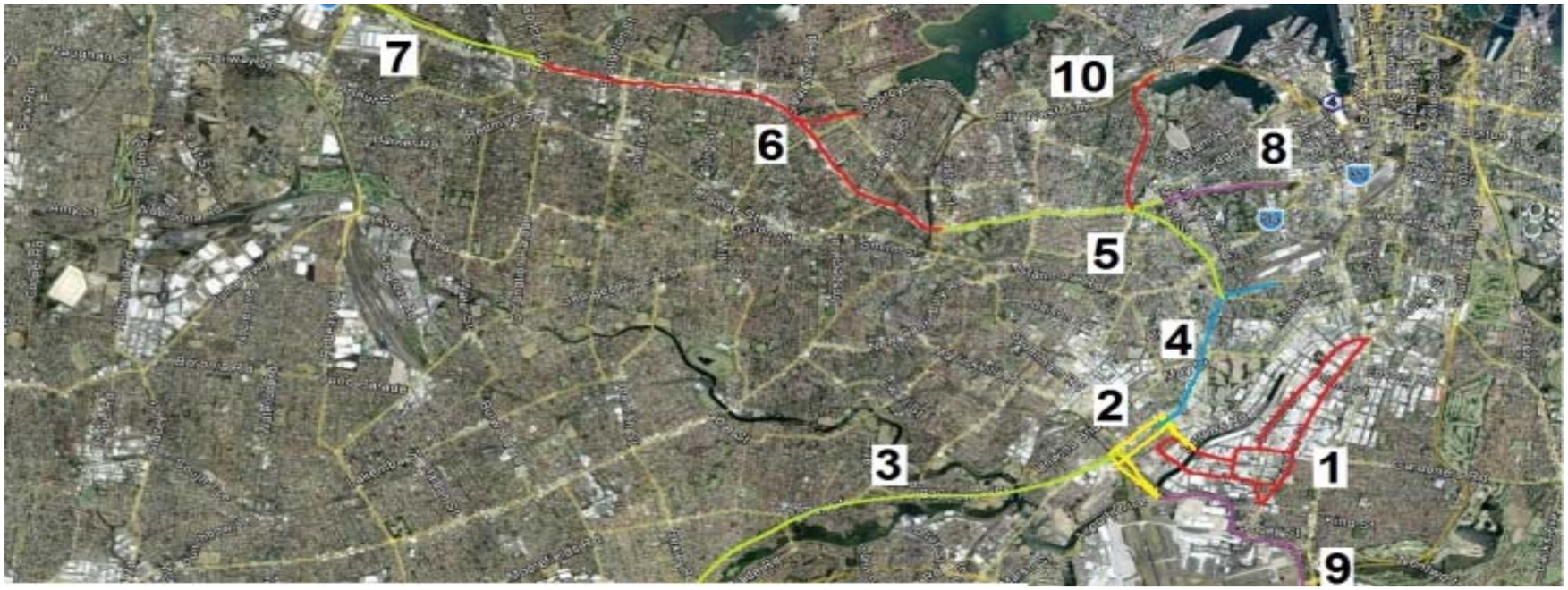


Figure 5.29: Proposed Construction Work Packages

	Item	Work Package	Construction Type	Length (m)	Client Budget (~$m)	Comments / Opportunities
M5	1	Mascot one way pair	Structure and at grade arterial	4,000	**$200**	To be completed before (2) and (3)
	2	Airport Access link Interchange - Tempe	Structure and at grade arterial	2,500	**$500**	Provides M5 and IWT launch areas, incl soft ground tunnel portals
	3	M5 Duplication - Bexley to Tempe	Tunnel	5,700	**$2,600**	To be driven from both ends
	4	Inner West Tunnel - Tempe to Henderson St	Tunnel	2,900	**$1,600**	Potentially significant tolling benefits
M4	5	Parramatta Rd Tunnel - Camperdown to Taverners Hill	Tunnel	4,300	**$1,600**	incl. Camperdown ramp
	6	Parramatta Rd Tunnel - Taverners Hill to Strathfield	Tunnel	6,000	**$3,600**	Spoil disposal via completed IWT
	7	M4 Freeway Upgrade	Structure and at grade motorway	9,600	**$700**	
Other	8	Parramatta Rd Tunnel - Arundel St Ramp (University)	Tunnel	1,600	**$500**	Spoil disposal via completed IWT
	9	AAL extension - Port Botany truck route	Structure and at grade arterial	3,200	**$600**	Can be added as trucking load increases
	10	Inner West Tunnel extension- Camperdown to White Bay	Tunnel	2,500	**$900**	Potentially significant tolling benefits
			Total constructed length (m)	42,300	$12,800	Total ($m)
			NB - Total tunnel length (m)	23,000		
		NB - This is not a Project estimate, the purpose is to compare relative package costs only				

Table 5.5: Proposed WestConnex Work Packaging Structure

The M5 “Bayview” tunnel (see Map Ref [3]) will be constructed in tandem with the AAL as mentioned above. Each needs the other to provide functionality. Although these sections could be constructed under separate contracts, both are required for the new M5 tunnel to deliver traffic to the Airport and the Mascot Industrial area. The construction of the new M5 tunnel, the AAL and the Mascot One-Way Pair completes a functional group of work packages providing access to the Airport and Mascot from the south-west.

The IWT section between St Peters and Henderson St Redfern (see Map Ref [4]) is an enhancement of the M5 Route providing a more direct connection to the city-south and reducing the traffic through the busy Mascot Industrial area travelling towards the city. It is a natural extension of the M5 route for those road users with a city, city-south or city-west destination.

5.10.3 Route: M4 to City

The disadvantage of constructing the M4 route section by section from the west is that, without adequate distribution at the end of the traffic “pipeline” each completed section of WestConnex will just transfer traffic congestion from one location to the next providing little immediate benefit. Construction from the city end towards the west provides immediate benefit in distributing traffic into several inner city destinations with additional sections constructed to the west feeding additional traffic to those distributors.

The IWT from Henderson to Taverners Hill (see Map Ref [5]). This section is the main distributor of M4 traffic to the city, the city-south, Mascot, the Airport and to the south-west via the M5 motorway. It is the most important part of the M4 route distributing the M4 traffic to a number of destinations and avoiding traffic congestion at a single end of “pipeline” destination.

The Parramatta Rd Tunnel (see Map Ref [6]) from Strathfield to Taverners Hill will be the next section to be completed, following the above logic of building the motorway from the city out. This section provides connection to City West Link providing further distribution of city and north-bound traffic with a direct connection to the traffic on the existing M4 Freeway.

M4 Freeway Upgrade (see Map Ref [7]). This upgrade will only provide benefit to road-users when there is a connection to an upgraded distribution system. Upgrading the M4 before the Parramatta Rd tunnel is complete will increase the flow of traffic to the current Concord Rd and Parramatta Rd interchanges creating an increase in traffic congestion and increased queuing, resulting in a level of road-user dis-satisfaction in the upgrade. By co-ordinating the opening of the M4 Upgrade with the completion of the Parramatta Rd tunnel traffic will flow freely into the inner city distribution network from day one.

5.10.4 Optional Connections

Several optional connections have been Identified as “add-ons which are not essential for the base functionality of the system but can be added at any stage when demand dictates to provide further functionality to the WestConnex Project and with future-proof the project for future decades.

The most significant of these connections are:

+ The Arundel St Ramp (see Map Ref [8]) which will deliver traffic to Parramatta Rd adjacent to Sydney University, closer to the city centre
+ The Port Botany Truck Route (see Map Ref [9]) which will provide a free flow connection between the Port and both tunnels at the Princes Highway Interchange

The IWT extension to Victoria Rd, Rozelle (see Map Ref [10]). Although not a part of the defined scope of the report, stub-tunnels have been included in the concept for future construction and it is likely that there is considerable traffic demand for this connection which would have the benefit of diverting a considerable load from ANZAC Bridge.

5.11 Re-Development Opportunities post Construction

5.11.1 General

As with most large construction projects there will be a substantial amount of land acquired in advance of construction and there will be parcels of land available for redevelopment on completion. Some of these acquisition areas are required to facilitate the construction of below ground structures while others are remnant pieces of land which can be repackaged for development. The attached sketch identifies several of the larger land acquisition areas, mainly associated with tunnel portal locations with the figures indicating the potential land area available for redevelopment.

5.11.2 Princes Hwy Urban Regeneration

The Land Acquisition proposed for the Airport Access Link is predominantly a strip of land along the Princes Hwy approx. 800m long by 100 m wide. Of this area it is anticipated that around 30% along Princes Hwy will be available for renewal at the end of the project. With considerations also being given to widening Princes Hwy in this area to provide better functionality for City bound traffic turning into Canal Rd and outbound traffic turning into Bridge Rd, the exact area available for development is still to be determined.

5.11.3 Canal Rd / Burrows Rd Sth Area

The proposed route for the Mascot One-Way Pair opens up the potential for development of those areas between the Cooks River Rail Depot and Alexandra Canal. With close proximity to the M5 and M4 freeway connections, the City, and the Airport and Mascot Industrial areas, this area will experience a significant increase in commercial demand. In building the extension to Burrows Rd Sth. and its connection to Canal Rd it is envisaged that there will be a significant area of residual land which could be repackaged and sub-divided, with the project benefitting from the potential increased land value.

5.11.4 Camperdown Portal Area

Parramatta Rd Camperdown is an inner city area which can benefit from the Urban regeneration that would flow from the redevelopment of the residual land in the portal area along the south side of Parramatta Rd which will become available following construction. The existing low quality commercial developments in this area which are substantially degraded and have little heritage value can make way for new development which can provide a driver for regeneration in the area.

5.11.5 Taverners Hill Portal Area

This portal location offers similar opportunities to the Camperdown area. As the portal configuration and developemnt for this area predominantly relies on the proposals for the Parramatta Rd tunnel, it is difficult to expand further on the opportunities in this location without further knowledge of the Parramatta Rd tunnel proposals.

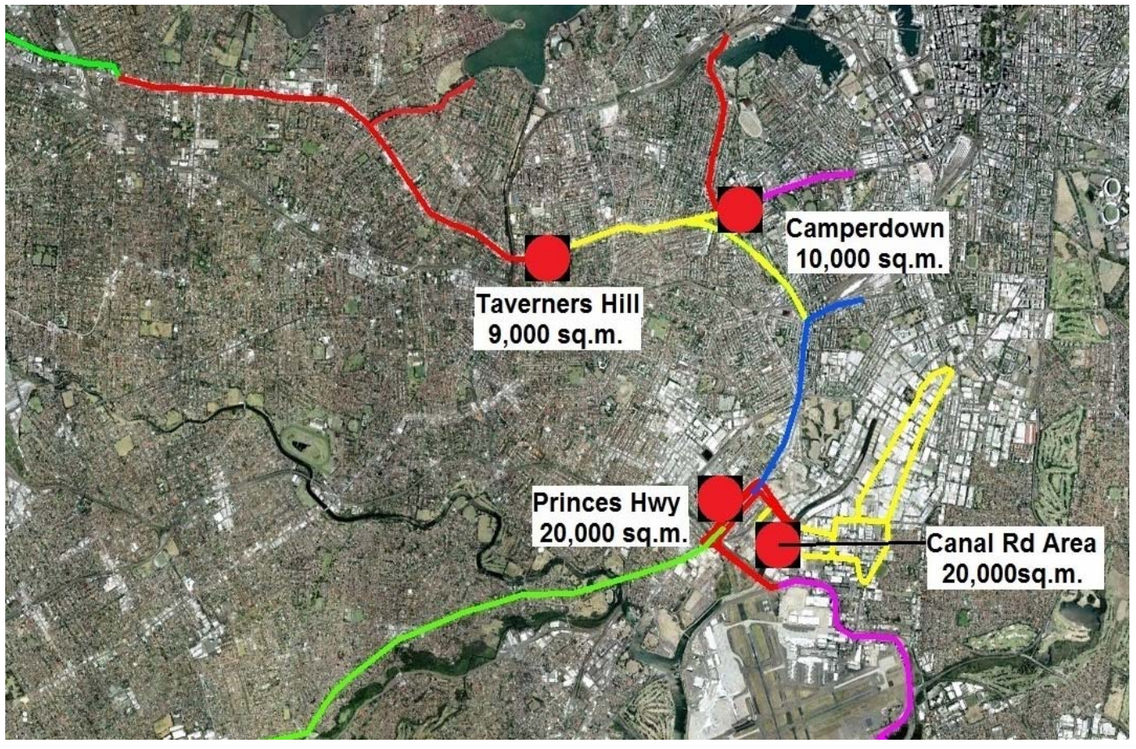


Figure 5.30 Development Opportunities from Land Acquisition

5.12 Timeframe for Implementation

5.12.1 Inner West Tunnel

The time-chainage programme for the PHO (Princess Highway Recommended Option) 5600m long 2x3 lanes tunnel, roadheader mode (+ rockbolts & shotcrete) is shown in Figure 5.31.

As mentioned earlier, the option with gripper-TBM (with rockbolts & shotcrete) has not been considered due the large diameter (14.5m outside).

The detailed time-chainage programmes for the 2x2 lanes configurations, which lead to the durations indicated in the summary table above, are not provided.

The main programme assumptions are as follows:

+ Start month 1 = Notice To Proceed (NTP), with: lands available, Preliminary Design completed, no critical administrative process pending (EIA...)

+ Include 1 month for internal finishes prior to fit-out works + 8 months for M&E (incl. testing & commissioning + 6 months contractor's contingency)

Roadheader mode option:

+ 9 months mobilisation time (from NTP to effective construction start), made of 0.5 month for contractual issues + 8 months for fabrication/procurement + 0.5 month for transport & commissioning)

+ Average advance rate, considering a 80/20 geological split sandstone/shale (with statistical distribution of UCS values), the few fault areas, as well as the scheduled stops for conveyor belt and HV cable extension: 95 m/month for the 77m2 3-lanes cross-section (note: as indicated in the summary table above, the assumption for the 2-lanes 62m2 section was 110 m/month)

TBM mode option :

+ 19 months mobilisation time, made of 0.5 month contract + 14 months fabrication + 1.5 month transport & commissioning + 3 months assembly on site)

+ Average advance rate, considering a 80/20 geological split sandstone/shale, the scheduled stops for conveyor belt extension, as well as the learning curve: 390 m/month for the Ø14.5m cross-section (note: as indicated in Table 5.4 above, the assumption for the 2-lanes Ø11.8m section was 530 m/month)

The resulting main issues from these time-chainage exercises are the following:

+ Heavy plant amount:
  - Roadheader option: 4 machines 300KW for the main tunnels (working from the portals) + 4 others (200-300KW) for the ramps (at Camperdown) and the miscellaneous excavations (cross-passages, ventilation and substations caverns...), + 4 others in case the optional connections at Arundel and Henderson Str are built, i.e. a total of 12 machines
  - TBM option: 2 machines, running northward from the St Peters portal; the 4 + 4 roadheaders are still needed to excavate the ramps and miscellaneous caverns

+ Total duration
  - The total construction duration from NTP to opening to traffic (excluding potential Client's contingency) are quite comparable for the RH option (52 months) and the TBM one (54 months)
  - An improvement of 5 months can be achieved on the RH programme, i.e. reducing it to 47 months, thanks to 2 additional roadheaders excavating the main tubes from the Campderdown ramps; the impact on the costs has not been assessed (it could be neutral, thanks to the shortening of the programme which reduces the indirect costs)
  - The duration of the 5.6 km long tunnel for the PHO recommended option reaches 55 months (with the same possible 5 months improvement thanks to additional roadheaders at Camperdown)
  - Providing an award can be placed in January 2016, the 2x3 lanes twin tunnel in the Recommended Option scheme could be delivered and opened to traffic in July 2020 (with a possible improvement at February 2020).

