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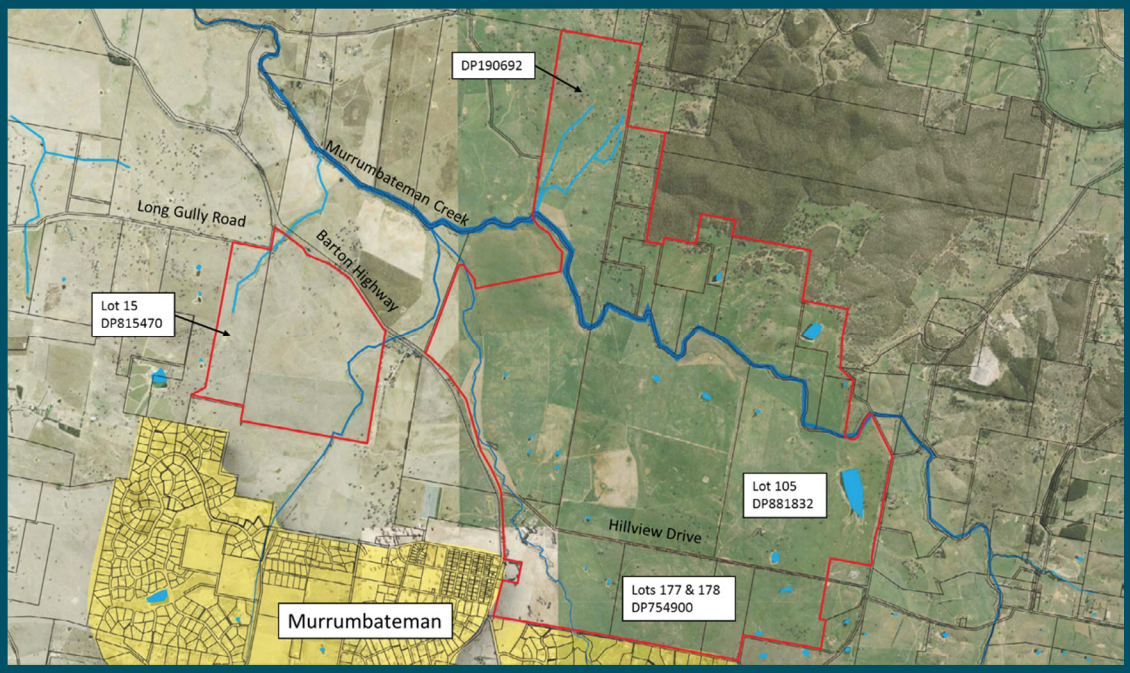

Murrumbateman Development Potential

Feasibility Study of Urban Infrastructure

Draft Report

COMMERCIAL IN CONFIDENCE

28 November 2014

C14089

Urban Development

Smart Consulting

COMMERCIAL IN CONFIDENCE

Brown Consulting (ACT) Pty Ltd
Level 6
121 Marcus Clarke Street
Canberra City, ACT, 2601

Ph: (02) 6211 7100

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EXECUTIVE SUMMARY

The Sustainable Development Company Pty Ltd has a substantial land holding to the north of Murrumbateman, New South Wales Brown Consulting has been engaged to investigate and determine the infrastructure requirements to support a possible urban development of the land. The reports provides details on existing infrastructure, the capacity of this infrastructure and the augmentation and costs required to support a range of possible future development scenarios.

The land area studied total area of the development is approximately 1,953 hectares. From an infrastructure perspective only, the land may be capable of supporting a range of urban development scenarios in excess of up to some 13,000 dwellings, with a population of up to 39,000 plus.

Consultation was undertaken with Yass Valley Council, ACTEW Water, Essential Energy, NBN, Telstra and ZNX to confirm capacity of the existing services and identify infrastructure upgrades that would be required to service future possible urban development at the site.

