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APA VTS 2023-2027 access arrangement proposal

March 18, 2022

Western Outer Ring Main (WORM) Project – Business Case Update 2022

Contents

1. Introduction

APA VTS Australia (Operations) Pty Limited has prepared a 2022 update of the Western Outer Ring Main (WORM) Project Business Case as part of the proposal for the 2023-27 Victorian Transmission System[1] (VTS) access arrangement proposal.

Following the submission of the APA VTS access arrangement proposal in December 2021, the AER and stakeholders queried the prudency and efficiency of the WORM in light of increased uncertainty in demand and supply conditions.

APA VTS has prepared this revised business case to demonstrate that investment in the WORM is prudent and efficient and is in the long term interests of Victorian gas consumers.

2. Project overview

Table 1	Project approvals
Prepared by	Sheila Krishnan, Manager Asset Capacity Planning, APA Group Tom Carroll, Program Manager South East, APA Group
Reviewed by	Scott Young, Manager Regulatory, Nives Matosin, Manager Regulatory
Approved by	Mark Fothergill, General Manager Infrastructure Engineering, APA Group

Table 2	Project overview
Description of Issue/Project	This revised business case for the Western Outer Ring Main (WORM) is in response to AER and stakeholder requests for a review of the WORM's prudency and efficiency considering unplanned project delays, increased costs to complete the project and increased uncertainty in demand forecasts due to changes in government policy objectives; and supply forecasts given declines in Victorian gas production. In 2017, the AER approved the WORM project for the 2018-22 VTS access arrangement to meet security of supply objectives. The project consists of a 50 km x 500 mm diameter pipeline interconnection between Plumpton and Wollert and a compressor station and regulating station at Wollert to enable gas to be transferred east-west across Melbourne (the WORM is a bi-directional pipeline). Due to the low-pressure inner ring mains around Melbourne, there is a limitation on how much gas the South West Pipeline can bring from Port Campbell or to Port Campbell though Melbourne. The objective was to increase the capacity of the South West Pipeline for underground gas storage (UGS) refilling from 147 TJ/d to 220 TJ/d. The increase in capacity will ensure sufficient storage availability for the supply reliability of the VTS during winter peak. The WORM is the missing link in the VTS configuration and will provide many benefits for gas consumers in Victoria. The WORM will provide an alternative route for gas from Port Campbell to flow into the Northern and Gippsland regions, higher refilling rate for Iona Underground Storage (UGS), better linepack management (particularly for increase in peak GPG operation) and increased security of supply in the event of Longford or Port Campbell outages. In 2017, the cost of the WORM was estimated to be $127 million ($2017), and the project was planned to be completed by Q1 2021. Since then, there has been a two-year delay to the project to meet Victorian Government planning requirements to conduct an Environment Effects Statement (EES). Unfortunately, the delay has contributed to increases in the cost of the project that were beyond APA VTS control.

[1] That is, APA GasNet System as defined under the Service Envelope Agreement (SEA) with AEMO.

	Further, there has been increased uncertainty about supply/demand forecast on the VTS. There is a risk of shortfalls in gas supplies with Longford decline by winter 2023 requiring more gas to be sourced from Iona and/or potential Liquified Natural Gas (LNG) terminal injections in the Geelong area and potential decline in gas demand due to electrification. The WORM project is currently in-flight and following the acceptance of the EES, work on the project has ramped up so as to meet the winter 2023 demand. The forecast cost to complete the WORM submitted as part of the 2023-27 access arrangement proposal was $185 million (excluding overheads) and was based on the best information available at the time. We note however, that there may be further changes to address concerns on the EES and depending on the tenders received for construction. APA VTS maintains that the WORM is integral to the security of supply on the VTS and that the additional capital expenditure is necessary to complete the works is prudent and efficient. The WORM will enhance the resilience and reliability of gas supply for Victorian consumers. This is especially important during the current period where there is uncertainty about gas supply options. The WORM will enable underground storage to play a more significant role enhancing reliability, security of supply and resilience on the VTS during this uncertain period
Options Considered	The following options have been considered: • Option 1: Complete WORM project • Option 2: Cancel WORM Project - (Do nothing further) • Option 3: Implement demand management and cancel WORM Project.
Proposed Solution	The Preferred Solution is Option 1 - Complete the WORM.
Estimated Cost	As at 1 December 2021, the total cost of the WORM was forecast to be $184.8 million (excluding GST and excluding capitalised overheads). Of this, $136 million will be incurred during 2018-22 period; and $49 million in 2023-27 period. Note that the costs of the WORM may increase further as a result of the Victorian Planning Minister's assessment of the Environment Effects Statement for the WORM; and outcomes from market tenders for construction of the WORM.
Consistency with the National Gas Rules (NGR)	The WORM project meets the criteria of Rule 79(2c) i and ii, and iv. The primary driver of the WORM project is to maintain capacity to meet levels of demand for services (r. 79(2)(c)(iv). This will enhance security of supply for Victorian gas consumers particularly since the declines in Longford gas production forecast by AEMO are expected to contribute to gas shortages starting in winter 2023. The capital expenditure is also necessary to maintain the safety (Public safety and APA personnel) and integrity of services on the VTS. Consistent with the requirements of Rule 79 of the National Gas Rules, APA VTS considers that the capital expenditure is such as would be incurred by a prudent service provider acting efficiently, in accordance with accepted good industry practice, to achieve the lowest sustainable cost of providing services (Rule 79(1)(a)).
Stakeholder Engagement	APA VTS has had regular engagement with stakeholders related to this project since it was first proposed. The stakeholders directly affected by this project are: • Australian Energy Market Operator • Lochard Underground Storage and Shippers.

	During preparation of the 2023-27 proposal, APA VTS engaged with the VTS stakeholder engagement group on the progress of the WORM, the EES and the increase in costs. Stakeholders raised concerns about the delays in the project and whether it would be built in time for winter 2023. Other concerns included whether the WORM would be needed in the longer term.
Benefits to customers and consumers	APA VTS maintains that the WORM is needed to maintain security of supply during the forecast tight gas demand-supply balance in Victoria forecast by AEMO. The need for the WORM remains the same as the case in 2017 but now with a greater level of urgency following the unanticipated two-year delay to meet Victorian planning requirements. The increased urgency is to build the WORM in time to meet forecast winter peak shortfalls in 2023 and onwards. Victorians are Australia's biggest users of natural gas for heating, hot water, and cooking. The WORM will ensure that consumers will have a reliable and safe supply of gas to meet their needs, particularly during winter. On average, the WORM will cost residential customers about $2.70 a year and will enable the VTS to continue to provide a reliable source of gas to meet heating, hot water, and cooking needs. As such an important source of gas this will contribute to the health and well-being of Victorians. For businesses, on average the WORM will cost $25 per year and will enable the VTS to continue to provide a reliable source and prevent disruptions to business activities. The WORM will enable AEMO to operate the VTS in a more flexible way by providing increased linepack to support demand and increased capacity into Melbourne's west and norther regions. As demonstrated below, the VTS would only need to fail to meet demand of between 2.4 and 8.0TJ/day in order for the cost of the WORM to be greater than the Value of Customer Reliability. (This compares to a VTS peak day in the order of 1,200 TJ/day) The benefits of the WORM to Victorian consumers and businesses far outweigh the financial cost of the WORM.

3. Background

3.1. Gas consumption in Victoria

Natural gas has been an important energy source in Victoria since the 1970s. Victoria has the highest national level of gas reticulation and Victorians are Australia's biggest users of natural gas for heating, hot water and cooking. Two million of Victoria's residential customers; 64,600 commercial businesses; and over 600 large industrial manufacturers consume gas. Victorians rely on gas to heat their homes and businesses during Victoria's cold winters and to power electricity generation. Natural gas is a key input for Victorian manufacturing.[2]

Gas consumed in Victoria (about 200PJ/ annum) is transported on the Victorian Transmission System to gas distribution systems and finally to connected customers. Gas consumption on the VTS peaks in the winter months due to the importance of gas to heat homes and businesses in Victoria.

The WORM is needed to maintain APA VTS's capacity to meet levels of demand during periods of peak demand along with providing other benefits for system security, resilience and flexibility for the benefits of gas consumers in Victoria.

3.2. The Victorian Transmission System and project need

The VTS comprises approximately 1,992 km of pipelines which transport gas from various inlet points to load centres throughout Victoria. The Victorian Transmission system has three main branches.

[2] Information sourced from About the gas sector (energy.vic.gov.au)

They are:

- The Longford Melbourne Pipeline (LMP) which lies between Melbourne and South Eastern Victoria
- The Victorian Northern Interconnect (VNI) which lies between Wollert just north of Melbourne and the NSW border, and
- The South West Pipeline (SWP) which lies between Melbourne and South Western Victoria.

The LMP and the VNI are linked by the high-pressure Outer Ring Main. The Outer Ring Main is a 93.1 km long 750mm pipeline with a MAOP of 6890 kPag. This provides the ability to send gas under high pressure between these pipelines.

There is no equivalent link between either the VNI and the SWP or the LMP and the SWP.

Sending gas between these non-linked pipelines involves using the lower pressure Melbourne network, and this limits the amount of gas that can be moved across the VTS. The Longford-Melbourne pipeline operates at 6.890 MPa; VNI operates at 10.2 MPa; the SWP operates at 9.7 MPa. The Melbourne zone only operates at 2.760 MPa because of safety reasons through Melbourne CBD High Consequence Area.