Further improvements of the construction programme can be possibly achieved in the next development phases of the project, thanks to:

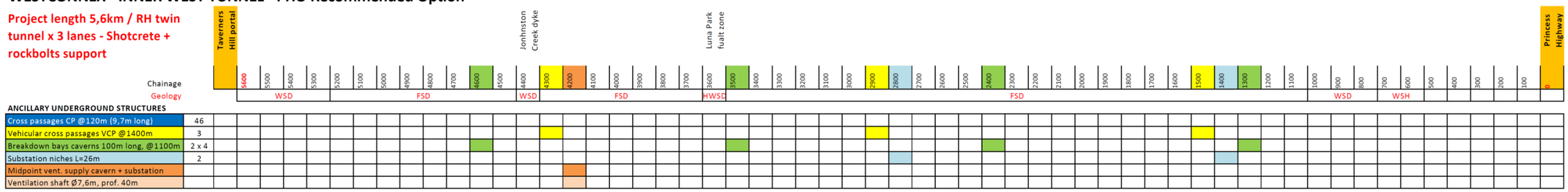
+ A better knowledge of the geological conditions along the finally retained alignment, which would allow improving the average advance rates

+ A deeper insight on the procurement times for both the roadheader machines and the TBMs , through direct discussions with the manufacturers

The other critical components of the programme, such as the fit-out advance rate, the 8 months period for the M&E installation, testing and commissioning, or the 6 months contractor's contingency, are considered as appropriate for a project of that magnitude and could be only marginally improved.

WESTCONNEX - INNER WEST TUNNEL - PHO Recommended Option

Project length 5,6km / RH twin tunnel x 3 lanes - Shotcrete + rockbolts support



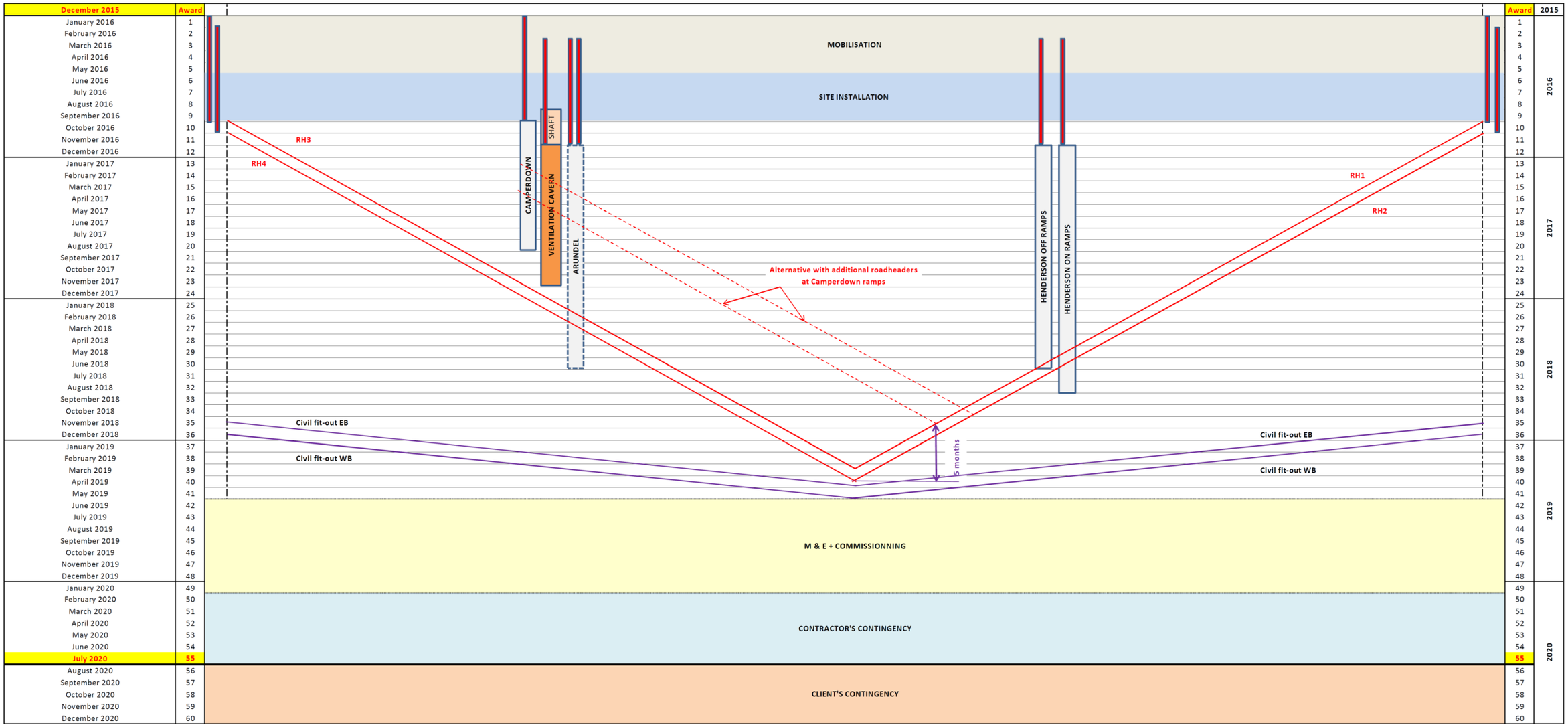


Figure 5.31: Recommended Option - Time Chainage Diagram (Road Header 5.0km Tunnel)

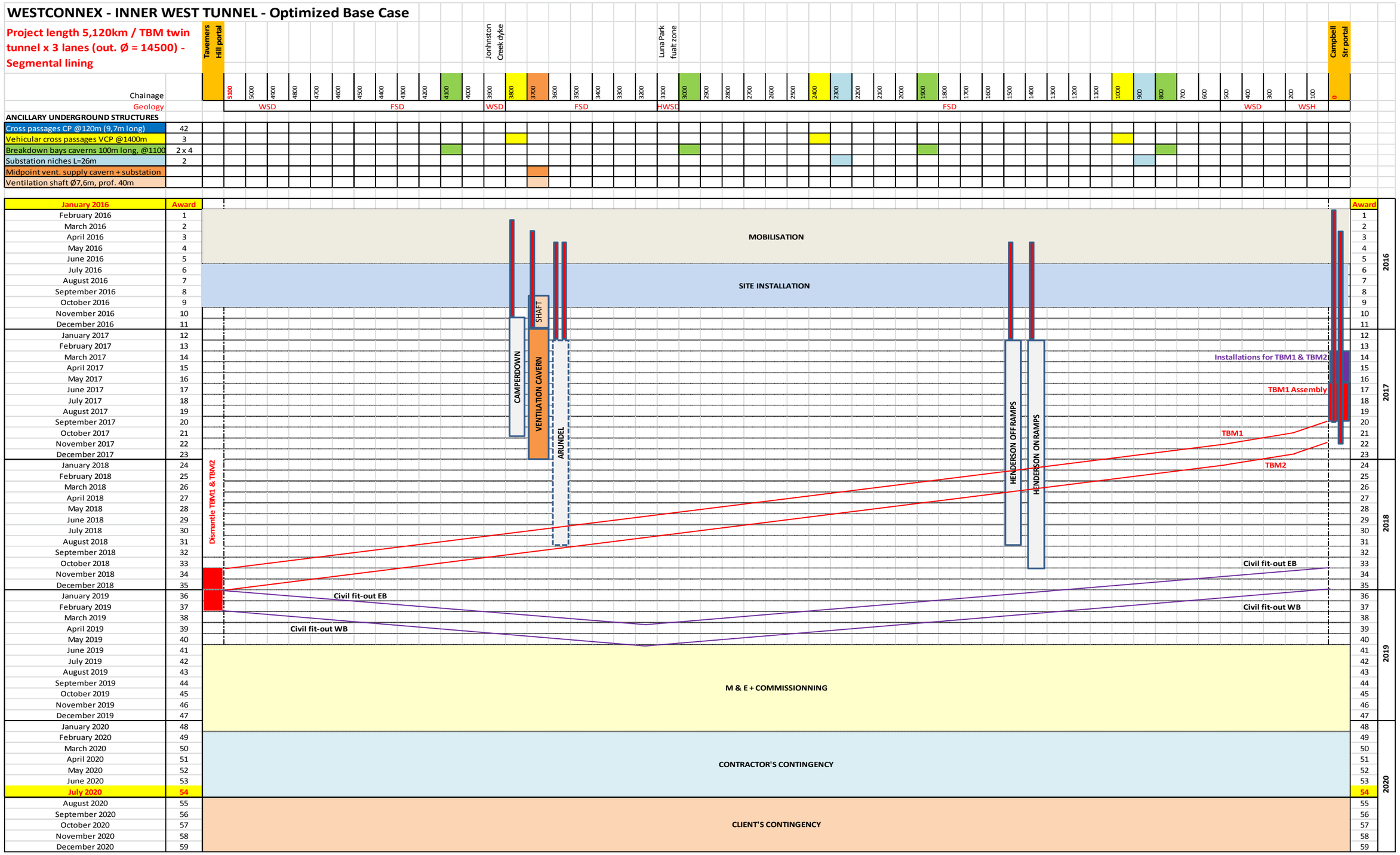


Figure 5.32: Recommended Option - Time Chainage Diagram (TBM)

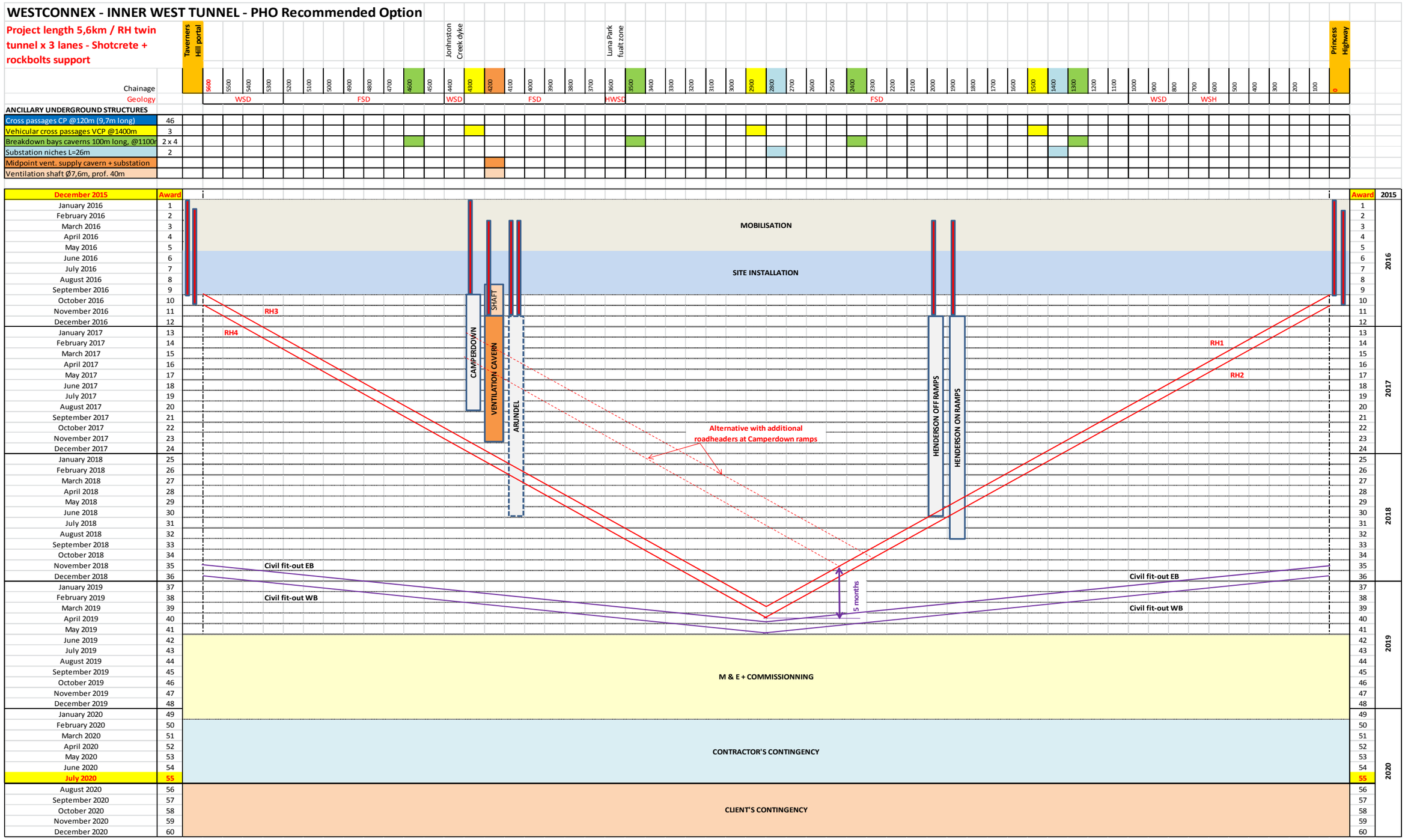


Figure 5.33: Recommended Option - Time Chainage Diagram (Road Header 5.6km Tunnel)

5.13 Tunnel Ventilation

Tunnel ventilation will consist of longitudinal ventilation with intermediate air replacement (extract & supply) in long tunnels and extract at the exit portals. Where there are ramp tunnels (e.g. Inner Western Tunnel) the ventilation system will ventilate these.

The ventilation system will be designed so that the failure of any one component (e.g. fan, power supply, control system module) will not affect the performance of the ventilation system. An additional allowance will be made in the provision of jet fans to allow up to 10% of the total number of jet fans installed to be out of service (either destroyed by a fire or out for maintenance) without affecting the performance of the system.

Two options for the ventilation system have been investigated. The first option prevents all discharge of air through exit portals. The second allows up to 200 m³/s air to leave through each exit portal. The object of comparing these designs is to assess the difference in electricity during peak hour traffic.

The ventilation system design has been based on a number of assumptions, which are detailed in Appendix G. This will be the list of assumptions sent out for the traffic study.

The outlines of the tunnel ventilation systems and alignment in the Bayview tunnel are shown in Figure 5.34.

Intermediate shafts for the eastbound tunnel are located at the same site as the intermediate shafts for the westbound tunnel. The locations have been selected as approximately half-way along the alignment, though in the case of the IWT the shaft has been moved to coincide with the construction shaft at the slip road site.

Influence of tunnel cross-sectional area

+ Volume flows at ventilation shafts do not vary with tunnel cross-sectional area. This is because the requirement to prevent portal discharge dictates the shaft volume flows.

+ Total numbers of jet fans needed for stationary and slow-moving traffic increase rapidly as the tunnel cross-sectional area falls. This is because additional jet fans are needed to force air through smaller cross-sectional areas.

+ Power usage for free-flow traffic reduces as the tunnel gets smaller. This because the jet fans operate in reverse to oppose the traffic-induced flow just enough to prevent portal discharge. Fewer reverse jet fans are needed for the smaller tunnel because the traffic-induced flow is less.

Influence of allowing limited portal discharge

+ Direct reduction in size of exit portal shafts or deletion of them.