Proposed infrastructure upgrades for the development are summarised in the table below:

Blocks	Water Supply	Sewerage	Electrical	Telecommunication	Gas
Servicing Strategy	Pipe from ACT Water System. No existing capacity in Murrumbateman	New Sewage Treatment Plant. No existing capacity in Murrumbateman	Major network upgrades	New NBN network from Yass or ACT	Pipe Gas from ACT
3,000	300mm diameter Pipe to Supply 5ML/day	7.6ML/day MBR* Sewage Treatment Plant	New supply point from 132kV network or new 22kV feeder for every 2,500 blocks and upgrade existing substation.	Existing Telstra network has insufficient capacity to service new development in Murrumbateman. New NBN network will be required to service the development.	There is no existing gas service in Murrumbatemen. A new 150mm diameter high pressure steel main from the ACT gas network.
5,700	375mm diameter Pipe to Supply 9.2ML/day	14.4ML/day MBR Sewage Treatment Plant			
9,000	450mm diameter Pipe to Supply 15ML/day + Major ACT Water Infrastructure Upgrade	22.7ML/day MBR Sewage Treatment Plant			
13,000	525mm diameter Pipe to Supply 15ML/day + Major ACT Water Infrastructure Upgrade	32.8ML/day MBR Sewage Treatment Plant			

*MBR stands for Membrane Bioreactor

High level cost estimates for the proposed infrastructure upgrades are summarised in the table below:

Blocks	Water Supply		Sewerage		Gas		Electrical/ Telecommunication
	Total Costs	Cost/Block	Total Costs	Cost/Block	Total Costs*	Cost/Block	
3,000	$28.1M	$9,353	$45.9M	$15,300	$14.6M	$4,862	
5,700	$30.3M	$5,311	$76.2M	$12,700	$14.6M	$2,559	
9,000	$36.4M+ Upgrade Costs	$4,040+ Upgrade Costs	$114.7M	$12,739	$14.6M	$1,621	Developer contribution to the infrastructure upgrades to be determined during concept design stage
13,000	$40.3M+ Upgrade Costs	$3,105+ Upgrade Costs	$161M	$12,385	$14.6M	$1,122	

*The new gas main, which is sized to service the ultimate development scenario or maximum yield, will be required to be constructed at the early stage of the development.

1. INTRODUCTION

1.1 Overview

The Sustainable Development Company Pty Ltd has a substantial land holding to the north of Murrumbateman, New South Wales. Brown Consulting has been engaged to investigate and determine the infrastructure requirements to support a possible urban development of this land. The report provides details on existing infrastructure, the capacity of this infrastructure and the augmentation and costs required to support a range of possible future development scenarios.

The subject land has an area of 1,953 hectares and is located approximately 39km northwest of Canberra. The subject land (or study area) is located to the north of the existing Murrumbateman Village and comprises Lots 177 & 178 DP 754900, Lot 105 DP881832 and DP190692 to the east of the Barton Highway and Lot 15 DP 815470 to the west of the Barton Highway. Refer **Figure 1** for the extent of the study area.

From an infrastructure perspective only, the land may be capable of supporting urban development in excess of 13,000 dwellings, with a population of 39,000 plus.

To support any development proposal a suite of other investigations would be required to confirm more accurately the urban suitability of the land and the potential yield.

