

Appendix E. MCA Report – NDW and DW pipeline options



Floor 11, 452 Flinders Street
Melbourne VIC 3000
PO Box 312, Flinders Lane
Melbourne VIC 8009 Australia
T +61 3 8668 3000
F +61 3 8668 3001
www.jacobs.com

Date 28 July 2016
Attention Rebecca King
From Amanda Gunawardena / Sam Barnes
Subject **NDW and DW pipeline alignment options**
Copies to Steve Hart, Andrew Radion, David White, George Lagwa, Hendry Young, Neil Gerhard

1. Purpose of the memo

The M733 Aitken Boulevard North Drinking Water (DW) and R001 Non-Drinking Water (NDW) mains will ultimately (2040 and beyond) provide water services to approximately 9,300 residential properties and 1,100 Ha of employment land in the Mickleham Area.

The Aitken Boulevard North M733 DW and R001 NDW mains are conceptually planned along the same route within public land (VicRoads future road acquisition for the Aitken Boulevard and private land in the proposed AMP Mickleham Business Park development at 255-285 Donnybrook Road). The proposed DW and NDW mains will connect the existing mains in Mt Ridley Road to the recently constructed mains in Donnybrook Road.

The Flora and Fauna assessment completed by Jacobs as a part of the Functional Design Stage of the project identified that native grasslands and threatened species present along the southern section of the alignment (between transmission lines and Mt Ridley Road- VicRoads future road acquisition) are of high ecological value. Any construction activities or intrusive investigations along the southern alignment require permits from Hume City Council, Department of Environment, Land, Water and Planning (DELWP) and the federal government. The flora and fauna assessment also indicated that specific offsets are required for the removal of threatened species, which are both costly and time consuming to purchase.

This memo documents a brief assessment of the possible alignment options to reduce the construction footprint and associated environmental impact and offset costs. A Multi-Criteria Assessment (MCA) has been carried out to recommend an alignment that minimises the impact to the natural environment, while maintaining economic viability and operating functionality.

2. Alignment options

The alignment options discussed in this assessment are:

- Base Case (Functional Design) – open trenched, along both sides of proposed road with a 40 m width construction corridor (full width of the future road acquisition area)
- Option B – Open trenched, along both sides of the proposed road, reducing construction footprint in highly sensitive areas in the southern section (Approximately 10m construction corridor on each side)
- Option C – Open trenched, on one side of the proposed road, reducing construction footprint in highly sensitive areas in the southern section (Approximately 15m construction corridor)
- Option D – Bored in sensitive areas, along both sides of the proposed road.



3. Analysis

3.1 Cost Comparison

A cost estimate was developed to compare the capital cost of each alignment option, and the results are summarised in Table 3-1. Refer to Appendix 1 for the detailed breakdown of the costs. The pre-feasibility cost estimates in this report were developed solely for comparison purposes to assist the MCA and must not be used for any other purpose (including budget forecasting). The cost estimates were prepared using information reasonably available (including data from recent projects and YVW cost curves). The offset costs are indicative only and were calculated assuming an average offset cost of \$234,830/ha. Actual prices, costs and other financial variables may differ to those used in this report and are subject to change.

Table 3-1 : Alignment option cost comparison

Option	Description	Pipe cost (\$)	Offset cost (\$)	Total Cost (\$)
Base Case	Open Trenched Both sides of Road - 40 m construction corridor	4,830,420	1,548,000	6,378,000
Option B	Open Trenched Both sides of Road - 10 m construction corridor for sensitive area	4,830,420	774,000	5,604,000
Option C	Open Trenched Single side of Road - 15 m construction corridor for sensitive area	4,830,420	580,500	5,411,000
Option D	Bored through sensitive areas - Both sides of Road	5,680,420	230,133	5,911,000

3.2 Multi Criteria Assessment

A Multi-Criteria Assessment considered the:

- Cost estimates for each alignment option identified in Section 3.1;
- Operational risks;
- Construction risks; and
- Environmental impact in the sensitive area.