As stated by AEMO in the 2017 VGPR (p56):

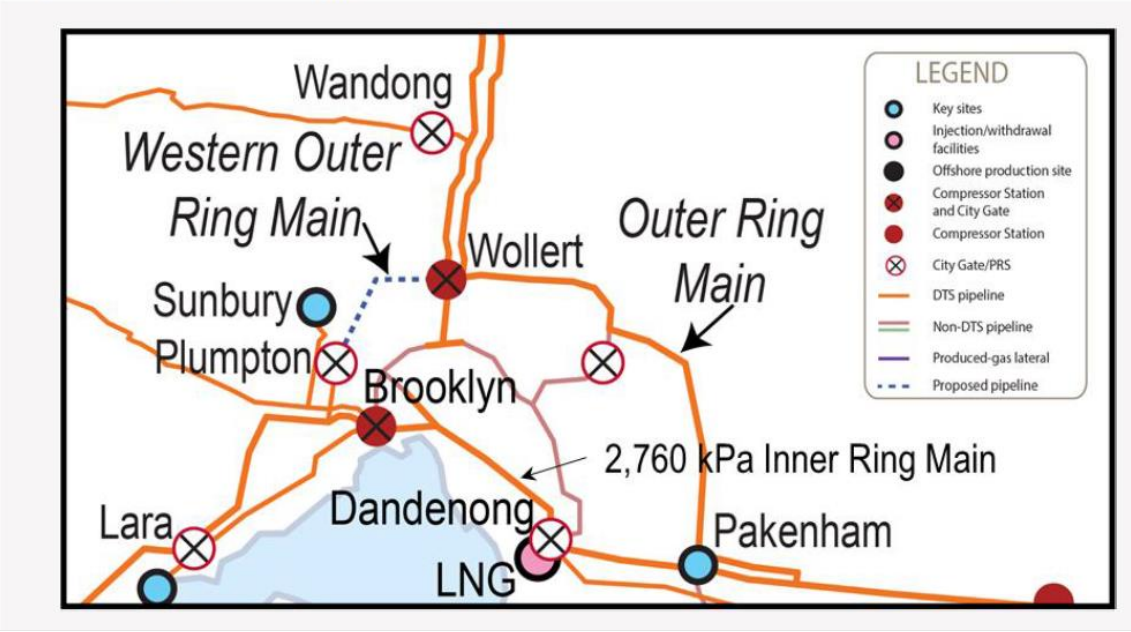
> *The current method of transporting gas from Longford to Port Campbell is very inefficient. Gas flows along the Longford to Melbourne Pipeline to Dandenong CG. During the summer the pipeline pressure is approximately 5,500 kPa. At Dandenong CG, the pressure has to be reduced to 2,760 kPa to flow through the low pressure transmission network from Dandenong to Brooklyn. At Brooklyn, the gas is recompressed to approximately 6,500 kPa (which is limited by the capacity of the Brooklyn compressors) to flow along the BCP, BLP, and SWP towards Port Campbell.*
>
> *With the WORM, gas would flow from Longford to Wollert via the existing (Eastern) Outer Ring Main. At Wollert, the pressure during summer would be approximately 5,500 kPa (similar to that at Dandenong CG). A compressor at Wollert would boost the gas pressure up to 10,200 kPa to flow around the 500 mm diameter WORM. The WORM would connect into the BLP, which would enable gas to flow to Port Campbell via the SWP.*
>
> *During the 2015–16 financial year, the Brooklyn compressors consumed approximately 331 TJ of fuel gas. Brooklyn CS had the DTS's highest contribution to AEMO's reporting under the National Greenhouse and Energy Reporting Scheme (NGERS). Assuming a wholesale gas price of $8.50/GJ, 311 TJ of fuel gas translates to a cost of approximately $2.8 million per year for market participants. As the quantity of gas transported from Longford to Port Campbell increases, and if gas prices continue to increase, this fuel gas cost will also continue to increase.*
>
> *With the installation of the WORM, half the fuel gas will be required, compared to the current quantity used for transportation via Brooklyn CS.*

The WORM is the "missing link" as it completes the higher-pressure ring around the low-pressure Melbourne system. When complete, the WORM will enable larger volumes of gas to be transported across the VTS and removes the bottleneck moving gas through low pressure Melbourne. (As shown in Figure 1 below).

Gas produced from the Bass Strait fields and processed at the Longford gas processing plant has been the dominant gas supply to the demands of the VTS. Smaller sources of gas supply are produced from other basins in the Port Campbell area and from NSW through Culcairn. The Iona underground gas storage facility (UGS) is used as peak shaving purposes during the winter.

Figure 1 Location of WORM

Figure 23 Proposed WORM pipeline



However, with the forecast declines in Longford supplies[3] there will be more reliance on the other sources of gas to meet winter peak demands. Currently the most viable source of gas to meet winter peaks is the Iona Underground Storage (UGS) facility. Iona UGS will need to be full prior to winter to manage peak demands.

There is an urgent need to address this problem considering AEMO is forecasting shortfalls in winter peaks. Noting that AEMO is expecting PKGT to come into play, APA VTS is concerned that the proposed PKGT has not yet reached Final Investment Decision (FID). This creates further uncertainty about gas supply sources into Victoria.

The WORM will increase both the capacity for Iona to withdraw from and inject into the SWP, hence increasing the supply reliability to the VTS.

3.3. Role of natural gas storage facilities

Underground storage plays a key role enhancing the flexibility and resilience of the VTS. Victoria has two major natural gas storage facilities, Iona UGS (owned by Lochard Energy) and Dandenong LNG Storage Facility (owned by APA). Of these two, the more significant in terms of capacity is the Iona UGS with a total storage capacity of 23.5 PJ compared to 0.7PJ for Dandenong LNG.

[3] AEMO 2021 Victorian Gas Planning Report, March 2021

The principal market roles of gas storage are:

- meeting peak seasonal demand that is above the aggregate capacity of gas production (peak supply), and
- meeting sudden increases in demand due to extreme weather events, unplanned generations outages and unplanned supply outages that other sources of supply do not have the flexibility or proximity to meet (flexibility supply). This flexibility is key to operating the system in response to short term changes in demand. AEMO, in its 2021 GSOO and VGPR, has been clear that Longford has historically been able to provide this flexibility but declines in Longford production capability have resulted in a reduction in system resilience.[4]

Lochard Energy has informed APA of their expansion plans[5] to increase reservoir injection capacity as well as storage capacity. With the development of new fields, storage capacity could increase up to 24-25.5 PJ by Q1 2023 and 30 PJ by Q1 2025.

Currently, the Iona nameplate capacity for injections into the reservoir is 155 TJ/d (and can achieve 260 TJ/d under favourable conditions) and is expected to increase to a peak rate of 340 TJ/d with addition of new storage fields. However, the SWP capacity current limits Iona withdrawals from the VTS (I.e., injections to storage) to 140 TJ/d.[6]

The WORM is expected to increase the Iona withdrawal capacity (that is, increase injections into the reservoir) from the SWP from its current 140 TJ/d to 280 TJ/d (summer period).

In addition, Lochard is increasing their injection capacity from the reservoir from its current nameplate capacity of 530TJ/day to 570TJ/day by 1 January 2023 (committed) and potentially up to 640 TJ/d with further expansions (FID not achieved yet). APA is proposing to expand the capacity of the SWP pipeline to 570TJ/day capacity to meet the expanded nameplate capacity. APA VTS has submitted a separate business case as part of the 2023-2027 access arrangement proposal supporting the proposal to expand the SWP capacity to 570 TJ/d.[7]

The WORM and the proposed expansion of the SWP (SWP570) together increase flexibility and resilience of the VTS, thus improving overall security of supply for Victorian consumers.

4. History of the Western Outer Ring Main project

4.1. 2008-12 Access Arrangement

The WORM project was initially proposed over 13 years ago by APA VTS. The project at that stage was known as the Brooklyn to Wollert Loop project which had a slightly increased scope to the current WORM project as it is known today.

In this access arrangement, APA VTS submitted a proposal to acquire the easement in anticipation of the future needs to construct the WORM. The main driver of the proposal was to secure easements for the WORM because the growing urbanization along the route was increasing land prices.

[4] AEMO, Gas Statement of Opportunities, p.3 states that "The last major southern gas field offering flexible supply is expected to be depleted ahead of winter 2023, reducing gas system resilience."
[5] Lochard Energy's communications to APA 3rd August 2021.
[6] AEMO, 2021 VGPR, p.69, Section 6.2.2, South West Pipeline to Port Campbell.
[7] Refer to APA business case "South West Expansion - Iona 570 TJ/d Injections" submitted to the AER 1 Dec 2021.

4.2. 2013-17 Access Arrangement

APA VTS submitted a proposal for the full WORM project including option analysis in the 2013-17 Access Arrangement proposal. This time, the main driver was the security of supply of the VTS and the many other benefits of the WORM.

The AER did not approve the project though stated in their Final Decision that the completion of the outer ring main around Melbourne "to have merit from a technical perspective and in the future, prove to be a prudent response to the augmentation needs of the VTS in the longer term".

4.3. 2018-22 Access Arrangement

In January 2017, APA VTS submitted a proposal for acquisition of easements for the WORM as part of the 2018-22 Access Arrangement proposal. The easement acquisition was proposed taking into account the problem that access and securing easements was becoming increasingly difficult and more expensive over time with urban growth along the route.

In March 2017, AEMO released the Gas Statement of Opportunity (GSOO) document which identified a tightening of gas supply demand balance in Victoria, South Australia and NSW, leading to an increasing risk of supply shortfalls in the gas and electricity markets. AEMO's 2017 Victorian Gas Planning Report stated that inadequate refilling the Port Campbell (Iona) UGS system outside winter due to capacity limitations on the South West Pipeline would increase the risk of shortfall in meeting gas supply in the VTS by winter 2018[8].

In light of the new information in the 2017 GSOO, 2017 VGPR and public submissions (from AEMO and UGS facility owner Lochard Energy, who was proposing to increase UGS storage and withdrawal/injection capacities) calling for more capacity to refill UGS and also to increase capacity towards Melbourne, APA VTS submitted a proposal for the full WORM to be built within the 2018-2022 Access Arrangement period. This proposal was approved by the AER in November 2017 at a forecast cost of $127 million ($2017) and APA VTS proceeded to commence the construction of the WORM.