+ No need to operate jet fans to retard the airflow through the tunnel during free-flow traffic

+ Eastbound tunnel is self-ventilating (just). This is probably due to the general downhill grade – traffic goes downhill for 87% of the trip through the eastbound tunnel and only goes uphill over the last 750 metres

+ If portal discharge is to be prevented, jet fans need to operate against the direction of traffic to reduce the air flow. Allowing portal discharge would allow a slight reduction in shaft capacity, no reduction in jet fan numbers and a large reduction in electricity usage.

General findings

+ In free-flow traffic, NO2 dictates the ventilation design, closely followed by visibility.

+ In slow traffic, NO2 dictates the ventilation design, with visibility much farther behind.

+ CO does not influence the ventilation design at all.

+ Forced airflow at ventilation shafts is dictated by fast traffic.

+ Numbers of jet fans are dictated by slow traffic.

+ Assuming a lower percentage of NO2 would substantially reduce ventilation capacity for slow traffic, but not affect ventilation capacity for fast traffic.

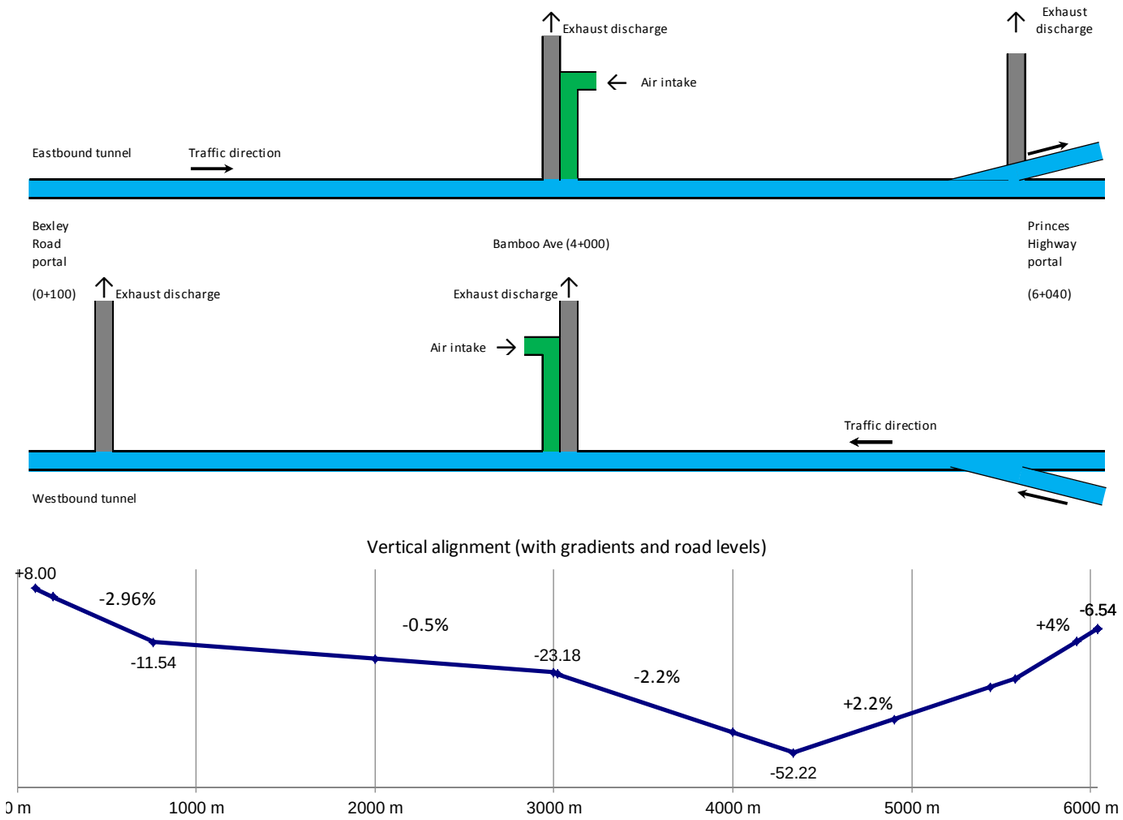


Figure 5.34: M5 Bayview Alignment and Shaft Locations

5.14 Land Acquisition

5.14.1 General

An assessment has been undertaken to determine the impact of the numerous design alignment option in relation to Land Acquisition for the project. SMPO provided the WestConnex – Southern Sector property acquisition schedule, which was used to evaluate the Land Acquisition cost for the RMS Base Case Option.

The WestConnex – Southern Sector property acquisition schedule provides details of the following: - land use areas; square metre areas; applicable RMS land rates; appropriate contingencies and total values.

A review of the RMS Base Case option indicated a Land Acquisition area of 497,509 m2, with a total value of $725,763,000. Within the total value calculation a figure of $50 million is included for SACL land swap contingency as detailed in the WestConnex – Southern Sector property acquisition schedule.

Furthermore; within the total value calculation a figure of $136 million is included for “Landfill Industrial Land” as detailed in the WestConnex – Southern Sector property acquisition schedule.

The Land Acquisition values for the BBJV recommended design solutions are calculated using the RMS land rates and contingencies as detailed within the WestConnex – Southern Sector property acquisition schedule.

5.14.2 Princes Highway

An assessment of the PHO option indicated a Land Acquisition area of 129,528 m2, with a total value of $194,961,480. Within the calculation of the total Land Acquisition area, we have adopted generally a 10 metre wide corridor either side of the permanent alignment.

The Princes Hwy option requires the Land Acquisition of the commercial properties on the eastern side of the Princes Hwy between Canal Rd and Bellevue St. The acquisition value of the commercial properties is $131,051,880.

However we note there may be an opportunity to re-develop the approximate 30 metre frontage along the Princes Hwy between Canal Rd and Bellevue St post construction to mitigate the Land Acquisition costs.

The tunnel connection option minimises the Land Acquisition upon the Sydney Ports Corporation (SPC) rail goods yard. The value of the Land Acquisition of a portion of the SPC rail goods yard is $19,203,012.

Land acquisition areas are shown in Appendix P.

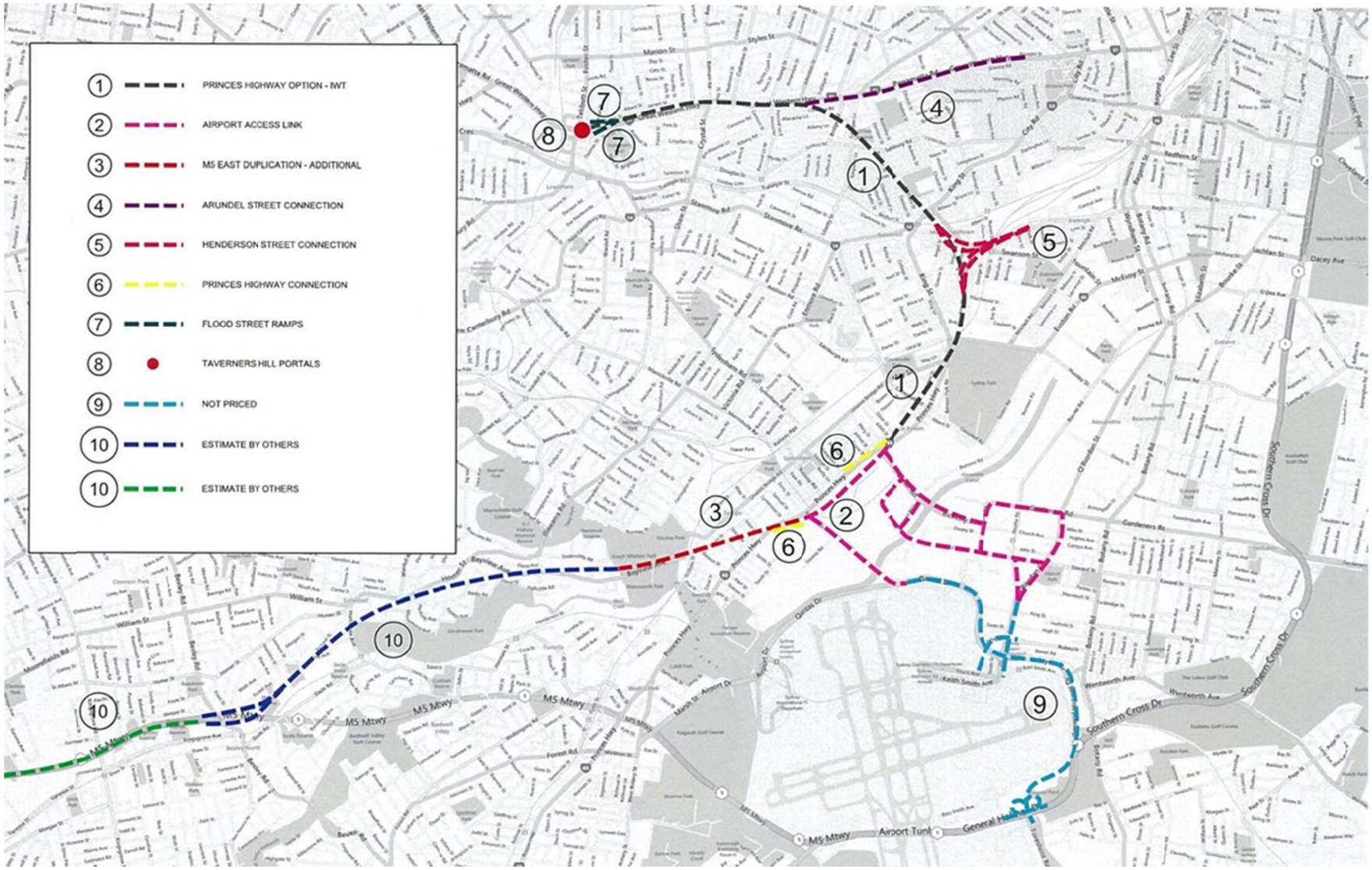
6.0 OPTION ENHANCEMENTS

6.1 Overview

A number of optional connections and arterial road improvements have been identified and may be taken up as a part of the project or may be added at a later stage when traffic load demands the additional functionality. These elements include:

+ Camperdown IWT ramps – Johnston St and / or
+ Camperdown IWT ramps – Arundel St
+ South Sydney IWT ramps – Henderson Rd
+ Camperdown IWT – connection to Victoria Rd, White Bay
+ Mascot AAL – reconfiguration of the arterials in the Mascot Industrial precinct to create a one way pair system
+ Princes Hwy ramps – allowing connections between the Princes Hwy and the M4
+ Airport AAL – grade separated connections to Airport Drive from AAL
+ Port Botany AAL – grade separated connection to Foreshore Drive from AAL

A technical description of the Princes Hwy Alignment Options is covered in further detail in the following sections.



6.2 Flood Street and Taverners Hill Portal

6.2.1 Urban Design

Constraints

The proposed location for the Taverners Hill Portal, is in a fairly constrained environment. The heritage conservation areas that abut Parramatta Road restrict the availability of properties for redevelopment and resumption.

Between Flood Street and Elswick Street the heritage conservation district align with Albert Street and leave a 40m zone for potential intervention. Larger parcels exist to the west of this zone.

The topography in this area slopes up to the east with a ridge line approximately along Elswick Street where the footbridge provides access to Fort Street High School. The Petersham Oval is the most prominent green space in this area.

Key Considerations

+ Topography and landform
+ Parcel size and configuration
+ Footbridge
+ Some relaxation of heritage restrictions
+ View corridors to/from adjacent green spaces
+ Rear access to residential properties
+ Transitions from corridor development and adjacent areas

Figure 6.1: Taverners Hill Portal Constraints

Opportunities

The intervention of WestConnex can unlock several major opportunities in this area. There will be both direct opportunities, created by changes to the urban fabric required to support the project, and indirect opportunities whereby the project acts as a catalyst for unlocking potential.

Should the project allow changes to be made to the configuration of Parramatta Road changes in the resulting public domain can unlock business and upgrade potential of the heritage conservation areas to either side of the corridor.

The project will directly affect several lots which can be redeveloped along the north side of Parramatta Road between Flood Street and Elswick Road.

The new public domain designs can provide for a greening of the corridor, improved quality of life and potentially recapture some roadway areas on minor local streets should they be closed as part of a traffic calming effort for local neighbourhood precincts.

The LGAs on each side of the corridor could likewise be encouraged to upgrade landscape and connectivity of major community spines across the corridor thus restoring the integrity of local hubs.

Key Considerations

+ Greening of the corridor
+ Potential FSR uplifts to encourage regeneration
+ Reinforcement of green links across the corridor
+ Improvements to public domain areas and character of Parramatta Road
+ Highlighting local landmarks
+ Providing a catalyst for redevelopment to the west of Flood Street
+ Providing a new footbridge as a local landmark and as an opportunity for public art

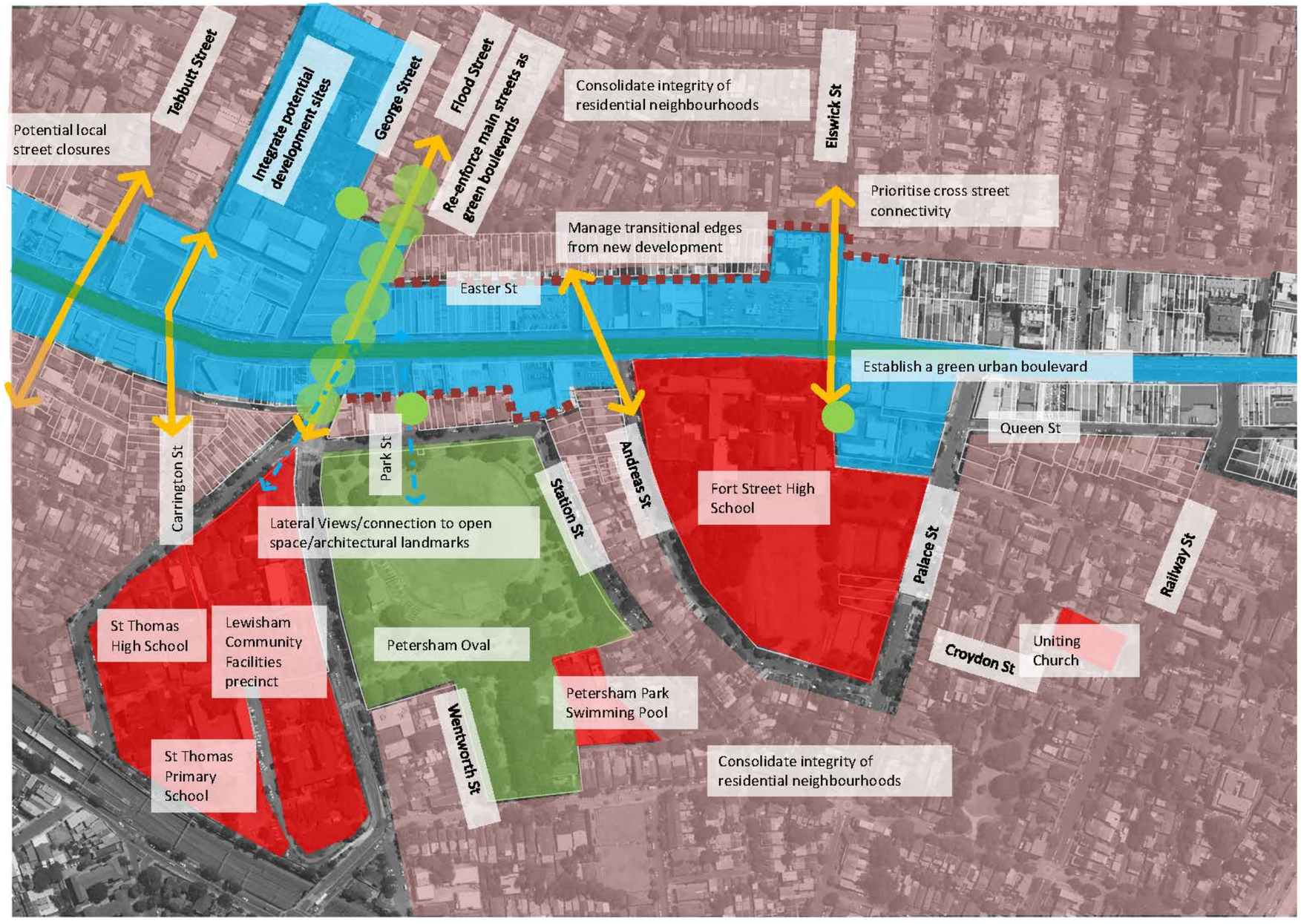


Figure 6.2: Taverners Hill Opportunities

6.3 Camperdown

6.3.1 Urban Design

Constraints

The proposed location for the Camperdown Portal, where the IWT turns to follow Parramatta Road is a fairly constrained environment.