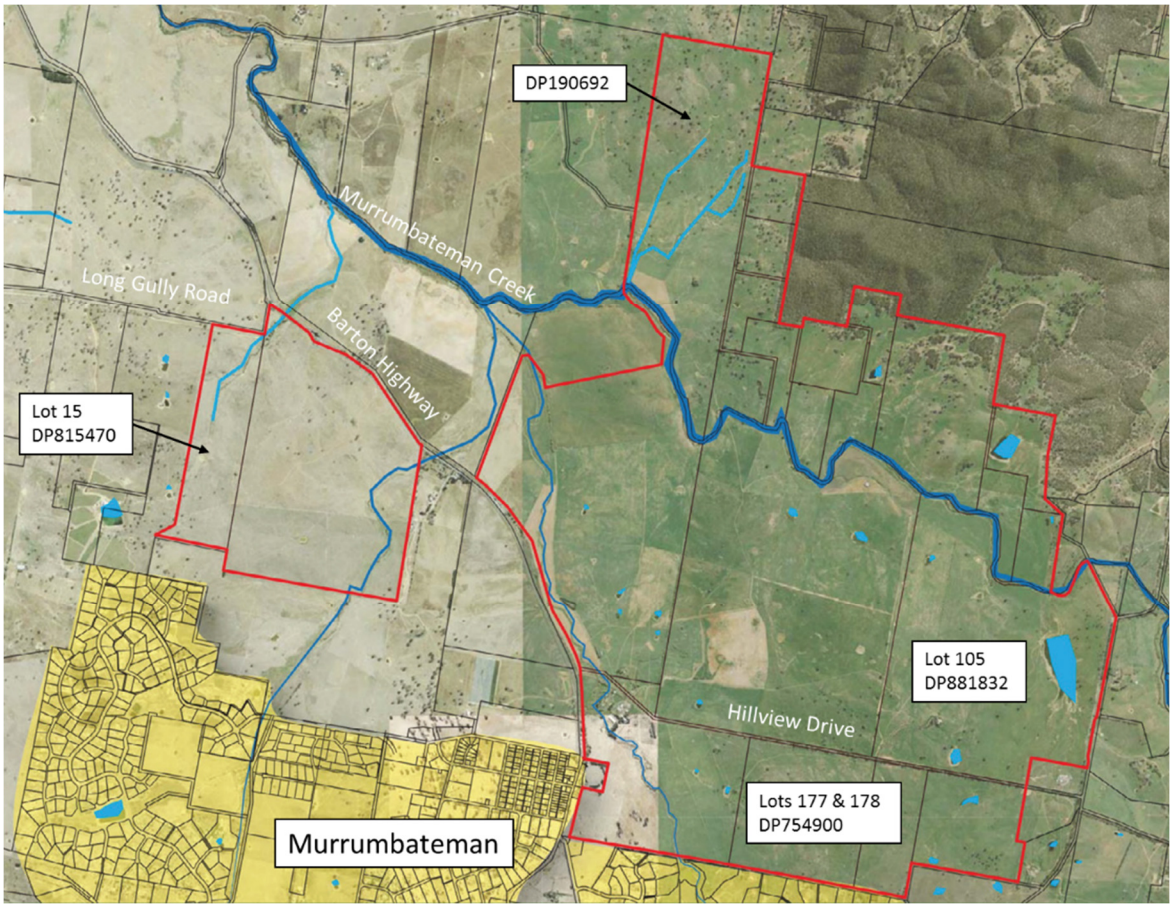


Figure 1 Murrumbateman Development Study Area

1.2 Project Background

The following background information and previous reports and studies were reviewed to inform this Feasibility Study:

- *Canberra to Yass Water Supply Pipeline Investigation, Engineering 'Pre-Feasibility' Study Phase 1*, ACTEW Water, February 2006.
- *Murrumbateman Master Plan 2031*, HBO+EMTB, May 2012
- *Murrumbateman Sewerage Scheme, Review of Environmental Factors*, NSW Public Works, December 2013.
- *C2M Estimate Summary V01.xlsx*, Yass Valley Council, May 2014.
- Water Quality and Capacity – Improvements, Yass Valley Council Website.
- *Barton Highway*, Roads & Maritime, http://www.rms.nsw.gov.au/projects/south-western/barton-highway/index.html
- *Investment Road and Rail Programme, New South Wales Schedule Projects*, Department of Infrastructure and Regional Development, http://investment.infrastructure.gov.au/publications/policies/pdf/NPA_Schedule_NSW_October_2014.pdf
- *Googong Design Assumptions for Potable and Recycled Water Systems*, MWH, August 2013.

1.3 Scope of Works

The scope of works for the study includes:

- Undertake consultation with Yass Valley Council, ACTEW Water and services authorities to confirm capacity of the existing services and identify infrastructure upgrades that would be required to service future possible urban development at the site.
- Undertake high level review and cost estimates for water supply and sewerage infrastructure.
- Undertake high level reviews on the electrical, gas and telecommunications services.
- Provide an update on the timing of and funding for the duplication of the Barton Highway and the Murrumbateman by-pass.
- Prepare a report to summarise the outcomes of this study.