APA VTS also submitted a proposal for the reconfiguration of Brooklyn Unit 11 and 12 compressors to compress directly into the Brooklyn to Lara pipeline and bi-directional works on Winchelsea compressor station to increase the capacity of the SWP to refill UGS from 104 TJ/d to 147 TJ/d[9]. These works were necessary to manage the capacity shortfall in the refilling of UGS until the WORM is completed. AER approved the capex for $3.5m and APA completed the works in early 2018.

4.4. Delivery of WORM project

In September 2018 the APA Board approved capital expenditure of $167 million (including $23.4 million allowance for unknown costs) for the construction of the WORM with a target operation date of July 2021. APA Board approval was based on AEMO's analysis (discussed above) indicating that the VTS will come under significant system stress from late 2021 without the WORM. The contingency allowance approved by APA's Board was to cover unknown costs as a result of not being able to lock down a final alignment and a detailed construction budget.

The WORM is being delivered under APA's Infrastructure Development Project Governance Structure which requires monthly reporting to a steering committee headed by APA's Group Executive Infrastructure Development (ID). In addition APA's Group Executive Infrastructure Development

[8] Since then, the forecast has been updated in the 2021 VGPR (we are awaiting confirmation in 2022 VGPR to be released end March 2022) that the shortfall due to Longford would be as soon as winter 2023.
[9] Since then, the capacity of the SWP has dropped to 140 TJ/d due to increased demand in the Melbourne region. Refer VGPR 2021, pg. 69, Section 6.2.2, South West Pipeline to Port Campbell.

updates the Managing Director and Board on the delivery of all APA's capital projects which includes the WORM.

APA has a strong governance structure for projects including the WORM. The WORM's governance structure can be summarised as follows:

1. Project/Program Managers control expenditure up to the APA Board Approval less contingency allowance. All capital expenditure must be made in compliance with ID's Procurement Procedure that requires three competitive quotes for items over $100K and formal quote/tender over $200K.

2. Project/Program Managers must request access to spend any amount from the contingency allowance from the Steering Committee

3. Approval from APA's Board is required for any expenditure above the APA Board approval

4. Actual costs spent (including accruals) to the end of each financial period are reported to the Steering Committee monthly together with a forecast cost at completion. Forecasts are typically updated when:

    a. Changes to scope are approved
    b. Procurement pricing is received, or
    c. Project delays are identified

5. Any changes to the projects forecast cost at completion, from the previous month, which are greater than $50k are reported and discussed at the monthly steering committee

6. Project delivery risks and issues are reviewed and reported monthly.

The governance structure provides strong oversight of the WORM project and particularly focuses on minimising project costs.

APA VTS plans to go back to Board in May 2022 to request addition funds to cover further cost increases that may result from market-based quotes for construction and addressing requirements in the EES assessment. At this stage, APA VTS does not have an indication of this figure.

4.5. Environment Effects Statement

On 22 December 2019, the Minister for Planning required APA VTS (Operations) Pty Ltd to prepare an Environment Effects Statement (EES) under the Environment Effects Act 1978 to assess the potential environmental effects of the project. The need to prepare an EES for the WORM had not been anticipated, as APA VTS had never been required to prepare an EES in Victoria.

The EES for the proposed for the WORM project, and the pipeline licence application, were released for public comment on 17 August 2021.

On 26 January 2022, the Minister for Planning completed the assessment under the Environment Effects Act 1978. The Minister's assessment concluded that the project can proceed with acceptable environmental effects, subject to the implementation of project modifications recommended in the assessment and environmental management measures consistent with those endorsed by the inquiry and refined as per the findings and recommendations of the assessment.

APA is currently assessing the recommended modifications and potential impacts on costs. APA VTS will provide an update of the costs as soon as possible.

4.6. 2023 -27 Access Arrangement proposal

In the initial proposal for the 2023-27 access arrangement, APA VTS proposed to continue investing in the WORM and explained that the total cost of the project had increased to $184.8 million. Part of the explanation for this is that in December 2019, the Victorian Minister for Planning determined that an EES was required for the WORM. The EES process resulted in an unanticipated two-year delay in the construction of the WORM.

The key cost variances from the original forecast in 2017 are discussed in section 6 of this business case.

In January 2022, following submission of the proposal, the AER queried the prudency and efficiency of the WORM and requested APA to produce a business case for WORM with the following considerations:

- Additional costs incurred on the WORM project and its delay
- Review of the updates in VTS demand/supply forecasts
  - Longford supply decline with predicted shortfall in winter 2023
  - Possible reduced gas demand in the VTS in the event of substitution with electrification and hydrogen, based on Victorian Gas Substitution Road Map
- Impact on the SWP expansion
- Impact on potential new LNG Import Terminals in the Geelong area.

This business case reviews the cost-benefit of the WORM project and whether there are other more prudent alternatives than the completion of the WORM.

5. Risk assessment

APA VTS risk assessment for the WORM project is discussed below.

5.1. Reliability

The reliability of gas supply refers to the continuity of supply to customers. An unplanned loss of supply (or interruption) to a customer in any circumstance is regarded by the ESV as a potentially dangerous and undesirable event.

> *"Unless gas supply to a customer is safely isolated and reinstated after an interruption, there is always the possibility of gas escapes at those few appliances which have had their supply interrupted and which do not have flame failure devices fitted"*[10]

According to Energy Safe Victoria this is a circumstance which presents a risk to public safety and must be avoided.

[10] ESV – Natural Gas Safety Report (Produced by the Office of Gas Safety the predecessor to ESV.)

Rule 79(2)(c) of the National Gas Rules lists the following justifiable methods for Capital Expenditure[11]:

i. to maintain and improve the safety of services; or
ii. to maintain the integrity of services; or
iii. to comply with a regulatory obligation or requirement; or
iv. to maintain the service provider's capacity to meet levels of demand for services existing at the time the capital expenditure is incurred.

The WORM project meets the criteria of Rule 79(2)(c)(i), (ii) and (iv), that is, the capital expenditure is necessary to maintain the safety and integrity of services associated with demand that exists at the time the capital expenditure is incurred.

5.2. Route and construction

There are a number of routes considered to complete the WORM project. The route presented in this business case represented the most likely route for the WORM. Which is the most cost effective and accessible route, taking into account urban encroachment and environmental considerations (Further information about the route is presented in Appendix A and B).

In terms of construction, the proposed project is of routine nature to APA. The risk is mainly related to factors that are outside APA control, particularly in built-up environment where placement of pipeline underground may be constrained by other utilities and controlling parties. The requirement by the Victorian Government to undertake an Environmental Effects Statement (as discussed above) delayed the project by over two years.

5.3. Construction costs

Proposed project is of routine nature to APA. The risk is mainly related to factors that are outside APA VTS control, particularly in urban environment where placement of pipeline underground may be constrained by other utilities and controlling parties. Additional trenchless crossings (typically by horizontal directional drilling) have been recommended under the EES and are yet to be finalised. If required these will contribute to the cost increase.

5.4. Technical

All construction work would be completed by technically proven contractors, to APA's engineering design and specifications. All construction processes will be overseen by APA.

5.5. Operation

The new mains and associated facilities will be operated in accordance with APA's standard management practices for assets of this type. APA has a suitably qualified and experienced workforce in Victoria to perform this type of operation.

5.6. Regulatory

This investment should be regarded as complying with Rule 79(2) (c) (i), (ii) and (iv), and therefore is conforming capital expenditure.

[11] NGR 79 New capital expenditure criteria.

6. Updated WORM costs and schedule

In the 2018-22 Access Arrangement, the AER approved the WORM for $127 million to be completed by 2020.

However, the EES has contributed to the project delay and cost increases. The cost increases were due to factors beyond APA VTS control. Key reasons for cost increases are:

- The requirement for an EES by the Victorian Environment, Land, Water and Planning (DELWP). This was not required at the time of the WORM submission, hence not factored into project plan. The EES was completed on 26 January 2022 but had delayed the project by over 2 years, with the WORM now planned to be completed by Q2 2023 (originally planned for completion by Q1 2021).
- The EES assessment was contingent on APA assessing additional horizontal direction drilling in certain sections of the route instead of direct lay which, if adopted, would increase the cost of the project.
- Additional Net Gain Offset costs. Following field ecological surveys in late 2019 it became evident that the project would require the removal of more native vegetation than originally considered. Both state and federal vegetation offset requirements have contributed to the increase in costs.
- Additional land acquisition cost:
    - Land within the Urban Growth Boundary and subject to the Department of Transport's Public Acquisition Overlay (PAO) was assumed to be similar value to Rural Zoning prices. However, APA became aware that only a small number of landowners had been compensated by DoT for the PAO when APA was valuing the land and therefore they were seeking higher compensation.
    - Due to delays with the EES, landowners have been reluctant to agree to an option for easement. This has resulted in higher easement compensation due to the increase in land value over time.
- The preparation of a Cultural Heritage Management Plan and corresponding pre-activity works were based on APA's previous experience with the Wurundjeri people and working through their land. However, it became apparent during the field surveys that more complex cultural heritage surveys were required and, in addition, the amount of salvage works prior to construction was higher than expected.
- Higher material costs – Material pricing (namely coated line pipe, pipe and fittings and valves) in general has risen since the project was approved which was not factored into the original budget. Coated line pipe was the key contributor to cost increases due to:
    - Chinese Government removing its export tax rebate
    - Increased amount of abrasive resistant coating required for the increased number of HDDs
    - Increased cost in sea freight due to Covid.
- Construction Cost Increases. Following in depth studies of the pipeline alignment through the EES process it has become apparent that there are additional construction requirements that have increased the scope and price of construction, including:
    - Longer and more Horizontal Directional Drilling required
    - More rock than expected
    - Deeper depth of burial and more concrete slabbing where the pipeline interfaces with Department of Transport's Public Acquisition Overlays
    - Increased number of sensitive receptors near the construction works as a result of urban development which now have more stringent controls.