The heritage conservation areas that abut Parramatta Road along its length continue in this location and restrict the availability of properties for redevelopment and resumption.

Between Northumberland Avenue and Bridge Street the heritage conservation district align with Corona lane and leave a xxm zone for potential intervention.

Larger parcels exist to the east of this zone, for a potential portal site, but these would not allow any traffic moving to/from the tunnel to access Pyrmont Bridge Road and thus disbursing more quickly into the local road network.

Key Considerations

+ Parcel assembly
+ Potential FSR uplifts
+ Some relaxation of heritage restrictions
+ Existing façade character of Parramatta Road
+ Maintaining watercourse capabilities for Johnsons Creek course

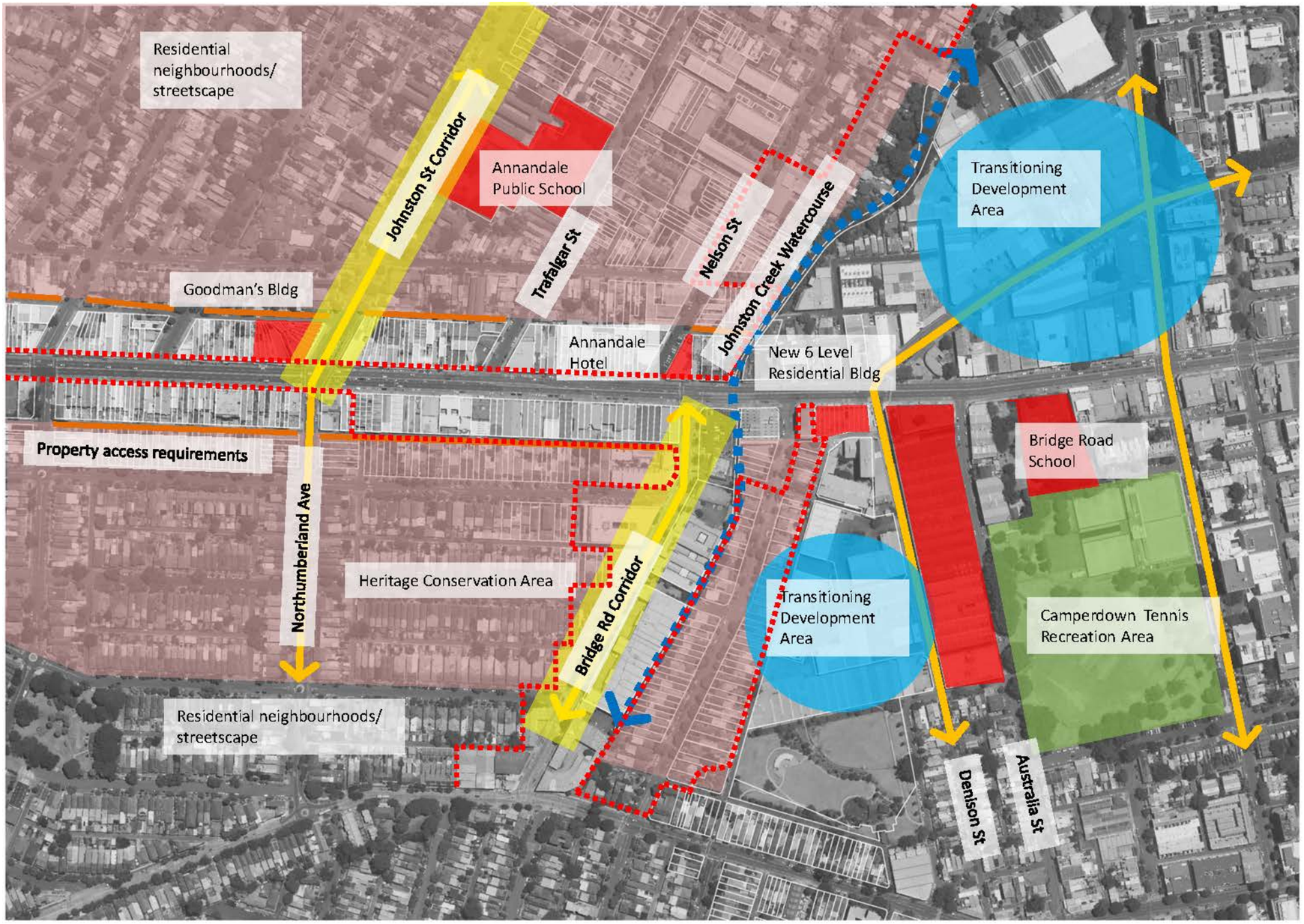


Figure 6.3: Camperdown Constraints

Opportunities

The intervention of WestConnex can unlock several major opportunities in this area. There will be both direct opportunities, created by changes to the urban fabric required to support the project, and indirect opportunities whereby the project acts as a catalyst for unlocking potential.

Should the project allow changes to be made to the configuration of Parramatta Road changes in the resulting public domain can unlock business and upgrade potential of the heritage conservation areas to either side of the corridor.

The project will directly affect several lots which can be redeveloped and continue the regeneration already occurring in and around Pyrmont bridge Road.

The new public domain designs can provide for a greening of the corridor, improved quality of life and potentially recapture some roadway areas on minor local streets should they be closed as part of a traffic calming effort for local neighbourhood precincts.

The LGAs on each side of the corridor could likewise be encouraged to upgrade landscape and connectivity of major community spines across the corridor thus restoring the integrity of local hubs.

Key Considerations

+ Greening of the corridor
+ Potential FSR uplifts to encourage regeneration
+ Restoring integrity of local hubs.
+ Improvements to public domain areas and character of Parramatta Road
+ Potential interpretation of Johnsons Creek across the corridor
+ Highlighting local landmarks
+ Providing city gateway at Camperdown

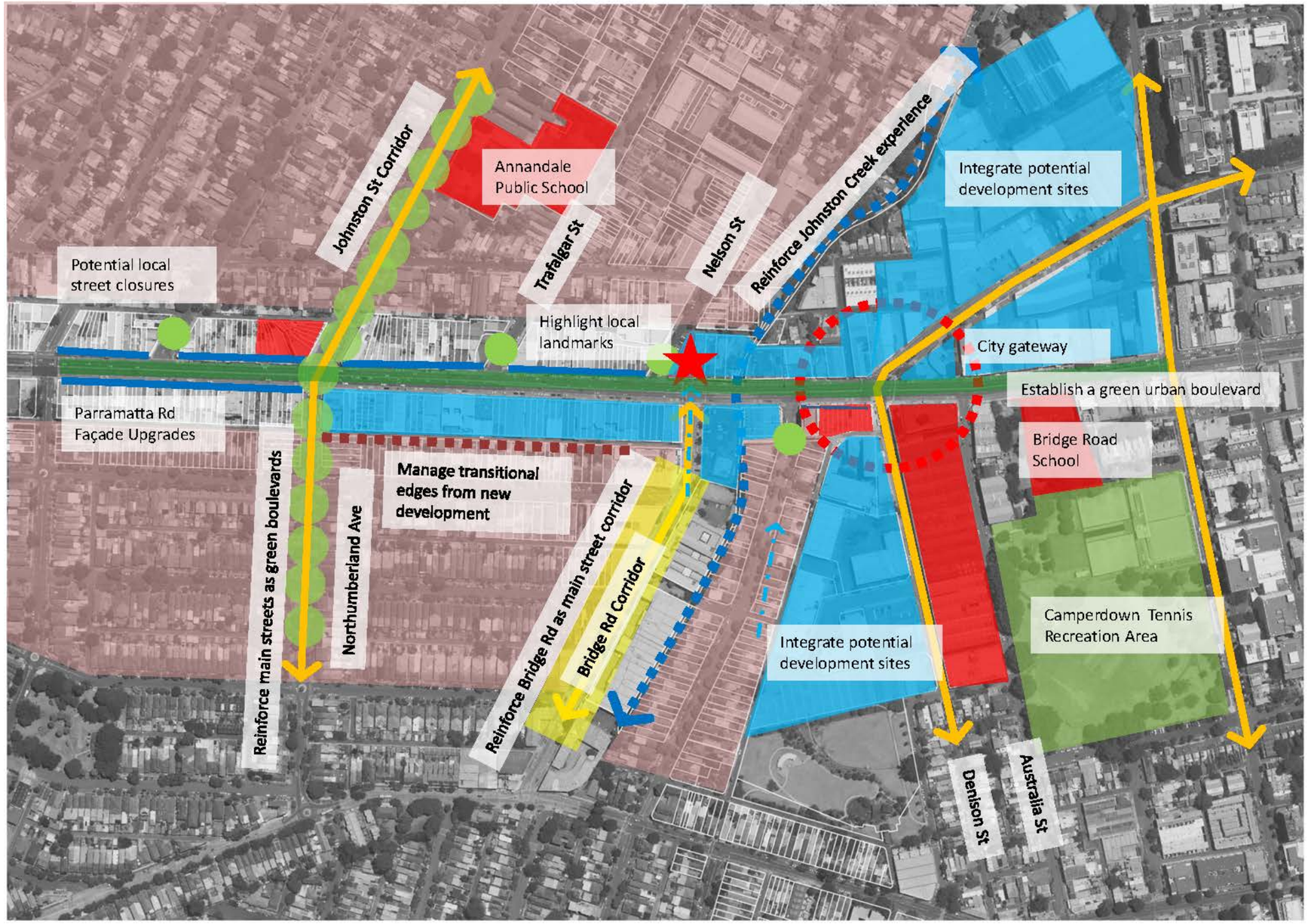


Figure 6.4: Camperdown Opportunties

6.4 Arundel Street

6.4.1 Overview

This functionality plug-in involves extending the Parramatta Road tunnel through to Arundel Street, east of the Footbridge Theatre. The proposed portal arrangements feature:

+ Provision of 2-lane exit and entry to the tunnel
+ Narrowing of Arundel Street to a single one-way (west) traffic lane and a bicycle lane
+ Provision of compensatory angle parking in Arundel Street to offset losses to parallel parking
+ Provision for a bus lane and a single general traffic lane on Parramatta Road in each direction
+ Provision for footpath widening and bus interchange facilities west of the footbridge
+ A reduction of the Camperdown portals from 2 to 1 lane.

6.4.2 Traffic

Traffic modelling suggests that demand for the Camperdown ramps would drop significantly under this scheme and that at least two lanes are required, in each direction, in the tunnel extension through to Arundel Street

Table 6.1: Comparison of 2021 AM peak Ramp flows at Camperdown with and without Arundel Street Ramps

Description	PHO	PHO + Ramps
EB Off-ramp @ Camperdown	3210	880
WB On-ramp @ Camperdown	1850	920
EB Off-ramp @ Sydney Uni	-	2440
WB On-ramp @ Sydney Uni	-	820

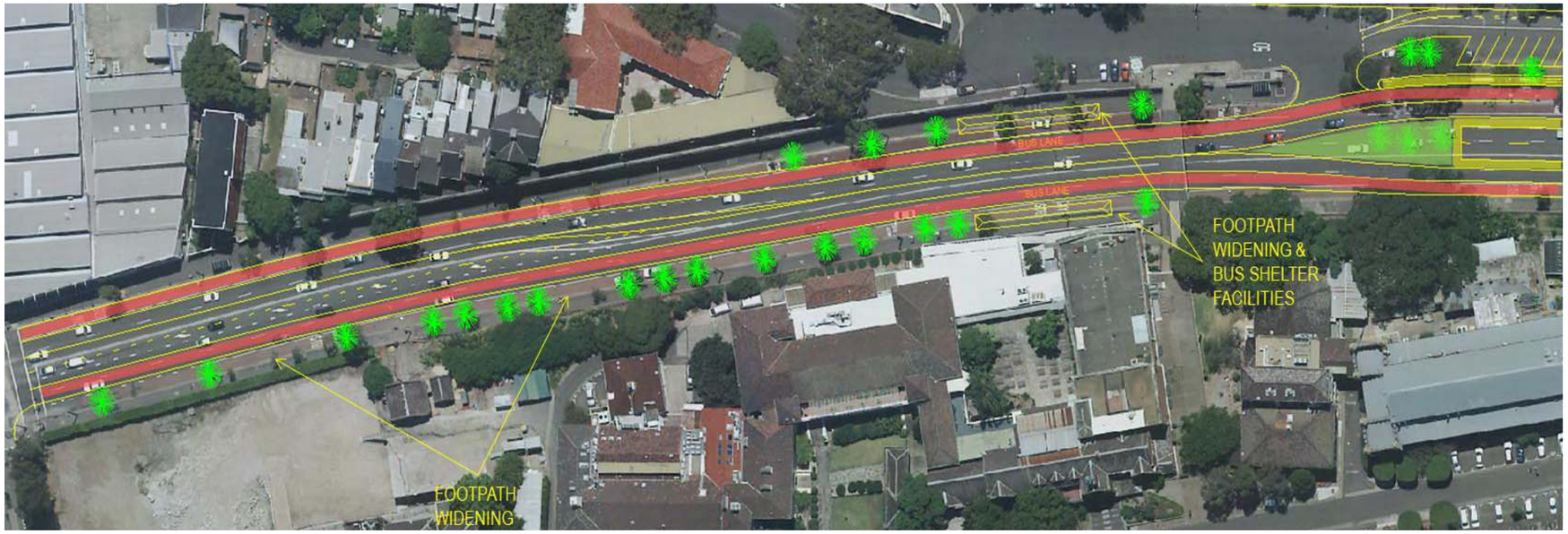


Fig 6.5: Arundel Street Portal Arrangements (West)