2. EXISTING INFRASTRUCTURE IN MURRUMBATEMAN

2.1 General

Existing infrastructure within the general vicinity of Murrumbateman has been identified via liaison and consultation with Yass Valley Council (YVC), Utilities, land owners and a "Dial Before you Dig" enquiry.

Existing services information has been specifically obtained from:

- Yass Valley Council for sewer & water supply services;
- Essential Energy for electricity services; and
- Telstra and Nextgen for telecommunications services.

The information supplied is qualified on the basis that it has been supplied by an external parties. Brown Consulting has digitised this information in shapefile format for presentation purposes in the report. However, the services locations are indicative only and will ultimately need to be confirmed by detailed survey. However they are of sufficient accuracy for the purpose of this study.

2.2 Water Supply

At present, rainwater and groundwater are the main sources of water supply for Murrumbateman. Two groundwater bores are located within the Murrumbateman Recreation Ground. Groundwater from the bores is pumped to two existing reservoirs located in the northeast corner of the Cemetery (refer to **Figure 2**).

Descriptions of component of the system is summarized in **Table 1**.

Table 1 Summary of Existing Water Supply System in Murrumbateman Village

Type	Description	Year Constructed	Capacity	Notes
Bore 1	30m deep bore	1984	3.5 L/s (0.3ML/d)	High hardness and elevated nitrate levels above Australian Drinking Water Guidelines Extraction for both bores shall not exceed 56 ML in any 12 month period.
Bore 2	6m away from Bore 1	2008	0.8ML/d	
Reservoir 1	Ground level	1984	272kL	Only supply water to the Murrumbateman Village Core, 120 properties
Reservoir 2	Elevated	1984	90kL	Only supply water to the Murrumbateman Village Core, 120 properties

The water supply network is shown on **Figure 2**.

Water supply to the rest of Murrumbateman outside the Village Core is provided via individual rainwater tanks and private bores. These bores are mainly used for irrigation and non-potable consumption. Rainwater is the main source of potable water for internal household use.