- The risk of more Covid restrictions during construction will be included in the construction pricing received from tenderers. Outcomes from the competitive market tender process for construction are likely to be higher than originally forecast and may result in an increase in the cost of the project.

Project completion is now scheduled to be Q2 2023 (May) ahead of the Victorian winter.

7. Identification and analysis of options

APA VTS has received feedback from AER and stakeholders about whether it would be possible to undertake demand management as an alternative to continue to invest in the WORM. The revised business case includes demand management option analysis.

The revised business case considers the following options:

- **Option 1.** Completion of the WORM
- **Option 2.** Cancel the WORM project (do nothing further)
- **Option 3**. Cancel the WORM project – implement demand management.

The cost and benefits of the options are assessed below.

7.1. Option 1: Full WORM Project - complete project as planned

Option 1 involves completing the WORM as planned. In addition, APA VTS is assessing the decision by the Minister for Planning that the project can proceed subject to the implementation of project modifications recommended in the assessment and certain environmental management measures.

Any additional costs resulting from the EES decision are currently being assessed.

The WORM project consists of the following stages:

Stage 1: 8.3 km x 500 mm Rockbank to Plumpton – Completed 2012	This project was completed in 2012 and the main purpose of the timing of this project was to remove an immediate capacity constraint on the Sunbury lateral. The pipeline was sized to 500 mm in order to be extended to form the WORM.
Stage 2: 50.1 km x 500 mm Wollert to Plumpton (in-flight)	The pipeline completes the WORM project. Included in this Stage is: • Installation of additional compression (WCS6 – Centaur 50) at Wollert Compressor Station (CS) 'B' allowing compression from Pakenham to Wollert pipeline (existing connection) to the new WORM (new connection). • A new interconnecting Pressure Reduction Station at Wollert connecting the Brooklyn Lara Pipeline (BLP) to the Pakenham-Wollert Pipeline.

The route chosen for the WORM avoids the urban encroachment (refer to Appendix A and B for WORM route).

The total cost of the WORM proposed is forecast to be $185 million. Of this total cost, $136 million will be incurred during 2018-22 period; and $49 million in 2023-27 period.

On average, the WORM will cost residential customers about $2.70 a year[12] and will enable the VTS to continue to provide a reliable source of gas to meet heating, hot water and cooking needs. This will contribute to the health and well-being of Victorians.

For businesses, on average the WORM will cost $25 per year[13] and will enable the VTS to continue to provide a reliable source and prevent disruptions to business activities.

7.1.1. Option 1 benefits

The benefits for customers of the VTS arising from the removal of current constraints through the construction of the WORM are:

Benefits of unlocking capacity to and from Port Campbell

The completed WORM project would be able to move the higher volumes of gas along the South West Pipeline, hence unlocking the supply capacity to and from Port Campbell. The benefits are discussed below.

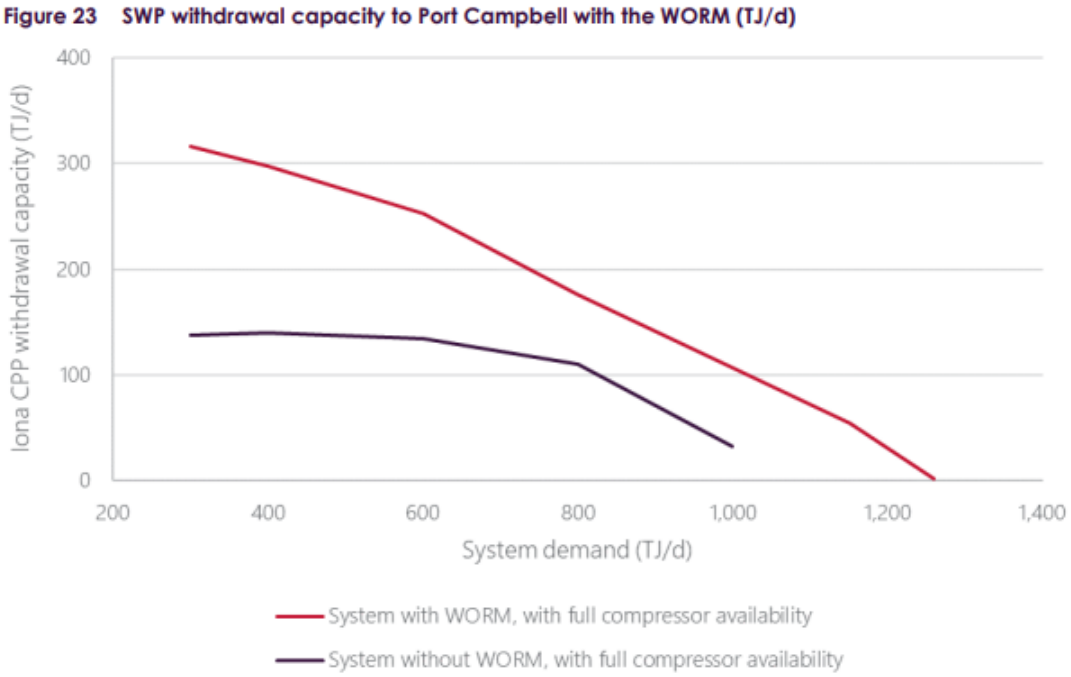
Gas into Iona UGS

With the WORM, the capacity for refilling UGS would be increased from 140 TJ/d to 280 TJ/d (based on a 400 TJ system demand day). The WORM not only substantially increases the ability to refill the Iona Storage facility at a higher rate, it also extends the period for refill into the colder months when system demand is high. This will allow Iona UGS to refill cyclically, especially if it is drawn down by GPG operations, and be replenished in time for the winter peak demands.

The Iona UGS has the capacity to refill Iona at a rate up to 260 TJ/d and a proposal to further increase capacity to 340 TJ/d. The WORM increases the SWP capacity to match the withdrawal capacity of the storage facility, which otherwise would be limited to 140 TJ/d SWP capacity.

[12] This is calculated based on the WORM adding 5 c/GJ to VTS tariffs multiplied by the average residential consumption of 54.4 GJ per year.
[13] This is calculated based on the WORM adding 5 c/GJ to tariffs multiplied by the average business consumption of 500 GJ per year.

Figure 2 WP Westernhaul Capacity with WORM (extract from VGPR 2021)



With the system as currently configured, Iona gas storage is unable to refill as fast as the market has nominated. Lochard Energy has received frequent constraint notices from AEMO and has provided APA a summary of recent constraint notices.

On 15 occasions between 1 October 2021 and 27 January 2022, storage users who had nominated to inject gas into Iona storage were unable to do so because AEMO placed a constraint on net withdrawals from the VTS to Iona due to SWP constraints. Noting that these constraint notices occurred during the summer period when storage refill would usually be expected to be unconstrained. These SWP constraints occurred because the inlet pressure at the Brooklyn compressor station was too low to enable sufficient gas to be sent west for injection into Iona storage, caused by increased GPG load in the (lower pressure) metro section. The WORM will allow gas to flow into the SWP at high pressure (rather than having to traverse the metro section), thus avoiding these constraints.

While AEMO forecasts a reduction in GPG in the near term due to the emergence of new grid-scale variable renewable energy (VRE), peak GPG demand is expected to maintain its critical role in meeting peak electricity demand during periods of low VRE generations or prolonged coal-fired generation outage[14].

The forecast is also subject to a wide range of uncertainty, such as, early closure of coal fired power stations (e.g., Liddell power station, and recent announcement by Origin Energy's Eraring Power Station closure in 2025, 7 years earlier than planned), delays in renewable generator projects and weather patterns, all of which may increase the GPG operations.

Hence the WORM remains important in ensuring sufficient refill of Iona UGS for winter operations and provide linepack to manage GPG peak consumption profiles.

[14] AEMO, 2021 Victorian Gas Planning Report, March 2021, Chapter 2.4.

Gas from Iona UGS to Melbourne

The WORM increases the capacity eastbound toward Melbourne by 23 TJ/d during the winter peak period, that is, from current 445 TJ/d to 468 TJ/d (refer to Figure 3 below, difference between red and orange lines). The increase is even larger outside the winter period, hence increasing Iona's ability to improve security of supply to the VTS.

Figure 3 WP Easternhaul Capacity with WORM (extract from VGPR 2021)

APA submitted a business case as part of the 2023-2027 proposal to increase the capacity of South West Pipeline. Two new compressors at Stonehaven and Pirron on the SWP[15] will increase capacity to from 468 TJ/d to 570 TJ/d. This matches Iona's committed upgrade of Iona injections into the SWP of 570 TJ/d. This capacity assumes the WORM was in operation. Without the WORM, the SWP expansion would only achieve a capacity of 547 TJ/d.

While the increase in SWP capacity is relatively small with the WORM, it will have a bigger impact especially when potential LNG Import Terminals[16] connect to the SWP around Lara. A maximum combined volume of around 770 TJ/d of gas can be supplied from the SWP from Iona and the LNG Import terminal with the WORM in place. Without the WORM, the capacity will reduce by over 100 TJ/d. This because the low-pressure system around Melbourne has insufficient capacity to transport the larger volumes of gas. The WORM provides another path for the gas to be transported into and around Melbourne via Wollert.

[15] APA VTS Business Case "South West Pipeline Expansion – Iona 570 TJ/d injection", submitted to AER 1 December 2021.
[16] Viva Energy and Vopak are proposing to build LNG Import terminals in the Geelong area.

Studies conducted by APA proposed upsizing the WORM and further augmentations if the volumes required to be supplied from the SWP exceed 770 TJ/d to compensate for the declining Longford supply. Hence the WORM remains a very critical investment when the major source of gas is supplied from the SWP.

Completion of the WORM will increase the optionality for potential future sources of gas to be provided by LNG import terminals.

Security of supply benefits

In the event of loss of supply from any of the Market scheduled gas trains at Longford, Port Campbell (UGS, Otway or Minerva) or Pakenham (Lang Lang), The WORM would allow for alternate supplies to be scheduled.