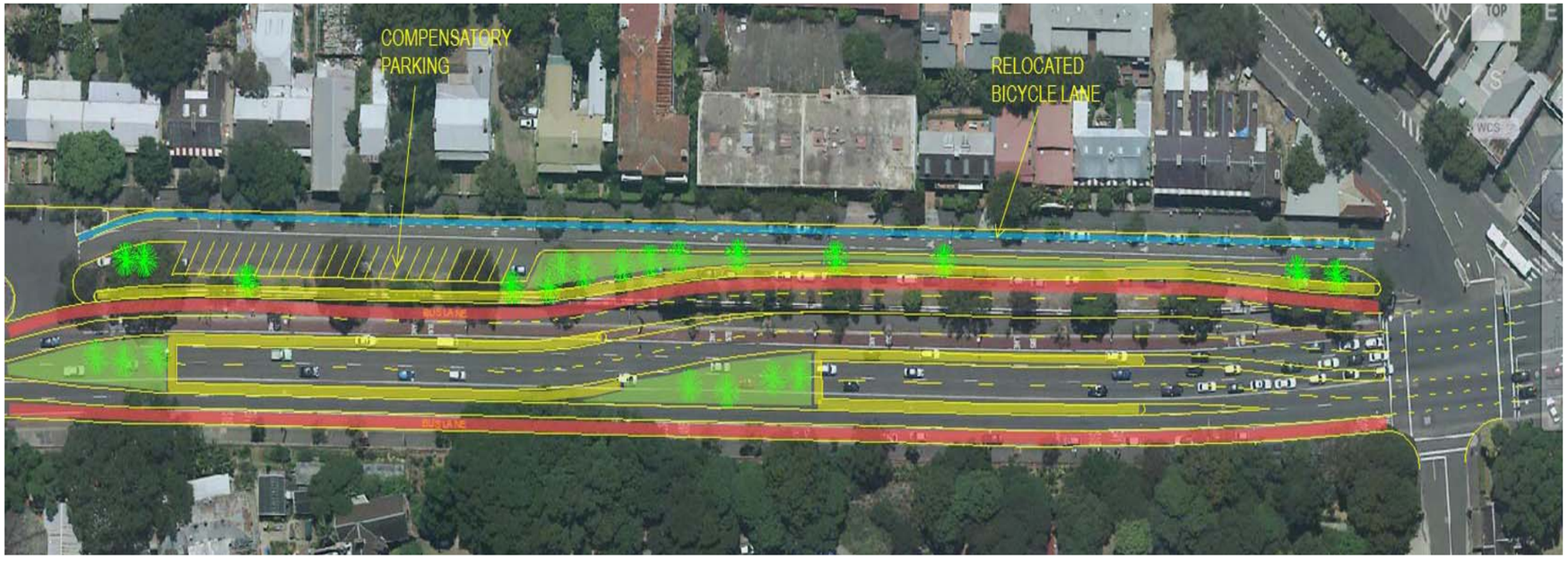


Fig 6.6: Arundel Street Portal Arrangements (East)

6.4.3 Urban Design

Constraints

The western portion of this proposed portal site is fairly wide, however, the topography between Parramatta Road and Arundel Street presents a number of challenges to any reconfiguration and a heritage sandstone wall would also be impacted. The area is also a major bus arrival/departure point for the university and this function will need to be maintained.

An alternate portal location at Arundel Street was also considered. The location is very constrained by the existing streetscape and would require partial closure of Arundel Street. The adjacent residential areas and the University of Sydney are within conservation areas and present a sensitive visual environment.

Key Considerations

+ Arundel Road topography
+ Heritage sandstone wall
+ Residential fabric edges and parking
+ Sensitive visual environment
+ University bus interchange potential
+ Landforms within the university
+ High traffic pedestrian environment
+ University footbridge

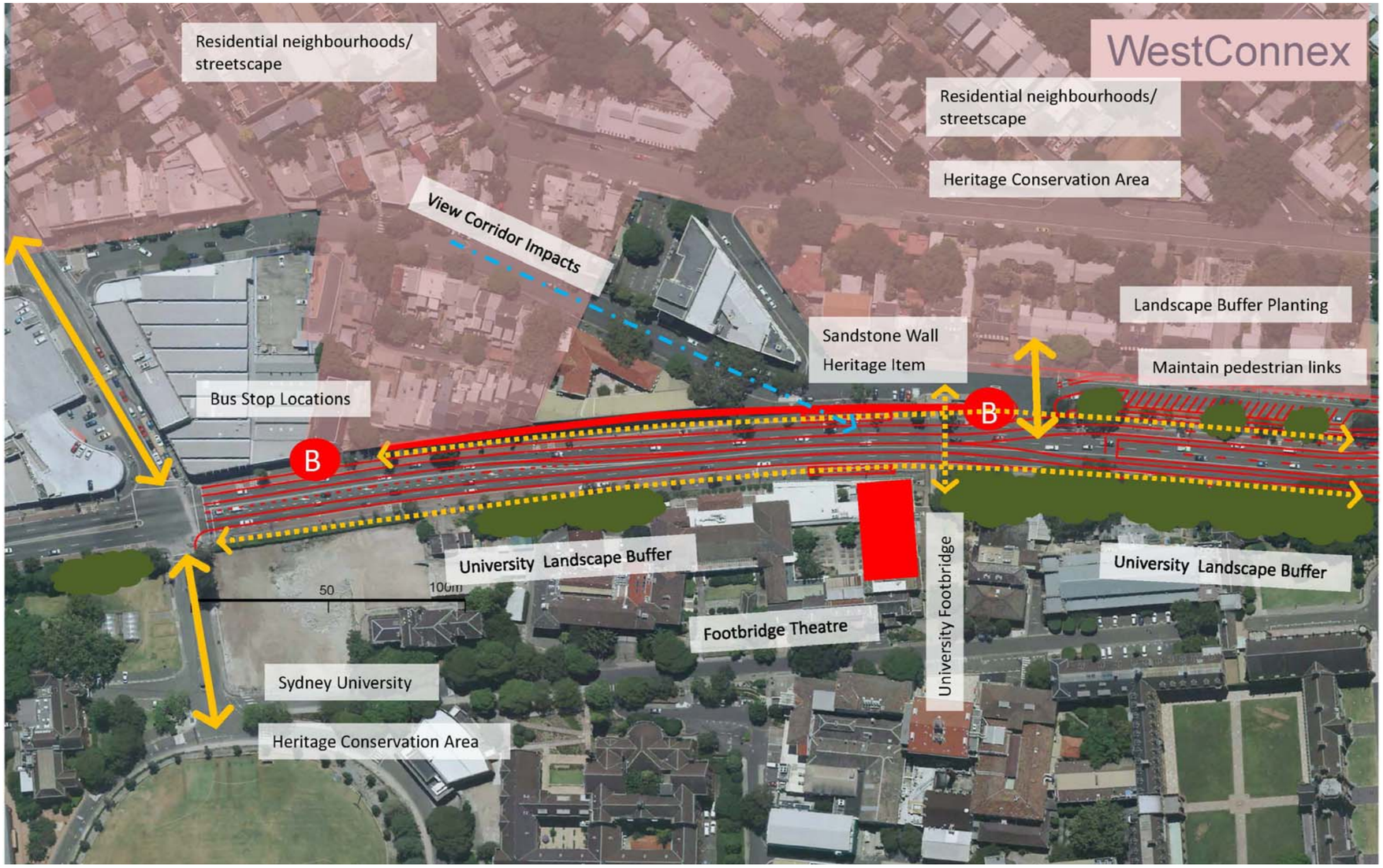


Figure 6.7: Arundel Street Portal West Constraints

The eastern portion of this proposed portal location is a fairly constrained environment. The adjacent residential areas and the University of Sydney are within conservation areas. Victoria Park also presents a sensitive visual environment.

Although the corridor at this location is fairly wide the topography between Parramatta Road and Arundel Street presents a number of challenges and constraints to any reconfiguration. The area is also a major bus arrival/departure point for the university and this function will need to be maintained.

Key Considerations

+ Arundel Road topography and sandstone wall
+ Residential fabric edges and parking
+ Sensitive visual environment
+ University bus interchange potential
+ Landforms within the university
+ High traffic pedestrian environment
+ University footbridge

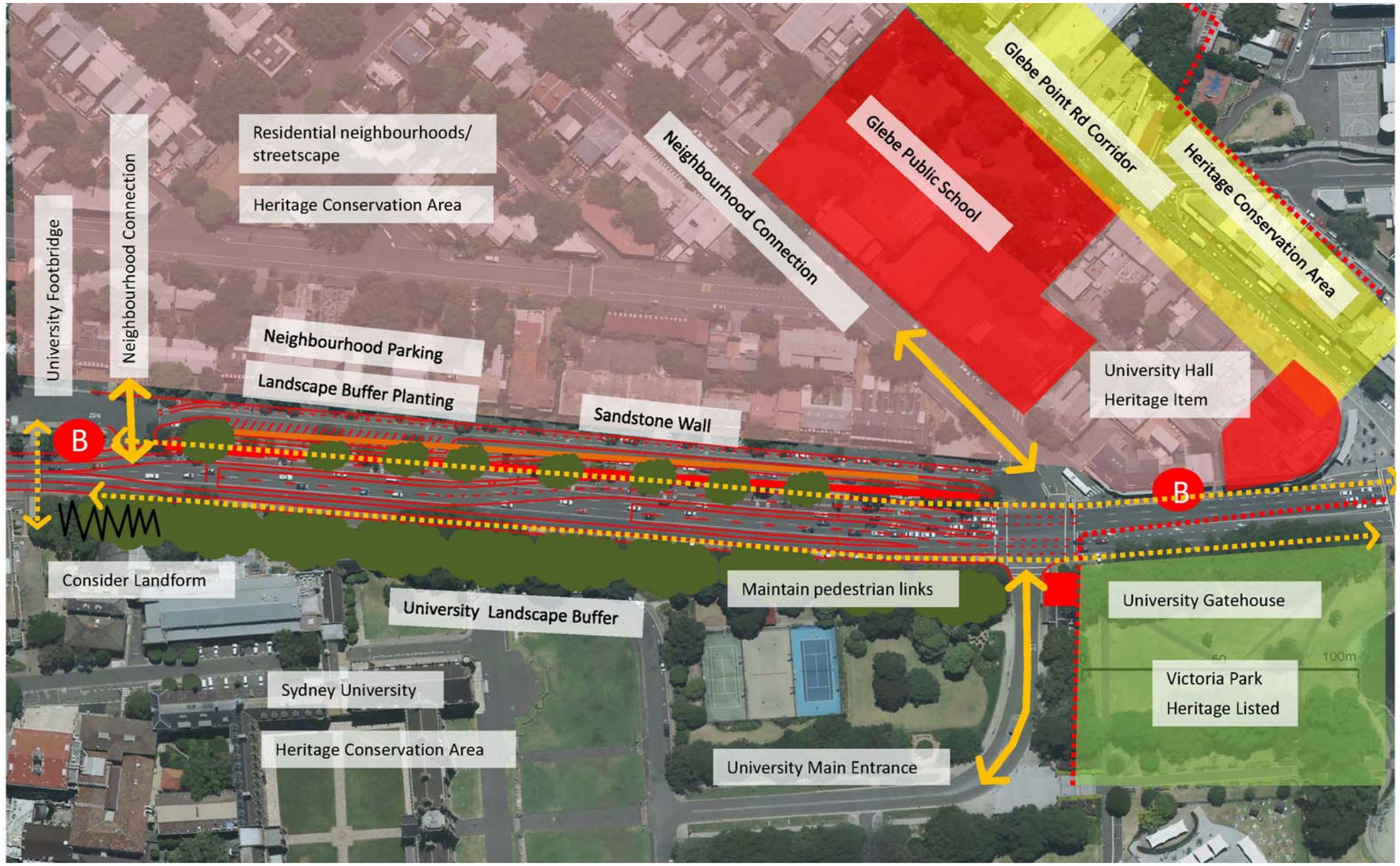


Figure 6.8: Arundel Street Portal East Constraints

Opportunities

Along the western portion of this corridor several improvements can be obtained. With this portion of Parramatta Road above the tunnel, it may be possible to implement a new road configuration at this location and provide significant improvements to the surrounding public domain areas. These improvements could run from the university footbridge to Ross Street.

Footpaths could be widened for a substantial length and relocated bus stops with new bus shelters could form part of a new university bus gateway.

Key Opportunities at Arundel West

+ Footbridge access upgrades
+ Improved bus interchange facilities
+ Maintain residential parking
+ Provide noise attenuation where required
+ Widen footpaths where possible
+ Generate university bus gateway

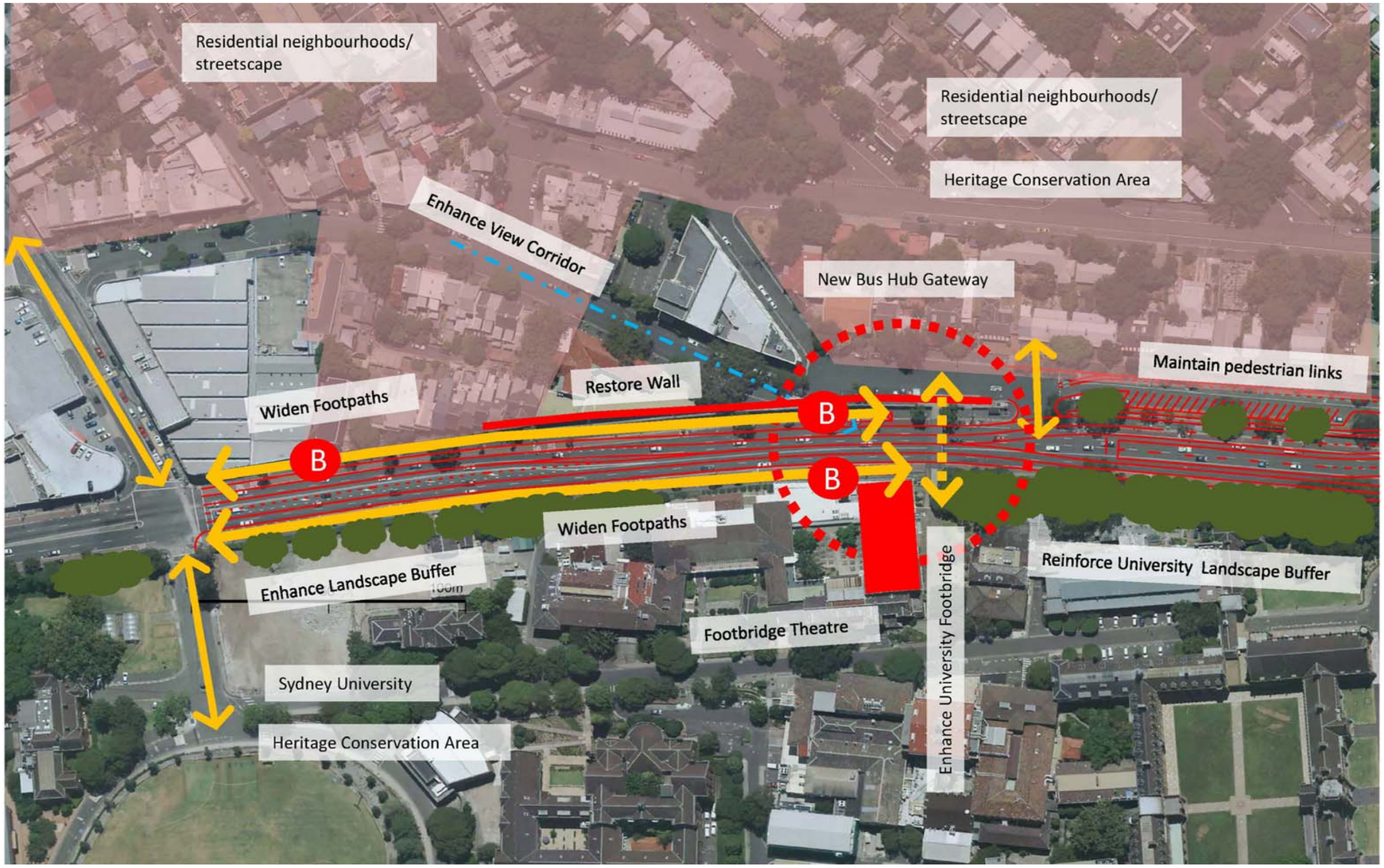


Figure 6.9: Arundel Street Portal West Opportunities

The proposed layout will place portals in a staggered tandem arrangement batten the university footbridge and Derwent Street. West of Derwent Street Parramatta Road moves into a cut with both Glebe and the University of Sydney remaining on higher ground along each side.