The MCA assessment is shown in Table 3-3 below. Option A was adopted as the Base Case for which all criteria were scored zero (0). The other options were assigned scores in the range -4 (very large disadvantage) to +4 (very much better) as per Table 3.2 below. The assessment was based on the criteria and weighting agreed during the Alignment Options Meeting on 26/07/2016 (See meeting minutes in Appendix 2).

Table 3-2 : Selection criteria scoring

4	Very Much Better (exceeds expectations and has no risks or omissions)
3	Significantly Better (fully acceptable with no risks or weaknesses)
2	Moderately Better (and has no minor risks, weaknesses or omissions, substantially compliant with regulations and is acceptable in current form)
1	Marginally Better
0	Base Case (option equal or nearest to Base case)
-1	Marginal Disadvantage
-2	Moderate Disadvantage (some acceptable risks, weaknesses and/or omissions)
-3	Significant Disadvantage (major risks, weaknesses and/or omissions including not fully compliant with regulations)
-4	Very Large Disadvantage (Serious and fundamental risks, weaknesses and/or omissions including non-compliance with regulations)

3.2.1 Capital Cost

The capital cost of the project was scored based on the results of the cost estimate summarised in Table 3-1. Refer to Appendix 1 for the detailed breakdown of the costs. Option C was identified as the least expensive option (comparatively) as there are significant offset and construction cost savings when the mains are located in the same side of the road. Option D (bored through sensitive areas - both sides of Road) minimises the construction footprint and hence the offset costs, but has the highest capital cost due to the use of trenchless excavation.

3.2.2 Natural Environment

The impact to the natural environment was scored based the construction footprint of the southern section of the alignment. The use of trenchless excavation will minimise the construction footprint, hence the impacts to the environmentally sensitive area. The large construction footprint in Option D (40m construction corridor) will have significant disturbance to the threatened species and native grasslands.

3.2.3 Construction Risk

Using trenchless construction methodology requires consideration of local geology. The method works best in homogeneous ground conditions, which may result in mains being much deeper than if laid in open trench. Trenchless construction is more expensive; requires shafts at about 100m intervals which



would require local construction area widening to accommodate several trucks and plant, and allow vehicles to pass.

Having a narrow construction corridor for the installation restricts the contractors working space, increases materials handling effort and lengthens pipe construction time. Normal pipeline construction width uses space for the trench, stockpiling and vehicle movement, so reduced construction width impacts one or all of these.

3.2.4 Operational Risk

There is a risk of cross contamination when installing the NDW and DW main on the same side of the road. Various measures, such as offsetting fittings, must be used to clearly distinguish the mains in order to minimise the risk of future shut down or connections to the wrong pipe.

Using trenchless construction could result in a deep pipe which will require break through overlying rock to get to for operations and maintenance purposes.

3.2.5 MCA Results

The MCA scoring and results are provided in Table 3-3 below. These scores have been based on the scoring assigned during the Alignment Options Meeting on 26/07/2016, and have been refined to fit with the selection criteria scoring provided in Table 3-2.

Table 3-3 : MCA results

Option	Capital Cost	Natural Environment	Construction Risk	Operational Risk	Weighted Score
Weight (%)	40%	20%	15%	25%	
A (Base Case)	0	0	0	0	0
B	1.5	1	0	0	0.8
C	2	1.5	-1	-3	0.2
D	1	3	-2	-2.5	0.075

The analysis is marginally in favour of adoption Option B – open trenched, along both sides of the proposed road, reducing construction footprint in highly sensitive areas in the southern section (approximately 10m construction corridor on each side).

4. Recommendation

On the basis of the MCA results, **Option B** – Open trenched, along both sides of the proposed road, reducing construction footprint in highly sensitive areas in the southern section (approximately 10m construction corridor on each side) is the recommended option for the proposed NDW and DW main alignment.