Flow constraints on either South West Pipeline/Brooklyn Lara Pipeline or Eastern systems are removed with the WORM. For example, gas from the UGS or from the north from Culcairn would be able to respond with additional shortfall volumes should a supply issue occur at Longford, and vice-versa.

In October 2016, a 6 hour unplanned outage of the Longford Gas Plant caused AEMO to issue a notice of a threat to system security. If the outage had persisted, curtailments in northern and eastern Victoria would have been required. There was sufficient gas at Port Campbell but due to the current system configuration, that gas could not be transferred from Port Campbell.

The completion of the WORM, will enable gas to be transported to and from Port Campbell, hence reducing the risk to system security during any future Longford plant outages.

Operational benefits

A direct connection between the WORM and the Pakenham to Wollert pipeline would allow gas to flow interchangeably between the east and west systems with fixed operating set points and without direct operator intervention.

The VTS will therefore be able to operate within a tighter band of operation than is currently achieved. AEMO currently manages linepack with stop/start operation at Brooklyn and Wollert Compressor Stations and Brooklyn City Gate. Current practices to move gas out of the South West Pipeline/Brooklyn Lara Pipeline is to change the set points at the Brooklyn, Wollert and Dandenong regulator stations.

Once the WORM project is completed, the operation of major supply Pressure Reduction Stations (PRS) stations at Dandenong, Brooklyn and Wollert would be set at fixed outlet pressure, including Brooklyn and Lara supplying the Geelong pipeline. Wollert becomes a hub managing transfers across the Pakenham-Wollert-Rockbank systems and balances linepack in the VTS.

With the WORM in place, there will be better management of the VTS. Currently, the VTS operates within a tight band of linepack. The WORM creates additional “storage” or buffer, hence having the following benefits:

- **Linepack Balancing**: The capability of balancing linepack across the Western/Northern/Eastern systems using the WORM and Wollert compressor hub reduces the risk of Longford or Port Campbell plant trip due to a high-pressure constraint (e.g., in early morning) in the supplying Longford or Port Campbell pipelines. High operating pressures presently at both Longford and Port Campbell are required in order to meet peak loads.
- **Gas Powered Generation (GPG) readiness**: Management of linepack depletion due to short-term operation of GPG in the first half of the gas day becomes easier with the facility to transfer gas across the WORM as required, matching the available supply to the demand location. Operation of the Geelong pipeline at 5000 kPag typical pressure (fixed nominal

setpoints at Lara and Brooklyn) allows GPG at North Laverton to be capable of immediate operation (whether gas is sourced from either Longford or Port Campbell), unlike the current operating position where system pressures may need to be adjusted or compressors started to permit the GPGs to operate. Similarly, GPG at Somerton would be capable of immediate operation, unlike current operations when Wollert is periodically shut down to facilitate SWP/BLP flows via Brooklyn.

- **Gas-on-gas competition:** Ability to maintain gas contracts with the assurance that any surplus gas supply can be physically injected into the VTS, even in periods of low system demand.

Reducing reliance on Brooklyn Compressor station site

The Brooklyn compressors are currently used to refill the Iona Underground Storage facility and also to maintain capacity on the Brooklyn to Ballarat and Geelong systems.

The construction of the WORM reduces the reliance on the Brooklyn compressor site both operationally and for future growth in capacity on the VTS. Brooklyn is not the optimal location in terms of capacity expansion of the VTS and the site is heavily congested making augmentations technically difficult and therefore expensive.

With the WORM, one compressor unit at Wollert would increase the capacity into the Underground Storage facility by over 100 TJ/d with 1030 TJ/d injections at Longford (and over 150 TJ/d with 750 TJ/d injections at Longford). The increased capacity to the Underground Storage facility is achieved with considerably less than half the compression required compared to using two or more compressors at Brooklyn.

Greater package efficiency (lower fuel per volume of gas moved) is achievable by compressing at Wollert into the WORM as available suction pressure from the Pakenham to Wollert pipeline is significantly higher than the Melbourne inner ring mains pressures.

The WORM also has the impact of reducing fuel gas consumption and compressor maintenance costs in transporting flows between Longford and Port Campbell. There will be less reliance on Brooklyn compressors to compress gas towards Port Campbell. Due to the more efficient compression at Wollert, the amount of fuel gas consumed by the WORM compressor at Wollert is less than that consumed by Brooklyn compressor station, hence a reduction in greenhouse gas emissions.

AEMO noted in the 2017 VGPR (p56) that in 2015/16 the Brooklyn compressor station used 331TJ of fuel gas. With the WORM, AEMO is estimating that half that amount will be required. The added benefit will be reduced CO2 emissions.

Future growth and optionality

Completion of the WORM will provide capacity for the VTS for any potential future growth. APA estimates that the WORM would be required for growth (in addition to the current system security benefits) by 2025.

The WORM route may provide an offtake point for mains extensions to Kalkallo and also provides future connection provisions for new custody transfer meter (CTM) stations for Network Operators at Tullamarine and Mickleham.

In combination with the Winchelsea compressor, the WORM provides the additional capacity to support growth such as new GPG, for example, Wollert Combined Cycle Gas Turbine (CCGT) (500MW to 1500MW). The WORM also supports gas exports to Culcairn by removing the constraint of western flow.

Consumer benefits – value of customer reliability

The WORM will provides a more reliable service and help to prevent gas shortfalls during peak times. One way to assess the benefit of the WORM to consumers is to calculate at what point the cost of the WORM matches the benefit of reliability of supply provided by the WORM.

A proxy value for the benefit of reliability is measured in the national electricity market by the Value of Customer Reliability (VCR). The AER publishes a Value of Customer Reliability (VCR) for electricity[17] and given that the AER does not publish one for gas, we have converted the electricity VCR to apply to gas.

We have applied the Value of Customer Reliability concept to ask the questions "How much gas would the VTS have to fail to deliver before the cost of building the WORM is the better option?" or "At what point does the reliability benefit of the WORM match the cost of the WORM?." (Breakeven analysis)

Breakeven analysis was prepared as follows:

1. Calculate the annual cost of the WORM (return on capital + depreciation + operating costs)
2. Calculate the value of reliability (using the electricity VCR and converting it to a value for GJ to get a Gas-equivalent VCR)
3. Dividing the annual cost of the WORM by the Gas-equivalent VCR.
4. Gives you the breakeven point.

Our analysis has found that, on an energy-equivalent VCR basis, the VTS would only need to fail to meet demand of 2.4TJ before the WORM became viable. That is, the reliability benefit of the WORM project outweighs the cost of the project if it helps to avoid an annual gas shortfall of 2.4TJ. This compares to a VTS peak day demand in the order of 1,200 TJ/day and an annual load in excess of 200,000 TJ.

We conducted the same test on the basis on a Gas VCR calculated using retail delivered price of energy. The breakeven point was 8TJ/year.

This analysis shows that the reliability benefits of the WORM are likely to be significant considering forecast shortfalls on peak gas days in the next few years.

Section 7 of this Business Case provides the calculation for this analysis.

7.1.2. Option 1 costs

As at 1 December 2021, the total cost of the WORM was forecast to be $184.8 million (excluding GST and excluding capitalised overheads). Of this, $136 million will be incurred during 2018-22 period; and $49 million in 2023-27 period.

Table 4 Actual and forecast capital expenditure

$millions	2018	2019	2020	2021	2022	2023	2024	2025	Total
CAPEX	0.9	7.0	8.9	28.0	91.0	46.3	2.8	-	**184.8**

Note that the costs of the WORM may increase further as a result of the Victorian Planning Minister's assessment of the Environment Effects Statement for the WORM; and outcomes from market tenders for construction of the WORM. APA VTS will provide an update of the costs as soon as possible.

[17] AER 2021 Value of Customer Reliability Annual Adjustment viewed at https://www.aer.gov.au/system/files/AER%20-%20Values%20of%20customer%20reliability%20%20update%20summary%20-%20December%202021%2813309497.1%29.pdf

7.1.3. Assessment of Option 1

While the project has been delayed and costs have increased, the WORM is still a prudent investment, even more from 2023 onwards. Uncertainty of gas supplies means that the WORM will support greater resilience, security of supply and optionality for potential new Gas Powered Generation.

The WORM will ensure that consumers will have a reliable and safe supply of gas to meet their needs, particularly during winter. On average, the WORM will cost residential customers about $2.70 a year and will enable the VTS to continue to provide a reliable source of gas to meet heating, hot water, and cooking needs. Gas is an important source of gas in Victoria and ensuring a reliable supply of gas will contribute to the health and well-being of Victorians.

For businesses, on average the WORM will cost $25 per year and will enable the VTS to continue to provide a reliable source and prevent disruptions to business activities.

Option 1 is prudent and efficient.

7.2. Option 2: Cancel WORM project - do nothing further

Option 2 involves stopping work on the WORM project and cancelling the project. This option is being assessed at the request of the AER.

7.2.1. Option 2 benefits

APA VTS considers there to be no benefits of cancelling the WORM at this late stage.

This option negates all the benefits of the WORM detailed in Option 1.