The location of the proposed portal presents a number of potential challenges and opportunities. Where the portals daylight, space will be at a premium and careful consideration of the arrangement of road elements is required.

Space for pedestrian circulation, neighbourhood parking, landscape, and heritage elements will need to be provided. The proposed new road layout however can also provide some opportunity for making public domain improvements and for allowing mitigating measures.

The new portal and road configuration will require some reconfiguration of site topography to provide a wider road corridor. This can be achieved by shifting the sandstone wall to the north and repositioning affected parking to the west along Arundel Road.

Grade change between Arundel Road and Parramatta Road can be generally be maintained to provide for some noise attenuation. Street trees can be provided in the new layout. A new lane configuration on Parramatta Road can provide wider footpaths and new bus shelters for the university bus interchange. Footbridge access can be upgraded.

Key Opportunities at Arundel East

+ Footbridge access upgrades
+ Improved bus interchange facilities
+ Maintain residential parking
+ Provide noise attenuation where required
+ Widen footpaths where possible

Figure 6.10: Arundel Street Portal East Opportunities

6.5 Henderson Road

6.5.1 Accessibility

This functionality plug-in is designed to improve accessibility between the IWT and the southern approaches to the city. The design provides single lane east-facing ramps rising up into the centre of Henderson Road in the vicinity of Park Street, Erskineville.

Henderson Street is 4-lane east-west collector road with direct access through to Australian Technology Park and the southern arterial one-way pairs of Wyndham Street (northbound) and Regent Street (southbound).

Whilst the western end of Henderson is used predominantly by local traffic, east of Mitchell Street, the road becomes much busier and performs more of an arterial road function.

The tunnels will exit through portals between Alexander street and Mitchell Road.

6.5.2 Traffic Demand

Initial modelling of the ramps under 2021 AM Peak Hour flows (no-tolls) suggests:

+ demand for the ramps may be heavier from the south (M5) than the west (M4)
+ the ramps may increase the patronage in the IWT
+ the ramps could take significant pressure off the Princes Highway, Mitchell Street, Euston Road and McEvoy Street
+ demand for the ramps, without tolling, may exceed 1-lane capacity
+ the ramps may encourage a transfer of traffic from the old M5-East tunnels to the new M5-East tunnels .

Table 6.1: Comparison of PHO 2021 AM Peak Hour Link Flows with and without the Henderson Street Ramps

Description	PHO	PHO + Ramps
New M5 Tunnel WB	1450	1700
New M5 Tunnel EB	3450	3830
Old M5 Tunnel WB	2680	2530
Old M5 Tunnel EB	3330	3020
IWT NB (North of Henderson Rd)	2400	2340
IWT SB (North of Henderson Rd)	3090	3400
IWT NB (South of Henderson Rd)	2400	3890
IWT SB (South of Henderson Rd)	3090	3370
NB Off-ramp @ Eveleigh	-	2210
NB On-ramp @ Eveleigh	-	670
SB Off-ramp @ Eveleigh	-	1040
SB On-ramp @ Eveleigh	-	1010

Fig 6.11: 2021 AM Peak Forecast Flows on the Henderson Road Ramps

6.5.3 Urban Design

Constraints

The area within the proposed corridor for a potential portal at Henderson Road is a fairly constrained environment. The current urban fabric along Henderson Road generally falls into two distinct characters; low scale residential neighbourhoods or large scaled redevelopment/commercial sites. The latter includes Australia Technology Park and the ongoing redevelopment of its parcels. The commercial environment runs from approximately West Link to Wyndham Street with the residential environment running from West Link to Railway Parade.

The proposed alignment of the portals will impact the visual environment and require some reconfiguration of the recreation facilities.

Key Considerations:

+ Narrow Corridor
+ Residential fabric edge to the south
+ Recreation facilities to the north of the corridor

Figure 6.12: Henderson Road Constraints

Opportunities

The geometry of the new road layout can provide some opportunity for making improvements to the environment and allow space for mitigating initiatives.

The layout of the proposed roadway is based on taking some land from the northern side of the roadway which will have a minor impact on the tennis and basketball courts. It is envisaged that these can be reprovisioned on site with some land acquired from the technology park. The path connecting the recreation facilities to the community to the west is expected to be unaffected. Links through the community to the south to the Erskineville Oval can be strengthened.

Key Opportunities

+ Provide additional landscape greening to residential frontages and on traffic islands
+ Reinforce green links to community facilities
+ Instigate traffic calming initiatives and capture additional public domain green space
+ Provide for strengthening of all street landscape planting along the length of the corridor

6.5.4 Constructability

The Henderson St ramps off the main IWT drive will be excavated by road header and will be constructed from the Henderson St site enclosure towards the main tunnel drive. Spoil from the ramps will be disposed of via Henderson St and Botany Rd. As the Henderson St location for the cut and cover portal and the temporary construction site is constrained, the South Sydney Rotary Park will need to be used during construction and the park footprint will be reduced to a small extent where the tunnels break the surface in the permanent case. It is anticipated that the ground water table will be deep in this area and contiguous piling and shotcreting will be suitable for the cut and cover portal construction.

Figure 6.13: Henderson Road Opportunities

6.6 Princes Highway Ramps to M4

Constraints

The Princes Hwy within the study area, from Cook's River to Sydney Park, area presents considerable urban challenges. It carries a significant amount of through traffic, has a deteriorated urban landscape and little in the way of public domain amenity. It sits directly under a flight path from Sydney Airport making parts of it subject to considerable aircraft noise.

The Princes Hwy is a series of differing road segments. Between the Cooks River and the IKEA Site, it is the main street for Tempe with a largely intact streetscape. To the north the street scape transitions to a fragmented urban streetscape of residential blocks on the north side and larger scale commercial blocks on the south.

At Campbell Road, it transitions into a more intact streetscape on both sides of the Princes Highway. Light industrial buildings and newer residential developments line this part of the Princes Highway. St Peter's Anglican Church faces onto this stretch of the roadway across a loop made by Bishop Street that encircles from several auto dominated uses.

Open Space and Recreation

+ St Peters sport fields
+ Sydenham Green areas

Transport

+ F6 Corridor to be retained
+ Princes Highway as a major traffic artery
+ Cooks River Rail Terminal
+ Canal Road and Ricketty Road serve as major links to mascot and the airport precinct
+ Railway lines act as edge to the continuous urban fabric in this area

Community

+ Residential neighbourhood edges along the north/west side of Princes Highway
+ OLS and airport noise constraints

Visual

+ No major visual constraints

Other

+ Tip soils provide poor building conditions

Opportunities

The Princes Highway corridor provides a unique opportunity for regeneration either through the direct intervention of WestConnex or its effect as a catalyst for others. Implementation of WestConnex would require resumption of properties on the east side of the highway between Canal Road and the railway line. The area is zoned IN1 General Industrial or B6 Enterprise Corridor.

The project envisages clearance of the sites and provision of an interchange adjacent to the Cooks River Rail Terminal. Some minor land resumption may be required at the rail terminal. It is believed that terminal operations would be largely unaffected by this and could continue operate whilst any land acquisitions were undertaken.

Open Space and Recreation

+ St Peters School sport fields and Anglican Church as gateway elements
+ Expansion of green space below OLS areas

Heritage

+ Minor heritage considerations.

Transport

+ F6 Corridor to be retained
+ Cooks River Rail Terminal retained with potential air rights airport related uses above
+ Canal Road and Ricketty Road enhanced as a boulevard connection to Mascot
+ Strengthened Green links to Sydenham station

Community

+ Neighbourhoods on the north side of Princes Highway can be buffered by new development

Visual

+ Gateway elements linked to adjacent green areas can be created

Development / Regeneration

+ Princes Highway could be regenerated if sufficient through traffic is removed.
+ Future Air Hub facilities could be located above railway yard site.

6.7 Mascot One-way Pairs

6.7.1 Traffic

The Mascot one-way pair concept was developed by BBJV to improve the connectivity between WestConnex and the Mascot town centre. The Long Term Transport Master Plan (LTTMP) has already outlined a proposal to implement a one-way pairing of Bourke Street and O'Riordan Street. This is designed to improve north-south capacity through and around the town centre. The BBJV has supplemented this existing scheme with the following:

+ Provision of an east-west one-way pairing of Ricketty Street and Coward Street connecting through to the Princes Highway and WestConnex
+ Provision of a clock-wise circulating ring road around the town centre via Kent Street, Gardeners Road, O'Riordan Street and Coward Street
+ The function of Bourke Street, between Coward Street and Gardeners Road, has been retained as a local access road. This supports local council endeavours to create a pedestrian friendly town centre around Mascot Station
+ Widening of O'Riordan Street to six lanes plus turn-bays between Robey Street and Bourke Street
+ Provision for contra-flow bus lanes on sections of Gardeners Road and Coward Street to facilitate Botany Road bus access to/from the Mascot Town Centre

The BBJV one-way scheme is compatible with both the Princes Highway Option and the Optimised Base Case option. A number of alternative one-way arrangements were considered. However, these alternate schemes:

+ Failed to provide the same east-west connectivity between the WestConnex and Mascot
+ Divided the town centre and introduced an arterial road through the Mascot Station pedestrian precinct. This section of Bourke Street is a local road and would need to be reclassified as a State Road.

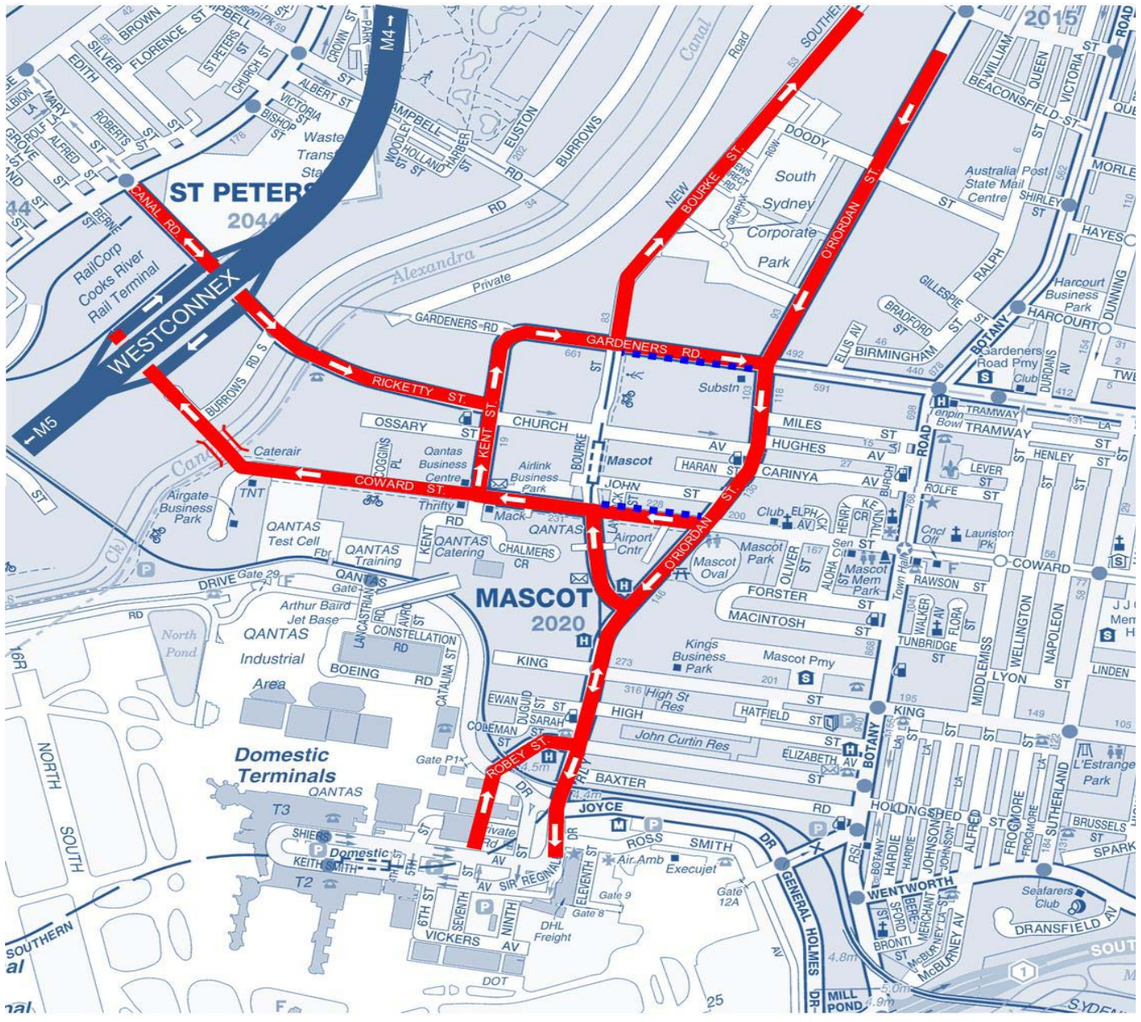


Fig 6.14: The BBJV Preferred Mascot One-way Pair Scheme

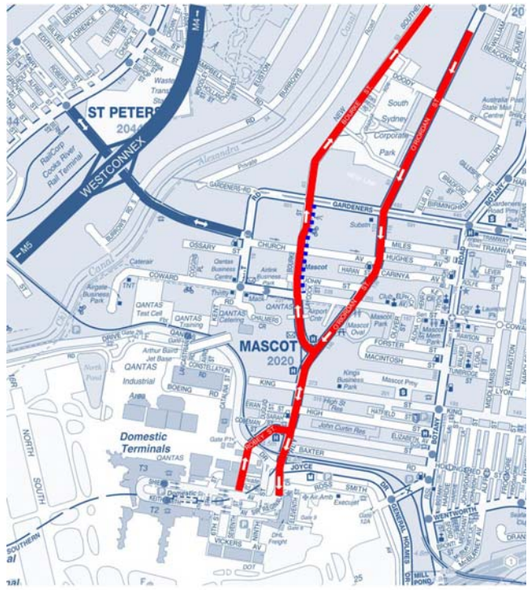


Fig 6.15: Mascot One-way Alternative #1

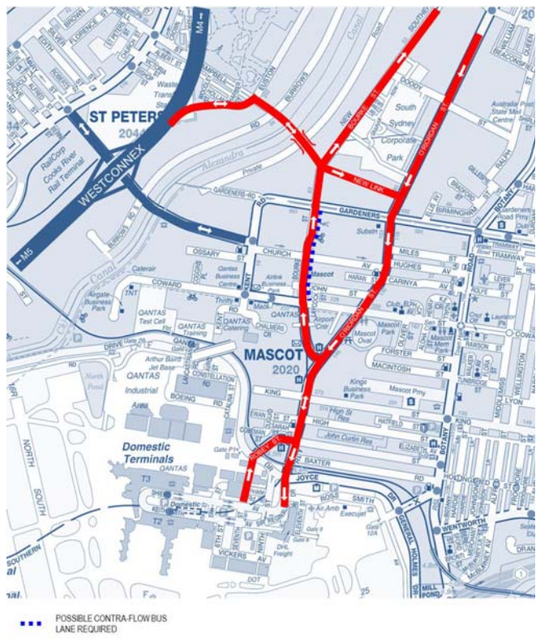


Fig 6.16: Mascot One-way Alternative #2

6.8 City Road

This functionality plug-in was designed to improve accessibility between the IWT and the Sydney CBD. The design provides single lane east-facing ramps rising up onto City Road, west of Cleveland Street.