It is recommended that if particular areas of high sensitivity are identified in flora and fauna site investigations in the detailed design stage, the construction footprint is modified locally to minimise the impacted area and cost of offsets. In areas of no or low sensitivity the available construction area may be increased locally to balance constructability requirements.

28 July 2016



Appendix 1

Cost Estimate

Preliminary Cost Estimate - Capital Cost



Base Case

Open Trenched Both sides of Road - 40 m construction corridor

	Length (m)	Cost/m	Cost	Construction width (m)	Offsets required	Averaged offset cost per ha
DN375 DW - Open Trench (southern section)	1648	\$ 746	\$ 1,229,408	20	\$ 774,000	\$ 234,830
DN300 DW - Open Trench (northern section)	1926	\$ 627	\$ 1,207,602	20	\$ -	\$ -
DN375 NDW - Open Trench (southern section)	1648	\$ 746	\$ 1,229,408	20	\$ 774,000	\$ 234,830
DN300 NDW - Open Trench (northern section)	1490	\$ 627	\$ 934,230	20	\$ -	\$ -
DN225 NDW - Open Trench (northern section)	436	\$ 527	\$ 229,772	20	\$ -	\$ -
Bored / HDD	0		\$ -	0	\$ -	\$ -
HDD launch/retrieval pits	0	included in above		10	\$ -	\$ 234,830
Total			\$ 4,830,420		\$ 1,548,000	
Total including Offsets			\$ 6,378,420			

Source: Tender costs for Donnybrook Road Water Main M692 DW Main

Source: Tender costs for Donnybrook Road Water Main -R001 (Recycled) - 4km

Source: Tender costs for Donnybrook Road Water Main M692 DW Main

Source: Tender costs for Donnybrook Road Water Main -R001 (Recycled) - 4km

Preliminary Cost Estimate - Capital Cost



Option B

Open Trenched Both sides of Road - 10 m construction corridor for sensitive area

	Length (m)	Cost/m	Cost	Construction width (m)	Offsets required	Averaged offset cost per ha
DN375 DW - Open Trench (southern section)	1648	\$ 746	\$ 1,229,408	10	\$ 387,000	\$ 234,830
DN300 DW - Open Trench (northern section)	1926	\$ 627	\$ 1,207,602	20	\$ -	\$ -
DN375 NDW - Open Trench (southern section)	1648	\$ 746	\$ 1,229,408	10	\$ 387,000	\$ 234,830
DN300 NDW - Open Trench (northern section)	1490	\$ 627	\$ 934,230	20	\$ -	\$ -
DN225 NDW - Open Trench (northern section)	436	\$ 527	\$ 229,772	20	\$ -	\$ -
Bored / HDD	0		\$ -	0	\$ -	\$ -
HDD launch/retrieval pits	0	included in above		10	\$ -	\$ 234,830
Total			\$ 4,830,420		\$ 774,000	
Total including Offsets	\$ 5,604,420					

Preliminary Cost Estimate - Capital Cost



Option C

Open Trenched Single side of Road - 15 m construction corridor for sensitive area

	Length (m)	Cost/m	Cost	Construction width (m)	Offsets required	Averaged offset cost per ha
DN375 DW - Open Trench (southern section)	1648	\$ 746	\$ 1,229,408	7.5	\$ 290,250	\$ 234,830
DN300 DW - Open Trench (northern section)	1926	\$ 627	\$ 1,207,602	20	\$ -	\$ -
DN375 NDW - Open Trench (southern section)	1648	\$ 746	\$ 1,229,408	7.5	\$ 290,250	\$ 234,830
DN300 NDW - Open Trench (northern section)	1490	\$ 627	\$ 934,230	20	\$ -	\$ -
DN225 NDW - Open Trench (northern section)	436	\$ 527	\$ 229,772	20	\$ -	\$ -
Bored / HDD	0		\$ -	0	\$ -	\$ -
HDD launch/retrieval pits	0	included in above		10	\$ -	\$ 234,830
Total			\$ 4,830,420		\$ 580,500	
Total including Offsets	\$ 5,410,920					