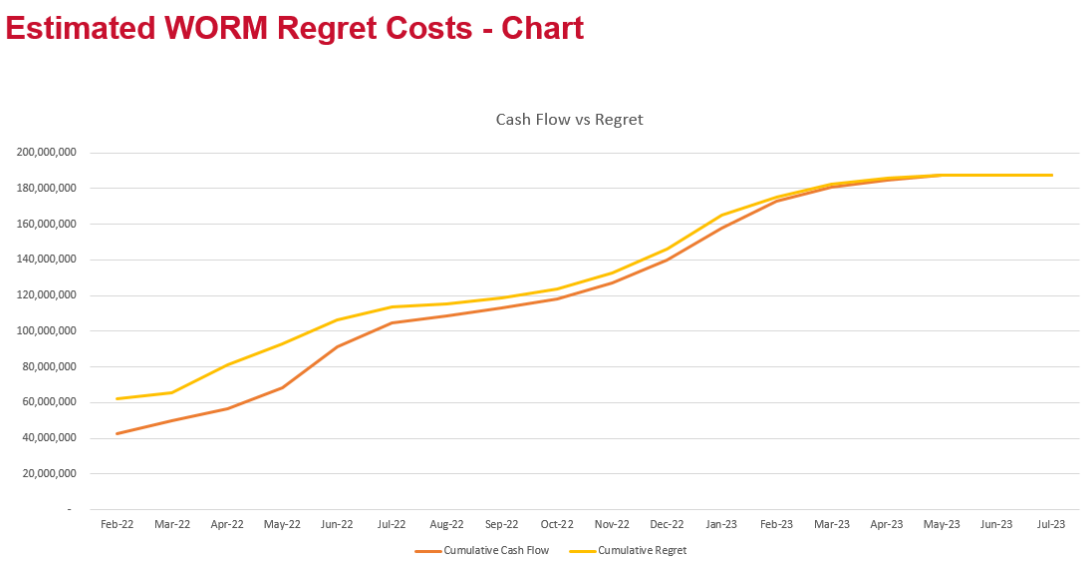
7.2.2. Option 2 costs

Following a two-year delay to meeting Victorian Government planning requirements for an EES, APA VTS has accelerated the WORM works program to ensure the WORM is available for winter 2023.

Cancellation of the WORM project mid-way through construction would result in significant ‘sunk’ costs and contract cancellation costs. As at end February 2022, expenditure on the WORM project has totalled $42.5 million. This would be sunk as the work so far could not allocated to another use. Further there are significant works/ contract cancellation costs that would be incurred for stopping the project while in-flight.

APA VTS has prepared analysis showing the ‘regret curve’ (sunk costs and cancellation costs) would be around $188 million. The regret curve is shown in figure 4.

Figure 4 Estimated cost of cancelling WORM in-flight - 'Regret curve'



The estimated costs of cancelling the WORM project are:

1. **APA acquires easements compulsorily** – Where APA has been unable to reach agreement with landowners, APA has applied under the Pipelines Act 2005 to compulsory acquire those easements. The Minister is due to decide whether to consent to the compulsory acquisition of easements in April 2022. Assuming the Minister consents to compulsory acquisition, the easements will be compulsory acquired and APA will be liable to landowners for the easement. The actual cost that APA must pay each landowner is determined under the Land Acquisition and Compensation Act. APA has assumed the value of easement compensation to be ~$11M and has represented this as a regret cost in April 2022.
2. **APA exercises easement options** – APA has entered into option agreements with 23 landowners for an easement to date. APA must give 20 days notice to exercise these option agreements before they expire in April 2022. Once exercised APA is liable to pay 75% of the easement compensation in that month.
3. **Easement Compensation** - APA has assumed that the remaining 25% of easement compensation payment could be contested by landowners if the project was cancelled, therefore this cost is included in the regret costs from April 2022.
4. **Construction Agreements** – APA will enter into construction agreements for pipeline and facilities works. Whilst these agreements will have an early works phase with limited liability prior to a "Notice to Proceed" being issued sometime in July 2022, contractors are likely to be carrying liabilities in the order of 10% of the contract value at any one time. This has been included in the regret costs.

The regret cost is an estimate only to provide an indication of APA's liability if the project was not to proceed from any one month.

APA has not negotiated cancellation clauses with any of its suppliers or landowners and has therefore estimated, to the best of its ability, the potential exposure of committed agreements. Regret costs do not allow for any consequential losses that may be claimed against APA.

Given that APA VTS commenced work on the project following AER approval we would expect to be fully compensated for these costs.

Cost of Brooklyn Compressor Station

If the WORM project is not constructed, refilling of Iona will rely on Brooklyn compression at its current lower capacity of 140 TJ/d and there is a risk of not being able to refill Iona UGS sufficiently to meet peak demands. As outlined in Option 1, item 3), Brooklyn is a congested site and will have limited room for any further expansion.

Further APA VTS would need to review the extra demands placed on Brooklyn Compressor Station (and possibly other compressors) and revise the replacement (stay-in-business) business case for Brooklyn Compressor Station (See APA VTS business case 204 - Brooklyn CS upgrade). This could potentially increase the cost of works at Brooklyn Compressor Station.

7.2.3. Assessment of Option 2

The detriment of Option 2 is that cancelling the WORM at this stage would mean that customers will not see the benefits of maintaining system security, resilience and operational benefits provided by the WORM as outlined in Option 1.

Further, the regret curve cost analysis shows that Option 2 will cost the same as if the project had gone ahead. Customers will incur the costs of the project without benefitting from any benefits.

In light of the uncertainty with gas supplies in Victoria and the forecast shortfalls in peak demand during Victorian winters, projects the enhance reliability and resilience are prudent more efficient than risking gas shortfalls.

Our finding is that Option 2 is neither prudent nor efficient as there would be no benefit to customers and consumers but the financial costs involved in cancellation would need to be recovered from customers.

Option 2 is not prudent nor efficient.

7.3. Option 3: Implement demand management and cancel WORM project

The AER and stakeholders queried APA VTS about the potential to use demand management as tool to avoid or to defer investment in completing the WORM. The AER sought assurance that the WORM was still a prudent and efficient project in light of increased uncertainties in the Victorian market.

Option 3 involves investigation of potential demand management arrangements. Demand management refers to implementing an activity that influences energy consumption by customers as an alternative to capital investment. The objective is often to curtail or smooth consumption during peak periods.

Alternatives to investment would be to implement curtailment or demand management where larger industrial customers or GPG are compensated for reducing demand during peak periods.

APA VTS has prepared a separate paper - VTS Demand Management - to be read in conjunction with this business case. The paper provides information about APA VTS investigations into the scope demand management to be used on the VTS[18].

7.3.1. Assessment of demand management

Under the VTS market carriage arrangements, there is no effective mechanism for APA to undertake demand management.

[18] VTS Demand Management information paper provided to the AER on 02 March 2022.

APA VTS, as the asset owner, does not have direct relationships with retailers under the market carriage model and does not have the complete visibility of VTS operations. AEMO operates the market and we believe is best placed to undertake demand management to meet system security.

APA VTS has provided a separate document (attached) discussing the scope for demand management activities to defer or avoid expansion of the WORM and SWP. In summary, our investigations found:

- Demand management investigations are an AEMO system planning responsibility
- Reliable demand management activity in the order of 100TJ/day would be required
- Retailers are not able to assist with demand management
- Curtailment of the Uranquinty Power Station is both prohibitively costly and unreliable from a demand management perspective
- There are no individual industrial customers that could make a significant contribution to demand management on the peak days – it would be necessary to coordinate a large number of industrial customers to simultaneously curtail demand in order to achieve the required load reduction.

In summary, demand management is not a viable alternative for APA VTS under the current market arrangements.

7.3.2. Assessment of Option 3

Under current circumstances, demand management is not a viable option to avoid or defer the proposed security of supply-related expansion capital expenditure for the VTS.

Our investigations have found that demand management is not efficient under current market arrangements because:

- the potential cost of implementing demand management is greater than the cost of investing in the WORM (and proposed South West Pipeline expansion), and
- the transaction costs, complexity of execution, and risks of an insufficient number of large users being able or willing to simultaneously curtail consumption on the peak days, renders this option unworkable and possibly ineffective.

APA VTS would support the AER/ AEMO undertaking a review into the potential for future demand management in the DWGM, taking into account:

- whether demand management is feasible under the market carriage framework, and
- the role that AEMO and other parties can play in demand management.

We note that in the National Electricity Market, transmission service providers can apply for the Demand Management Innovation Allowance Mechanism. There is no such mechanism for gas transmission service providers.

Until a framework for demand management is developed, curtailment and demand management is not a viable option as an alternative to continuing to invest in the WORM (nor the expansion of the South West Pipeline).

Further information about APA VTS investigation into the potential for demand management options is available in the supplementary information ‘VTS Demand Management’.

Similar to Option 2, the cost to cancel the project will make this Option neither prudent nor efficient.

7.4. Summary of option analysis

Of the three options, Option 1 is the preferred option.

Table 3 Summary of options analysis

Option	Benefits (Risk Reduction)	Costs
Option 1: Complete construction of the WORM **Preferred option**	Increased Iona UGS refill capability for winter peak operations. Increased system capacity, reliability and security of supply. Improved operability of the VTS with increased available system linepack and provides the "missing link" in the ability to transfer linepack between the high pressure pipelines around Melbourne. Reduced dependency on Brooklyn Compressor Station which is in an ageing site. Provide capacity for future growth in Melbourne's west and north, to facilitate new offtakes into distribution systems, or potential GPG sites along the WORM. Increase capacity for potential future LNG terminals in the Geelong area. Ensure consumers will have a reliable and safe supply of gas to meet their heating, hot water and cooking needs. For businesses, the WORM will enable the VTS to continue to provide a reliable source and prevent disruptions to business activities. VTS would only need to fail to meet demand of 2.4TJ before the WORM became viable. That is, the reliability benefit of the WORM project outweighs the cost of the project if it helps to avoid an annual gas shortfall of 2.4TJ. This compares to a VTS peak day demand in the order of 1,200 TJ/day and an annual load in excess of 200,000 TJ.	Capex: $185 m Construction to be completed by May 2023 at a cost increase of $60 m against AER approved in Access Arrangement 2018-2022. For residential customers, the WORM will cost on average about $2.70 a year For businesses, on average the WORM will cost $25 per year.
Option 2: Cancel WORM project – (Do nothing Option)	No benefit – The project is in-flight and is at a crucial stage.	Sunk cost + extra cost to stop project

	The costs to cancel the WORM are estimated to be similar to completing the WORM.	No additional capacity to and from Iona. Risk of Iona refilling shortfall for winter peak conditions as the refilling rate and window of refill opportunity remains constrained by SWP pipeline capacity to 140 TJ/d. No increase in security of supply to the VTS in an event of an outage at Longford. Limited opportunity for growth and optionality of new LNG sources Risk of disruption to residential consumers and business customers
Option 3: Cancel WORM - Curtailment and Demand Management	No benefit – The project is in-flight and is at a crucial stage. The costs to cancel the WORM are estimated to be similar to completing the WORM. Not a viable option.	Sunk cost + extra cost to stop project As per Option 2 Currently no process mechanism to curtail customers in a market carriage system. Not a viable option.