This option is only suitable for a connection to/from the M5 for the following reasons:

+ Ramps to the M4 would preclude any extension of the IWT to White Bay (future F6)
+ Ramps to the M4 would duplicate the function of the Camperdown and/or Arundel Street ramps
+ This option was not pursued any further for the following reasons:
+ It places more pressure on the City Road and Broadway intersection
+ It changes the traffic patterns approaching the City by directing M5 traffic away from the southern arterial approaches to the CBD towards the Broadway approach
+ The opportunities for widening to accommodate the portals and ramps, with acceptable grades, are inadequate
+ Constructing the portals under the heavy traffic of this major city arterial would be problematic
+ It would require long ramps and/or realignment of the IWT further to the east
+ It precludes M4 access to the areas south of the CBD via Henderson Road ramps.

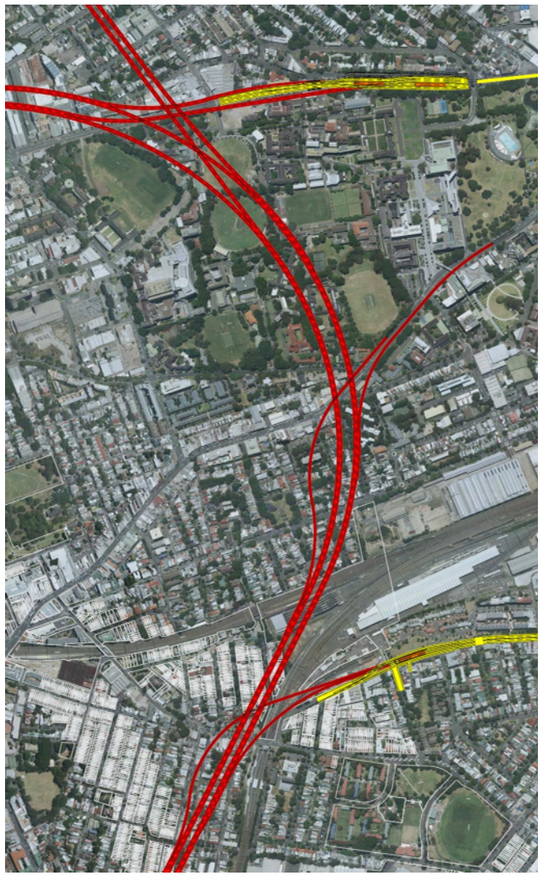


Fig 6.17: City Road and Henderson Road Ramp Alignments

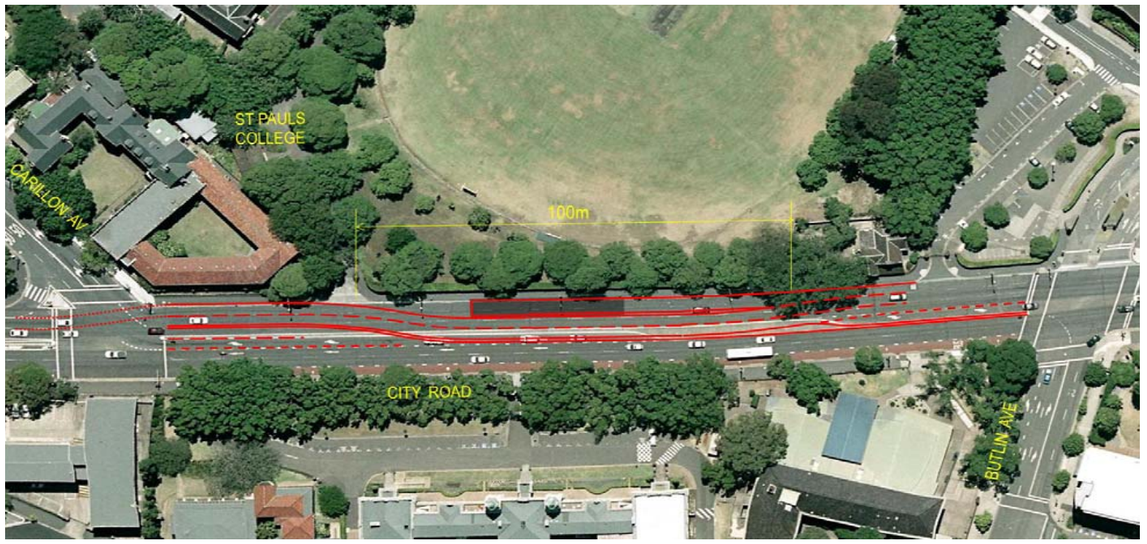


Fig 6.18: City Road EB Exit Portal Concept

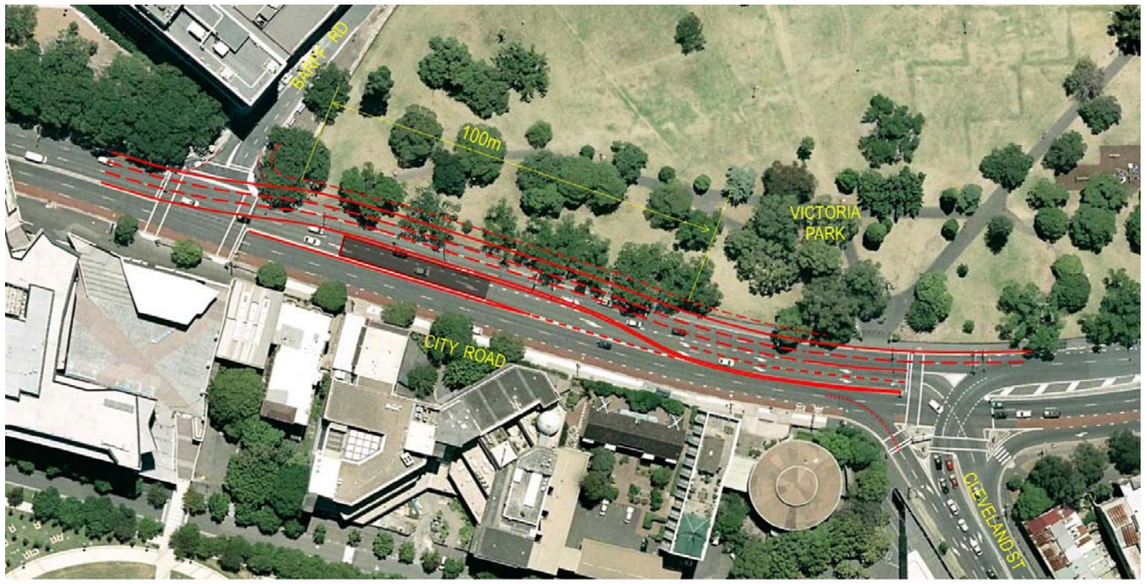


Fig 6.19: City Road WB Entry Portal Concept

6.9 Port Botany Connection

Although currently contributing less than 10% of the overall traffic volume in the area, Port Botany is a major stakeholder in the development of WestConnex. The movement of trucks into and out of the Port is currently hindered by the following restrictions:

+ A height limit of 4.4m through the Airport runway tunnel
+ The 8% grade at the western end of the M5 East tunnels which severely limits the speed of heavily loaded westbound trucks with a consequent impact on all westbound tunnel traffic
+ A height limit of 4.4m along Airport Drive past the N-S Runway OLS
+ 9 signalised traffic intersections between Port Botany and Marsh St when travelling around the north side of the Airport and an additional 22 signalised intersections for the equivalent over height vehicle route

The SMPO Port Botany Connection Concept (refer Appendix L and M1) was reviewed and the following features were noted:

+ The large proportion of structure in the Concept
+ The extent of land acquisition
+ The amount of SACL land required
+ The major interface with the Port Botany Rail line
+ The absence of any provision for the proposed connection to Domestic Terminal by SACL between Robey St and Seventh Ave
+ The construction of elevated structure over the Engine Pond on General Holmes Drive

The BBJV Port Botany Connection Concept (see Appendix M1) addresses the above issues and provides a solution with the following characteristics:

+ A predominantly at-grade solution relying on the widening of the existing road corridor and minimising land take
+ The construction of a cut and cover underpass at the Southern Cross drive intersection to avoid OLS impacts with the East-West runway and to minimise SACL land impacts
+ Discrete grade separation viaducts at Airport Drive, O'Riordan St and General Holmes Drive to provide a free flow connection between the Port and the AAL for over height vehicles
+ This concept is based on the rail crossing connection to Botany Rd being, closed requiring vehicles to cross General Holmes Drive at Mill Pond Rd; alternatively another grade separation could be added at this location

We are confident that this solution offers equal or better functionality at lower cost while minimising land acquisition and environmental impacts.

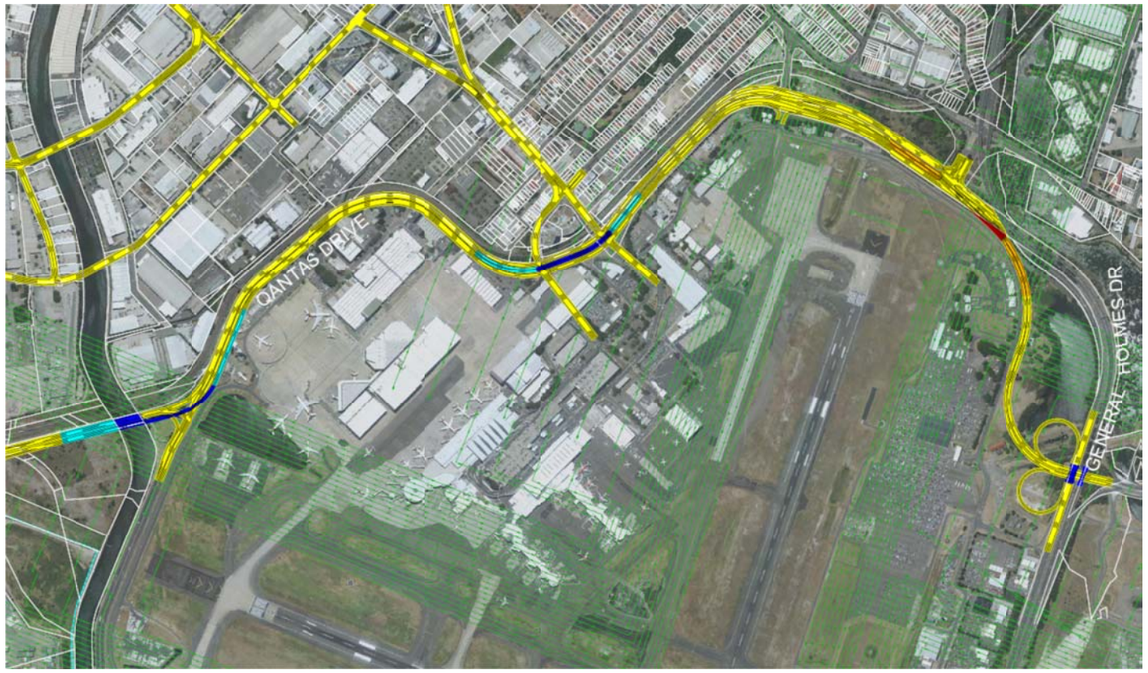


Fig 6.20: Extract From Appendix L of the Port Botany Connection

Figure 6.21: Aerial View from Princes Highway tp Port Botany (copyright RMS, 2009)

7.0 FUTURE PROOFING

7.1 F6 Freeway

The integration of the future F6 motorway connection with the BBJV preferred solution was considered and a concept is shown in Appendix L. The future road follows the F6 reservation through the Kogarah golf course, crosses the Cooks River and runs in tunnels parallel to the Princes Highway potion of the BBJV option. The northern continuation of the F6 could be through additional tunnels continuing north from the St Peters portals. The F6 can be connected with the existing M5 tunnels with a grade separated interchange, or alternatively M5 southern tunnel connections could be provided as shown in Appendix L. Provision for a connection into Mascot via Campbell Road has also been made.

7.2 Environmental Quality

Environmental Risks and outcomes have been subjected to a desk top analysis of the anticipated outcomes of the project.

This section is not intended to replace a full environmental assessment for the project but to highlight general issues and identify potential mitigating measures should it be determined that a negative impact may occur without them. As the project progresses appropriate approval instruments will be developed and provided to appropriate authorities for consideration.

The study area of WestConnex traverses a number of differing areas of urban fabric to the west of central Sydney. These areas have been defined for ease of identification and represent a broadly consistent urban fabric and character areas. They also correspond roughly to different segments of the project alignment. These areas will be used for assigning assessment considerations.

These areas include:

+ Parramatta Road Corridor
+ Inner West
+ South Sydney
+ Airport Environs

Figure 7.1: Metropolitan Sydney From the South-west

8.0 FUTURE ACTIONS

8.1 Introduction

SMPO have requested the Industry Partner Development Teams to outline actions that can be undertaken by Government that will reduce the risk for the Motorway and also provide more certainty for the Government and for Industry.

BBJV make the following suggestions in relation to the key areas:

+ Project Scope
+ Project Operations
+ Project Procurement

8.2 Project Scope

8.2.1 Corridor Alignment Selection and Protection of Corridor

It is understood that SMPO review the various studies and proposals provided by the Industry Partner Development Teams and determine an optimal solution including a Motorway Corridor. This will be provided to the NSW Government for a decision on WestConnex.

SMPO having selected the preferred Motorway Corridor, and in particular the surface locations for entry and exit to the surface roads from the tunnels should define this corridor in the Metropolitan and Local Planning Instruments in order to protect the corridor from other development proposals that may preclude options the Government is considering.

The corridor definition should be sufficiently broad so as to allow for minor changes in alignment as detail design develops. These changes may be as a result of changes in alignment to satisfy safety issues such as sightlines, or to avoid geological conditions that had not been previously detected.

8.2.2 Project Definition

The NSW Government is proposing an overhaul of the Environmental Planning System.

A key component is that community consultation and involvement is preferred at the 'front end' of a Project when standards can be defined and methods of compliance determined.

The Project Definition should be developed to a sufficient stage that encourages and enables constructive community participation in the consultation process.

8.2.3 In-Tunnel Air Quality

There are known standards for in-tunnel air quality that are widely recognised, mostly framed around concentrations of carbon monoxide (CO) nitrous oxide (NOx). The former is lethal depending on duration of exposure. Nitrogen oxides, in themselves are not lethal. However they can combine with other compounds and form small particles that aggravate existing lung conditions, or cause lung conditions.

In meeting in-tunnel air quality a prime consideration is the ambient air quality at air intakes, and how this relates to the nominated air quality goals.

There is a relationship between the cross sectional area of the motorway tunnel, and the number of fans required to achieve the air tunnel exhaust. Also related to this is the significant amount of energy consumed in preventing emissions of in-tunnel air at portals.

Thus questions for SMPO to consider for Tunnel exhaust air discharge are:

+ Locations of exhausts at portals and nominal mid points along the tunnel that could effectively disperse tunnel air at lower concentrations over a wider area then if tunnel exhausts are located at a few points;
+ Permitting Tunnel portal emissions leads to significant reductions in operational energy consumption

8.2.4 Tunnel Water Treatment

Tunnels within Sydney experience a reasonable level of groundwater seepage, although the amount and location of ingress will vary along the tunnel route. Based on experience and current limits from Planning Approvals (1L/sec/km) the amount of seepage could be 25ML a month for a 5km twin lane tunnel.