Source: Tender costs for Donnybrook Road Water Main M692 DW Main

Source: Tender costs for Donnybrook Road Water Main -R001 (Recycled) - 4km

Source: Tender costs for Donnybrook Road Water Main M692 DW Main

Source: Tender costs for Donnybrook Road Water Main -R001 (Recycled) - 4km

Preliminary Cost Estimate - Capital Cost



Option D

Bored through sensitive areas - Both sides of Road

	Length (m)	Cost/m	Cost	Construction width (m)	Offsets required	Averaged offset cost per ha
DN375 DW - Open Trench (southern section)	648	\$ 746	\$ 483,408	7.5	\$ -	\$ -
DN300 DW - Open Trench (northern section)	1926	\$ 627	\$ 1,207,602	20	\$ -	\$ -
DN375 NDW - Open Trench (southern section)	648	\$ 746	\$ 483,408	7.5	\$ -	\$ -
DN300 NDW - Open Trench (northern section)	1490	\$ 627	\$ 934,230	20	\$ -	\$ -
DN225 NDW - Open Trench (northern section)	436	\$ 527	\$ 229,772	20	\$ -	\$ -
DN375 DW - Bored (southern section)	1000	\$ 1,171	\$ 1,171,000	0	\$ -	\$ -
DN375 NDW - Bored (southern section)	1000	\$ 1,171	\$ 1,171,000	0	\$ -	\$ -
HDD launch/retrieval pits	240	included in above		20	\$ 112,718	\$ 234,830
Access track along alignment	1000	included in above		5	\$ 117,415	\$ 234,830
Total			\$ 5,680,420		\$ 230,133	
Total including Offsets			\$ 5,910,553			

20 m x 20 m area for pits and access x 6 for DW and x 6 for NDW
5 m construction corridor for trucks to travel along alignment to bored sections

28 July 2016



Appendix 2

Alignment Options Meeting Minutes

Purpose of Meeting	NDW and DW main alignment		
Project	Aitken Boulevard DW & NDW Main Detailed Design	Project No	IS0803HJ
Prepared By	S Barnes	Phone No	03 9872 1503
Place of Meeting	M16	Date/Time	11.00am, 26-07-2016
Present	Rebecca King (YVW, Project Manager, Asset Creation) George Lagwa (YVW, Asset Optimisation) David White (YVW, Asset Optimisation) Steve Hart (YVW, Water Growth Planning) Andrew Radion (YVW, Water Growth Planning) Sam Barnes (Jacobs, Design Manager) Neil Gerhard (Jacobs, Technical Lead) Amanda Gunawardena (Jacobs, Design Engineer)		

Apologies

Distribution *All participants*

Item	Action
<p>1 <u>Introduction</u></p> <p>SB identified the purpose of the meeting as to decide on the alignment philosophy for the Aitken Blvd north mains</p>	
<p>2 <u>Alignment Constraints and considerations</u></p> <ul style="list-style-type: none"> ■ Flora and Fauna : Northern section of alignment – No significant environmental constraints identified to date. Southern section of alignment – Significant environmental constraints identified due to native grasslands and species present (Matted Flax Lily, Plump Swamp Wallaby Grass). Requires approval from the relevant authorities includes 3 levels of government, Hume Council (for impacts on native vegetation), state DELWP (for removal of native vegetation, threatened species impacts and threatened communities) and federal DotE (for impacts on EPBC listed threatened species and communities). ■ Geotechnical Investigations: Previous geotechnical investigations for the site gives a good indication of the depth to rock along the entire alignment, but not of the strength of the rock. Jacobs has undertaken geotechnical works to test the strength of the rock– From an initial assessment: fairly hard basalt. Results are still to be finalised. ■ Cultural Heritage : No further CH assessments are required for the alignment, as per Functional Design Report. ■ VicRoads / Road layout and alignment 	JACOBS