8. Value of Customer Reliability of the WORM

One way to measure the benefit of the WORM to consumers is to assess at what point the cost of the WORM matches the value of the reliability benefits resulting from the WORM.

A proxy value for the benefit of reliability is measured in the national electricity market by the Value of Customer Reliability (VCR).

The AER publishes a Value of Customer Reliability (VCR) for electricity[19], and given that the AER does not publish one for gas, we have used the electricity VCR and converted it to apply to gas.

Below, we apply the Value of Customer Reliability concept to ask the question "How much gas would the VTS have to fail to deliver before the cost of building the WORM is the better option?" or "At what point does the value of the reliability benefits provided by the WORM match the cost of the WORM?" (known as breakeven analysis).

Step 1: Estimate the annual cost associated with building the WORM

Total capital cost of WORM	**$ 184,800,000**		
WACC [per PTRM]	x 4.27%		
Return on Capital (annual)			7,897,782
Depreciation over	30	years (annual)	6,160,000
Opex (annual)			593,804

[19] AER 2021 Value of Customer Reliability Annual Adjustment viewed at https://www.aer.gov.au/system/files/AER%20-%20Values%20of%20customer%20reliability%20%20update%20summary%20-%20December%202021%2813309497.1%29.pdf

Total WORM annual revenue impact per annum	**$ 14,651,585**

Step 2: Estimate a Gas VCR

Victoria electricity VCR (residential customer)	$ 22.23 /kWh	
Convert to GJ:	÷ 0.0036 GJ/kwH	
Victoria Gas VCR		**$ 6,175 /GJ**

Step 3: Calculate the amount of unserved energy at which the Value of Customer Reliability and the cost of the WORM breakeven

Total WORM annual revenue impact	$ 14,651,585	
Vic Gas shadow VCR	÷ $ 6,175 /GJ	
Breakeven unserved energy		**2,373 GJ/year**
		2.4 TJ/year

This analysis finds that the breakeven point for the WORM project cost is 2.4 TJ/year. The benefit of the WORM matches the cost of the WORM at 2.4 TJ/year. If the WORM is not built, and consumption is curtailed, by as little as 2.4TJ because Iona gas storage was unable to refill fast enough, then the cost of building the WORM would be the preferable option.

For perspective, this compares to a VTS peak day in the order of 1,200 TJ/day and an annual load in excess of 200,000 TJ.

We conducted the same test on the basis on a Gas VCR calculated using retail delivered price of energy[20].

Step 2: Estimate a Gas VCR

Average residential customer bill - market offer	$ 1,202 /year		
÷ Average residential customer consumption	÷ 4,000 kWh		
= Average cost per kWh	$ 0.3005 /kWh		
VCR per kWh	$22.23 /kWh		
Ratio of VCR to retail price		73.98	times
Average residential gas bill	$ 1,350 /year		
÷ Average residential consumption	÷ 54.40 GJ		
= Average residential price / GJ	$ 24.82 /GJ	$ 24.82	/GJ
Victoria Gas VCR based on retail energy cost		**$ 1,835.82**	**/GJ**

[20] Annual bill and volume benchmarks are taken from the Essential Services Commission Victoria, Victorian energy market update: June 2021, p6. https://www.esc.vic.gov.au/sites/default/files/documents/Victorian%20Energy%20Market%20Update%20-%20%20June%202021%20-%2020210629_1.pdf

Using this Victoria Gas VCR in the calculation above:

Step 3: Calculate the amount of unserved energy at which the Value of Customer Reliability and the cost of the WORM breakeven

Total WORM annual revenue impact	$ 14,651,585	
Vic Gas shadow VCR	$ 1,836	/GJ
Breakeven unserved energy	**7,981**	**GJ/year**
	8.0	**TJ/year**

Again, this compares to a VTS peak day in the order of 1,200 TJ/day and an annual load in excess of 200,000 TJ.

This analysis finds that the breakeven point for the WORM project cost is 8 TJ/year. The benefit of the WORM matches the cost of the WORM at 8 TJ/year. Again, to summarise, if the WORM is not built, and this means that we have to curtail consumption by as little as 8.0TJ because Iona gas storage was unable to refill fast enough, then the cost of building the WORM would be the preferable option.

9. Consistency with the National Gas Rules

Consistent with the requirements of Rule 79(1) of the National Gas Rules, APA VTS considers that the capital expenditure in the WORM is:

- **Prudent** – While the project has been delayed and costs have increased, the WORM is still a prudent investment. Uncertainty of future gas supplies means that the WORM will support greater resilience, security of supply and optionality for potential new Gas Powered Generation. The expenditure is necessary in order to maintain and improve the capacity of the VTS to maintain integrity of services and safety for APA VTS personnel and the public. Gas is an important source of gas in Victoria and ensuring a reliable supply of gas will contribute to the health and well-being of Victorians. The expenditure is of a nature that a prudent service provider would incur.
- **Efficient** – Expenditure on WORM is being undertaken consistent with APA procurement policies which require competitive procurement for all delivery/construction work.
- Capital expenditure on the WORM will be undertaken in accordance with APA's procurement policies. The procurement policies require competitive procurement for all delivery/construction work. APA VTS is currently undertaking a tender process for the WORM construction costs. The outcome will deliver the best value available in the market today.
- APA implements strong governance processes for projects. The WORM Steering Committee provides strong oversight of the WORM project with a focus on minimising project costs.
- As an ASX listed company APA faces market scrutiny for its investments. This provides a strong incentive for APA to ensure it invests efficiently.
- **Consistent with accepted and good industry practice** – Addressing the risks associated security of supply is accepted as good industry practice.
- **To achieve the lowest sustainable cost of delivering pipeline services** – The sustainable delivery of services includes reducing risks to as low as reasonably practicable and maintaining reliability of supply.

Overall, consistent with the requirements of Rule 79(1) of the National Gas Rules, APA VTS considers that the capital expenditure is such as would be incurred by a prudent service provider

acting efficiently, in accordance with accepted good industry practice, to achieve the lowest sustainable cost of providing services (Rule 79(1)(a)).

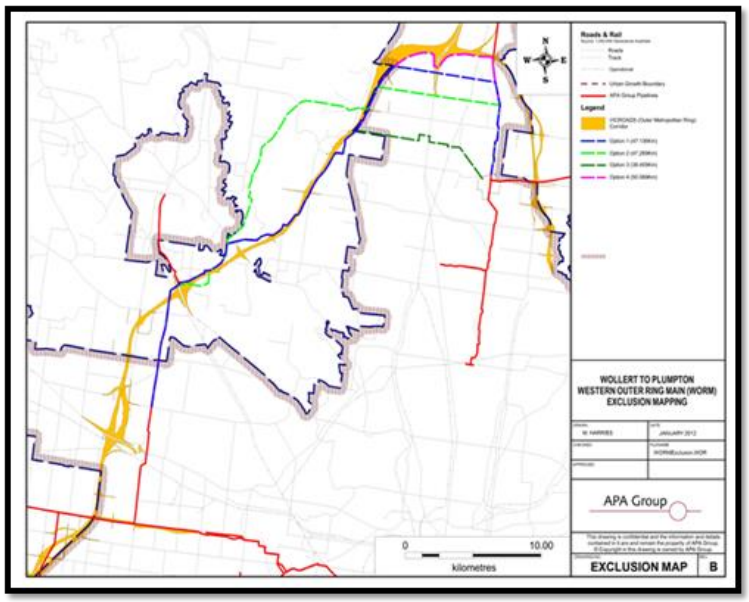
Consistent with the requirements of Rule 79(2) APA VTS considers that the WORM is justified on the following basis:

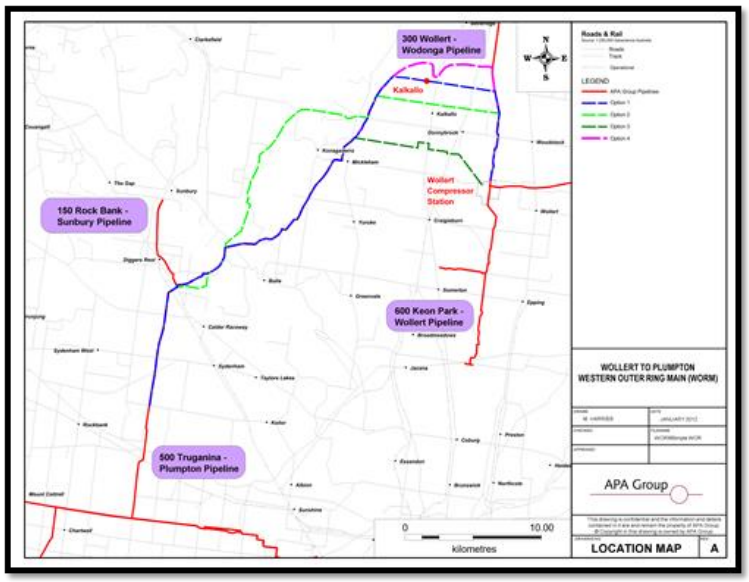
- The primary driver of the WORM project is to maintain capacity to meet levels of demand for services (r. 79(2)(c(iv)). This will ensure reliability of supply for consumers.
- Investment in the WORM will enhance integrity of supply for Victorian gas consumers particularly since the declines in Longford gas production, and uncertainty about other gas sources are expected to contribute to gas shortages starting in winter 2023.
- The capital expenditure is also necessary to maintain the safety for APA VTS personnel and public safety.