Combine this with vehicle borne water, fire system testing water (deluge systems), and wall washing, the amount of water treated is considerable.

Treatment standards are dictated by the receiving waters which have been saline for most of the Sydney tunnels, and mineral salts and iron impurities have not been totally removed. Effective reuse of treated water is dependent on removing most of the salts and impurities to make reuse effective for irrigation, washing of paths, etc.

Given the large quantity of water potentially available and the sustainable uses by Council, or local businesses it may be put to, investigations on its feasibility is recommended. It will require a higher level of treatment then is currently the case in the older tunnels.

8.3 Project Operations

It has been assumed, as a basis for discussion, that the overall WestConnex would be managed from a central location, such as the RMS Traffic Management Centre, but using linked satellite locations to reduce incident response times. These satellite locations are likely to be existing control centres or new purpose built centres according to the location of the project.

Motorway traffic management relies on utilisation of the capacity of the road and needs to be able to respond to traffic incidents quickly to prevent or minimise the flow on effects that downgrade the Network. These incidents are as simple as vehicle run out of fuel, broken down vehicle (immobilised), fire in a vehicle, and single or multi-vehicle accidents. These do not necessarily involve a response from the Emergency Services.

A fast response to these incidents has typically been included within management contracts, and the response time period would require a response vehicle and crew to be stationed at appropriate points along the network in order to act quickly.

The design requires that along with breakdown bays, there be waiting bays for crews, distributed entry and exit points to enable response vehicles to enter or exit, and locations for emergency response vehicles to turn around (outside of tunnels) without impacting on more than one lane of traffic.

These physical features, along with the suite of lane utilisation signs, motorist message signs, etc allow for the effective management of incidents.

However, the best benefit in keeping traffic flowing is the ability to divert traffic of a clogged route on to another. For tunnels this means there needs to be sufficient means to exit to an alternate route undertaken in the initial planning of the Project.

8.4 Project Procurement

The overall WestConnex Project, including additional works that enhance the WestConnex but not officially part of the Project, can be delivered using a number of different procurement strategies according to the scale and demands of the specific work.

The BBJV Team will comment only on the aspects that we have been involved in, namely Inner West Tunnel, Airport Access Link, and the realigned M5 East Duplication. Other sections such as the Port Botany Connection, the Mascot 'one way pairs', are capable of being done independent of the WestConnex Project.

8.5 Contractor's 'Top of Mind' Issues

Both Baulderstone Pty Ltd and Bouygues Construction Australia have a depth of experience in project procurement both throughout Australia and internationally. We can bring that range of experience to provide experienced insight for the benefit of the NSW Government.

BBJV have prepared Table 8.1 to outline a number of issues, with 'possible resolution' methods or mechanisms that address issues that we have experienced in a number of Project Tenders and Procurement Methods.

Table 8.1: Contractor Top of Mind Issues

Project Phase	Issue	Context	Possible Resolution
Pre EOI	Delivery model - Use of Managing Contractor	Due to the size of some projects committing purely Government Agency resources to the project may not provide an optimal outcome.	Client to decide if they require specialist help to deliver large infrastructure projects. Current indications suggest that if RMS/SMPO are to continue delivering new projects then they will need assistance to deliver concept designs, detailed estimates, developing procurement strategies, review of bids and supervision of construction. Client should be aware that if a Managing Contractor format is adopted then major contractors will need to discuss returns on staff investment. Typically Contractors recover cost and profit from the turnover of projects. A Managing Contractor role does not provide the same returns unless there is a significant uplift in their fees. The order of magnitude fee that would be applicable would be in the 25-30% range on top of the appropriate staff cost to provide an appropriate level of return. Matters for consideration include:- * To provide maximum value a Managing Contractor, as part of an integrated delivery team, should have responsibility for managing the interfaces over a number of packages, if this model is adopted then It may be necessary to establish probity processes that allow participants of a managing contractor contract to participate in a bid for D&C contracts. * As the Managing Contractor forms part of a larger integrated team, that integrated team needs to have the capacity to engage with Authorities and compel them to act in a manner that does not delay the overall project delivery timetable. * Probity – if a tier one contractor is selected as Managing Contractor will other affiliated companies be able to bid for this parcel of work? * Fee – typically fee is based on total contract value, for Managing contractor to recover full value of staff there will need to be a higher than normal multiplier similar to an alliance (24-30%). * Fee breakdown should be a combination of fixed fee and incentive based on agreed project outcomes * Design Risk – Managing contractor is unlikely to accept the full design risk. Client should consider who will carry this risk carefully. * Risk Profile – the Client needs to review the overall risk allocation for the project and ensure that all relevant Government Agencies are on-board with the Project Risk Profile * In a 'heated' market will Tier 1 contractors be willing to assign 'key staff' to low reward Managing Contractor Contracts? * Ensure best possible contracting method is adopted to advance the design in parallel with Government Planning approvals. Contract types worthy of consideration are: o Alliance o Collaborative Contracting o Early Contractor Involvement (ECI) o Competitive TOC, costs reimbursable for unsuccessful proponent o Use of a Construction Panel to deliver the project * Work done by Managing Contractor could include:- o Developing the design o Advancing planning approvals o Developing a CEMP o Developing Interface Agreements o Providing constructability input o Developing RFP documentation o Calling RFPs o Evaluating offers o Supervising Construction * Relationship between two Tier 1 contractors when 1 is 'managing' the other – this has been done successfully in the past. * Client should bear in mind the following issues when selecting their preferred contracting method:- o Availability of resources o Other projects currently underway which may diminish availability o Upcoming projects sponsored by Government

Table 8.1: Contractor Top of Mind Issues (Cont.)

Project Phase	Issue	Context	Possible Resolution
Pre EOI	Project Planning	There needs to be a well defined project delivery programme developed and adhered to. That allows all government agencies to be aware of the project delivery plan and their part in ensuring its successful implementation.	The whole of government needs to be aligned with the project's business case and commit to adhering to the timetable for delivery. To this end major projects should have a 'Project Champion' supported by a strong Project Management Team comprised of appropritely talented people who can manage the processes and exhibit strong project management disciplines
Pre EOI	Early Contractor Involvement	Often projects are brought to market with an approved concept that locks in project outcomes at the Project Approval stage, this stifles innovation by the Contrcctors	Early involvement of the Contractors will allow constructability issues and innovation to be brought to the Project before approvals are given by the relevant government agencies. This involvement could be in the form of an ECI contract, an integrated team of CLient, COntractor and Designers to lock in best value for money prior to the RFP phase of the Project.
Pre EOI	Industry Capacity	Typically Australian Tier 1 Contractors will compete for $1 to $1.5 billion projects in their own right. They may choose to Joint Venture with another Tier 1 Contractor to bid for projects in excess of this value, or when a partner offers complimentary skills.	Client needs to review delivery strategy to ensure that Project Packages are sized to suit the industry's appetite for work and their ability to deliver providing the Client with Certainty.
EOI	Project Timing	The timing of bringing project to market can have a material impact on the project price which can impact of the Value for Money proposition for the Client. Currently there is not a lot of infrastructure spending in NSW. In the	The Client needs to be aware of the timing of similar work throughout the Australian market and they need, where possible, to time the release of projects so that there is a reasonable continuity projects so that there is reasonable expectation that Industry will be able to service the Client's needs and provide Value for Money. Currently there are major tunnelling works planned in NSW (NW Rail and F3 to M2), Victoria (East-West Link & CBD metro), Queensland (Cross River Rail and Curtis Island) so the timing of the release of WestConnex projects will test the availability of skilled resources. While a possible solution is to introduce
EOI	Administrative	Considerable time and effort is involved with the administrative requirements during the bid process.	Administrative initiatives to reduce costs include electronic lodgement of EOIs with defined lengths and formats. Also, only one printed copy of the RFP response with accompanying soft copies. Finally, specified inclusions or exclusions to RFP documents (e.g. expensive fly- throughs and accompanying video materials).
EOI	Interface Agreements	Interface agreements with Third Parties need to be resolved	TO provide certainty to the shortlisted tenderers Interface agreements should be in place prior to RFP. This provides tenderers with certainty when preparing their prices and ensures the Client hasmitigated the risks of the project for major stakeholders
EOI	Risk Profile	A clear list of Risks to be accepted by the Parties prior to RFP being called	Tenderers add cost for risk that they are expected to carry through the project. The Client needs to critically review the risks that they are prepared to carry and those they expect the Tenderers to deal with. Clients need to carefully assess which of the project parties are best equipped to deal with risks.
EOI	Project Approvals	Currently Project Approvals are not available until late in the RFP phase and can often cause significant increases in cost when known. These approvals have been known to delay the RFP phase because they are not ready by the agreed date and the RFP phase has to be extended. The Approvals also lock in a concept design before constructability issues can be properly addressed.	Develop the design, with constructability input and obtain project approvals prior to the commencement of the RFP phase. This will place significant pressure on the Client resources available and consideration should be given to ways to supplement their resources. Use of a Managing Contractor or Design Alliance may provide a suitable solution.
RFP	Specification documentation	Client issued project specifications are becoming more prescriptive. The prescriptive nature of the document stifles innovation and new technology opportunities. The prescriptive nature of specification reduces any opportunity reduce costs.	A change in focus from a prescriptive specification to a performance based specification would create an environment that delivers the best possible outcomes for the client. A performance based specification would encourage innovation and latest technologies from around the construction world. A performance based specification would potentially reduce costs whilst maintaining the client performance requirements. The challenge in adopting this solution is that it puts pressure on Clients to be able to analyse different offers.
RFP	Project Verifier Role	Recent projects have required and demonstrated the impact of the Project Verifier's role in the successful delivery of a project. When the Verifier is bound literally to a Project Deed the outcome can be sub-optimal and not provide the Client with a Value for Money Outcome.	The Project Verifier has an important role within the process for successful delivery of the project. By promoting a more inclusive role where the project verifier shares risk in overall project outcomes will produce better outcomes. The performance of a project verifier team is driven by individuals and past experience. The criteria for the selection of Verifier could be amended to allow the principal contractor assist in the choice of project verifier based past experience and individual team member strengths. This would result in shared vision for the project by all parties, leading to better project outcomes.

Table 8.1: Contractor Top of Mind Issues (Cont.)

Project Phase	Issue	Context	Possible Resolution
RFP	Designated Level of Design	Governments should be able to stipulate a level of materiality in the development of designs for all large D&C bids.	This would ensure that unnecessary investments in design fees are not made that have no material bearing on the assessment of bids.
RFP	Bid Costs	The most common form of describing bid costs is as a percentage of the total project. This approach however, masks the real issue of concern for contractors which is what the bid costs are as a proportion of profit. Australian bid costs are in the order of 0.5 to 1.5 per cent of project capital value. Therefore the average bid costs for a $2 billion project could be approximately $30 million. By way of example, it would not be uncommon for a Tier One Contractor to make an annual profit of approximately $50 million. A bid on a $2 billion project would represent 60% of the single company's total yearly profit! Further, in an environment where there are usually 3 bidders on a $2	Focus on the minimisation of the actual costs incurred to win projects. Substantial external bid cost reimbursement linked with bid bonds is a more equitable and economic way of ensuring the private sector remains focussed on the procurement. In the event that a bidder walks away or does not submit a compliant bid the State would not only withhold any reimbursement but stand to receive some compensation in the remote scenarios that are often raised as risks associated with bid cost recovery.
RFP	Recovery of Bid Costs	A common misconception is that bid costs are simply borne by the private sector at no cost to either the Government or the general public. This is simply not the case. Currently the State incurs the majority of both the winner's and losers' costs via a higher D&C price, as the successful proponent seeks to add a multiple of their external costs to their bid and the State accepts the total	A far more effective and efficient way would be for the Government to offer a defined contribution to all unsuccessful bidders on the proviso that all external costs were fully documented and accounted for. This greater level of transparency would, in turn, provide a clear incentive for all parties to remove or reduce the costs involved and not include an inflated recovery amount in the actual bid. Baulderstone does not believe that it is appropriate to fix a specified quantum or percentage for all projects. Rather, projects should be assessed on a case by case basis with due regard given to the nature and complexity of the project. However, disclosure of the intended quantum of reimbursement should be released sufficiently early for consortia to form without bid costs acting as a major impediment.
RFP	Adherence to Bid Timetable	Currently bidders are being asked to adhere to specified deadlines, it is reasonable that the Government comply with its own designated timetable. From the release of the initial EOI (or first bid timetable) to the selection of the preferred tenderer, bidders should be able to rely on the declared timing of procurement. There is a very	The Government committing to the proposed bid timetable for the project, the risk of bid costs increases associated extended durations are diminished, which ultimately results in lower Direct Costs.
RFP	Conditions of Contract	A considerable amount of time, effort and cost is expended on all bid teams negotiating the terms of contract, often with the use of external legal firms. Unfortunately, these negotiations are only of relevance to the successful proponent. Ideally, all procurement should be premised on the Australian Standard contracts in an unamended form.	Considerable time and effort has been put into ensuring these contracts represent an appropriate allocation of risk. Utilising these contracts with attached deeds that relate back to the specifics of the project would save considerable legal fees. Failing that it should be possible to have a term sheet of in the order of 25 key considerations (e.g. contamination, LDs and liability etc.) that the Government is requesting of the bidders. The full contract would then only be finalised with the successful bidder, with the key terms already agreed through the tender process.
RFP	Probity	Concerns around probity have evolved to the extent that on past projects it has become a hindrance to productive interaction between the procurer and bidders. It is vital that government bid leaders have the training, capacity and support to drive the procurement process.	Interactive workshops need to be used positively to ensure that bidders are responding to the key objectives of the procuring agency. Bidders should be directed away from frivolous or unwanted design pursuits. Probity should not be interpreted as not saying anything, but rather to be used as a tool to ensure impartial procurement and to protect the intellectual property of competitors.

Table 8.1: Contractor Top of Mind Issues (Cont.)

Project Phase	Issue	Context	Possible Resolution
RFP	Probity	Concerns around probity have evolved to the extent that on past projects it has become a hindrance to productive interaction between the procurer and bidders. It is vital that government bid leaders have the training, capacity and support to drive the procurement process.	Interactive workshops need to be used positively to ensure that bidders are responding to the key objectives of the procuring agency. Bidders should be directed away from frivolous or unwanted design pursuits. Probity should not be interpreted as not saying anything, but rather to be used as a tool to ensure impartial procurement and to protect the intellectual property of competitors.
RFP	Performance Obligations	There needs to be a clear set of Performance Obligations to ensure assessment of offers is as straightforward as possible	Often where there is poor project scope definition the evaluation process is delayed while divergent offers are assessed. By providing a clear set of project performance obligations the tenderers will provide comparable offers that do not have excessive risk allowances to cover scope growth.
Post RFP	Shortlist of Bidders	A key element of the costs involved in major D&C or PPP bids is the maintenance of three bidders in the interest of competition.	Whilst we appreciate the concerns that Government may have if one bidder were to withdraw post the short-listing stage, we would maintain that this problem can be overcome with the introduction of bid bonds. A material bid bond, along with their consideration of reputation risk, would ensure that all shortlisted bidders would fulfil their tender obligations.
Post RFP	Early Selection of Preferred Bidder	It should be possible to identify a leading bidder at an earlier stage without having full and final development of all design and construction methodology.	This earlier selection would rely on Government working with the preferred bidder to develop their proposal. By removing the need to maintain for the entire duration would result in reduced costs and provide resource availability.