Item		Action
	<p>Detailed design has not been completed for the southern section of the road alignment. The vertical alignment of the southern section needs to be confirmed with VicRoads. Jacobs to follow up further discussions.</p> <ul style="list-style-type: none"> ■ Current arrangement of existing tie-in points The mains will have to cross over at some point in the alignment due to connection point arrangement in Mt Ridley road and Donnybrook Road ■ Offtakes Offtakes, and valve arrangement yet to be confirmed. Jacobs to conduct further design investigations. ■ Hydraulic results : Pipe Diameters Steve Hart to reconfirm hydraulic results 	<p>JACOBS</p> <p>JACOBS</p> <p>SH</p>
3	<p><u>Alignment Options</u></p> <ul style="list-style-type: none"> ■ Base Case (Functional Design) – open trench, both sides of road, 40 m width construction corridor ■ Option B – Open Trench, both sides of the road, reduced construction footprint in southern section ■ Option C – Open Trench, single side of the road, reduced construction footprint in southern section ■ Option D – Bored in sensitive areas (approx. 1000 m), both sides of the road 	
4	<p><u>Risks</u></p> <ul style="list-style-type: none"> ■ DW and NDW distribution mains on same side of road If this option is selected, perhaps limit this to the southern section of the alignment. <ul style="list-style-type: none"> ■ Insufficient Space in road corridor ■ Other services to go in road corridor ■ Increased risk of future cross connection ■ Risk of affecting other main in case of burst/failure <ul style="list-style-type: none"> ■ Effect of both mains out of service on 95% day This is critical between the built time and 2023 – Approximately 1000 lots in Merrifield affected in case of failure. ■ Trenchless construction <ul style="list-style-type: none"> ■ Variability of depth and high strength and variability of rock ■ Potential of hitting ‘floaters’ ■ Securing Offsets <ul style="list-style-type: none"> ■ Currently no listed plump swamp wallaby grass offsets available in Victoria ■ Considerable time to secure specific offsets <p>Pressure for contractor – for impact –what’s being purchased and what’s impacted – may be a benefit to YVW after survey</p> <p>Expiring and can’t transfer to other projects</p>	
5	<p><u>Costs</u></p> <ul style="list-style-type: none"> ■ See cost estimation sheet for option costs 	

Item		Action
	<p>The costs for Options A, B and C will increase depending on the vertical alignment and the geotechnical conditions of the southern section of the alignment. Jacobs to update costs upon consultation with VicRoads.</p> <p>The trenchless option costs should include costs of shafts – 20 x 20 m approximate – disturbances (launch and retrieval pits) and 5 m corridor to drive along also needs to be included. Jacobs to revise costs</p> <p>Reduction of construction corridor width to 10m should be revisited to confirm there's adequate space when you consider valves and offtakes. Jacobs to revise costs</p>	<p>JACOBS</p> <p>JACOBS</p> <p>JACOBS</p>
<p>6</p>	<p><u>Outcome</u></p> <ul style="list-style-type: none"> <p>■ Decision on alignment philosophy</p> <p>Preliminary comparison of the options against Cost, Construction Risk, Operational Risk and Natural Environment (when considering equal weighting) is in favour of Option B. Jacobs to change the weightings as per below, conduct assessment and send out results to the project team.</p> <p>40% -Cost</p> <p>15% - Construction Risk</p> <p>25% - Operational Risk</p> <p>20% - Natural Environment</p> <p>■ Reduced construction footprint – Road pavement (Risk) –DW (Operations)</p> <p>Identify areas with high environmental significance so that the construction footprint in these areas can be minimised.</p> 	<p>JACOBS</p> <p>JACOBS</p>