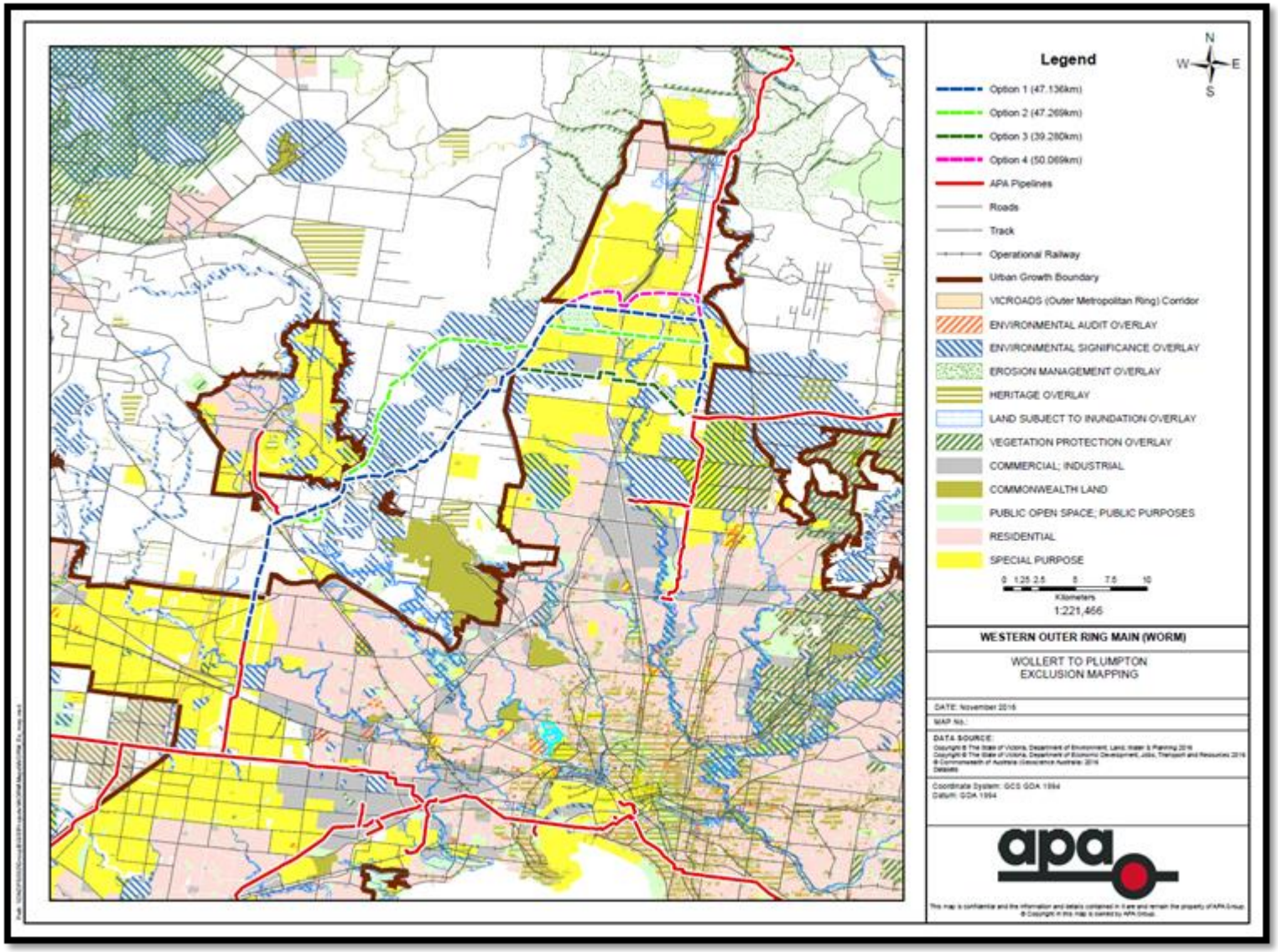
Investment in the WORM meets the criteria for conforming capital expenditure.

Appendix A Route option overview map

A.1 Option 4 is the chosen route






Legend
N
W
E
S
Option 1 (47.136km)
Option 2 (47.269km)
Option 3 (39.280km)
Option 4 (50.069km)
APA Pipelines
Roads
Track
Operational Railway
Urban Growth Boundary
VICROADS (Outer Metropolitan Ring) Corridor
ENVIRONMENTAL AUDIT OVERLAY
ENVIRONMENTAL SIGNIFICANCE OVERLAY
EROSION MANAGEMENT OVERLAY
HERITAGE OVERLAY
LAND SUBJECT TO INUNDATION OVERLAY
VEGETATION PROTECTION OVERLAY
COMMERCIAL; INDUSTRIAL
COMMONWEALTH LAND
PUBLIC OPEN SPACE; PUBLIC PURPOSES
RESIDENTIAL
SPECIAL PURPOSE
0 1.25 2.5 5 7.5 10
Kilometers
1:221,466
WESTERN OUTER RING MAIN (WORM)
WOLLERT TO PLUMPTON
EXCLUSION MAPPING
DATE: November 2016
MAP No.:
DATA SOURCE:
Coordinate System: GCS GDA 1994
Datum: GDA 1994
apa

Appendix B WORM preliminary route and land description

B.1 Option 4 preferred route

The pipeline consists of an additional 50 km of 500mm NB pipeline partially laid in existing easement (approximately 8km, Wollert to Wodonga Pipeline) and the rest in greenfield easement. Three intermediate mainline valves are required, as well as pig traps and hot taps at Wollert and Plumpton.

The topography of the preferred route is generally flat; however, several very steep gullies exist at creek crossings (Deep Creek, Emu Creek, and Jackson's Creek). It is estimated that 250 trench breakers are required. Surface ground conditions reveal basalt plains on part of the route. The remainder of the route is a combination of sedimentary/siltstone/gravel/sand with the odd section of basalt. In total there are 6 major waterway crossings. All creek crossings will need to be open cut due to basalt.

Preliminary design has indicated there will be 22 road bores, including extensive bores under the Western Ring Road, Deer Park By-Pass, Western Freeway, Calder Highway and Hume Highway. In addition, there will be 3 railway bore crossings and 5 road open cuts.

Construction within road pavement is expected for approximately 1900 metres. Roads affected are Fitzgerald Road, Fairbairn Road, Boundary Road, and Westside Drive.

Environmental issues are likely to include the following:

- Native grasslands – protected ecological communities and associated habitat for protected species.
- Crossings of the Merri Creek may be opposed by community groups (e.g., Friends of the Merri Creek) given their opposition to a previous pipeline crossing of the creek in relation to protection of the Growling Grass Frog.
- Noise, dust, and access near residential homes along proposed route.

There will be a requirement for offsets of losses of native vegetation and habitat compensation (within the urban growth zone) in relation to impacts on native vegetation. An amount has been included for offsets however environmental field studies would need to be carried to accurately determine the exposure.

There is likely to be Crown Land along the route that will be subject to Native Title. A full historical title search needs to be carried out followed by a referral to Native Title Services Victoria to conclusively establish whether native title exists. As it is likely an allowance has been made on the assumption that Native Title does exist on the route.

There will be one local Aboriginal group dealing with Cultural Heritage. An allowance has been made for the negotiation of a Cultural Heritage Management Plan with the group. Until field surveys are undertaken to assess potential cultural heritage places an accurate cost of the likely extent of work is difficult to quantify.

The chosen pipeline route will be a mix of existing pipeline easement and greenfields easement. As with the Brooklyn Lara project, the greenfields section will affect Green Wedge zoned land that is currently experiencing a dramatic upwards movement in market sale prices as a result of land speculation. In addition, the land parcels vary greatly in size and land value per hectare. Until the final route is chosen and environmental studies completed an accurate estimate of the cost of easement acquisition cannot be finalised. The estimate provided has used an "average" amount for land value and also includes consideration for compulsory acquisition of a number of easements. In addition to the easement acquisition, APA will be required to negotiate additional temporary workspace with private landowners.

B.2 Pipeline Route Alternatives

The following are alternative pipeline routes that were considered:

B.2.1 The High Voltage Electricity Transmission Line

An electricity transmission line is located roughly parallel to the gas pipeline route for the majority of the route. Being an overhead lineal infrastructure however, its alignment follows land contours that are not possible to follow with a buried pipeline. For approximately 20.5 kms, the route runs within escarpments, with the towers located on high ground. There are also critical construction and operational safety issues to overcome when running a lineal steel pipeline parallel to high voltage transmission lines.

B.2.2 Railway lines

The rail routes are not located in areas where they could be of practical benefit to the pipeline route. In addition, the rail authorities will generally not allow high pressure gas pipelines to run parallel within their land.

B.2.3 The Hume Freeway or another Major Arterial Road

Like railways, VicRoads will generally not allow infrastructure similar to gas transmission pipelines to run within freeways or major arterial roads. This option was explored during route selection of the Brooklyn Lara Pipeline.

B.2.4 Other Cross Country Routes

A new pipeline route to the west of Melton and north and west of Sunbury.

This route would give reasonable certainty that there would not be any changes to planning zones or land use beyond the year 2015. The length of this pipeline would be 105 kms, with 63 kms of Greenfield easement.

B.2.5 Utilising green wedge areas within Melbourne Airport flight paths

There is reasonable certainty that development will continue to be restricted along the flight paths of Melbourne Airport. The pipeline route already crosses one of the flight paths. It is not practical to use the flight paths to a greater extent. To reach the flight path the pipeline alignment would need to cross the Organ Pipes National Park and encounter severe escarpments or pass through areas of Sydenham and neighbouring areas that are already under development. A route utilising flight paths to a greater extent would result in about the same length and would still encounter development.