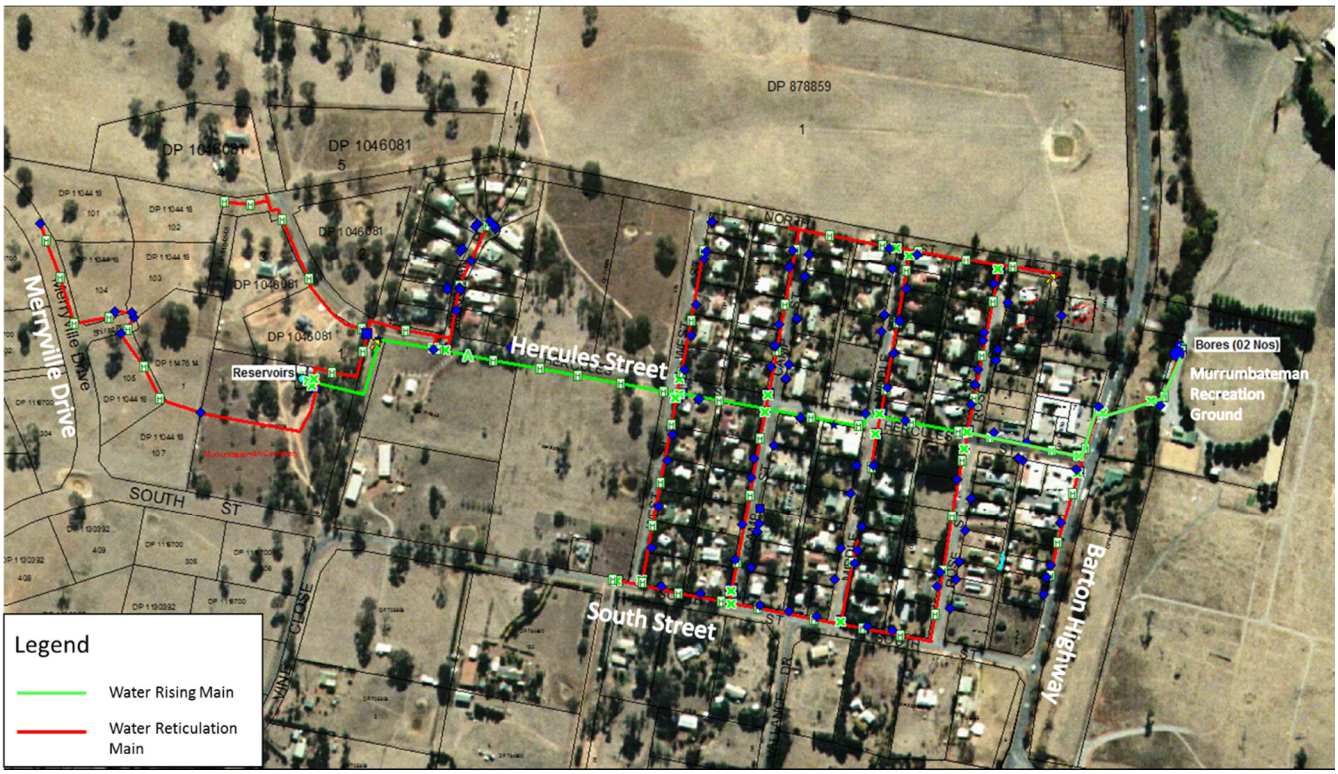


Figure 2 Existing Water Network within Murrumbateman

Water System Deficiency

YVC advised that the existing water supply system has insufficient capacity to meet the current maximum peak day demand from the 120 properties. Groundwater is untreated and has high hardness and elevated nitrate levels, which does not meet the Australian Drinking Water Guidelines. The condition of the underground piped network is also unknown. On the basis the existing system is deficient in terms of capacity and quality it is concluded the existing system is not suitable as a source for future development.

2.3 Sewerage

There is currently no existing centralised sewage treatment plant nor sewage pipe network in Murrumbateman. A majority of the residences are serviced by the individual septic tanks or aerated wastewater treatment systems with onsite effluent disposal via trench absorption systems. YVC however proposing an oxidation pond system (see section **4.3**) to treat sewage from two new development areas identified in the current LEP.

Septic System Deficiency

Septic systems are not recommended for any future development due to the following reasons:

- Potential for contamination of downstream creeks and water bodies due to excess loading and resulting overflow.

- Failure of the outlet/trench absorption system due to saturated soils from high rainfall.
- Potential for downstream algal blooms due to the poor removal of nitrogen compounds by septic tanks.
- Transmission of pathogens to Murrumbateman Creek and the resultant contamination on downstream water supply.

2.4 Stormwater

The subject of stormwater is briefly discussed although not specifically in the scope of the study. The existing natural water courses and farm dams/ponds within Murrumbateman are shown in **Figure 3**. In general, the study area falls towards north to Murrumbateman Creek. The creek forms a central spine for the subject lands east of the Barton Highway. Apart from drainage pipes associated with roads little existing stormwater infrastructure is located within the study area. This infrastructure would be of little value for any future development. With respect to any future development YVC advised that:

- There are no existing flooding studies or reports available but that, in general, building levels should be 0.5m above the Q100 level once this level is determined
- There is no current policy on stormwater retardation requirements (i.e. no requirement on reduction on post development flows to meet pre-development flows).
- The section of Murrumbateman Creek in the study area is within the water supply catchment of Yass Dam. Therefore, appropriate treatment should be applied to stormwater runoff from the proposed development. In general, the treatment elements are determined based on the pollutant reduction target required by Council. YVC currently has no policy on stormwater treatment.

The Office of Environment and Heritage (Environment NSW) recommends that Landcom's Water Sensitive Urban Design Guidelines should be used for stormwater management targets. Landcom's guidelines recommend 45% reduction in the mean annual load of total nitrogen, 65% reduction in the mean annual load of total phosphorus and an 85% reduction in the mean annual load of total suspended solids. These targets can be met by installation of bio retention systems, swales, wetlands and ponds, which can be incorporated into public open space, street landscapes or on lots on any development.

Policy on these important matters will need to be developed over time and further advice can be provided when appropriate.

Ultimately, a stormwater and water sensitive urban design management strategy and plan will need to be developed to address these matters as part of any development proposal.

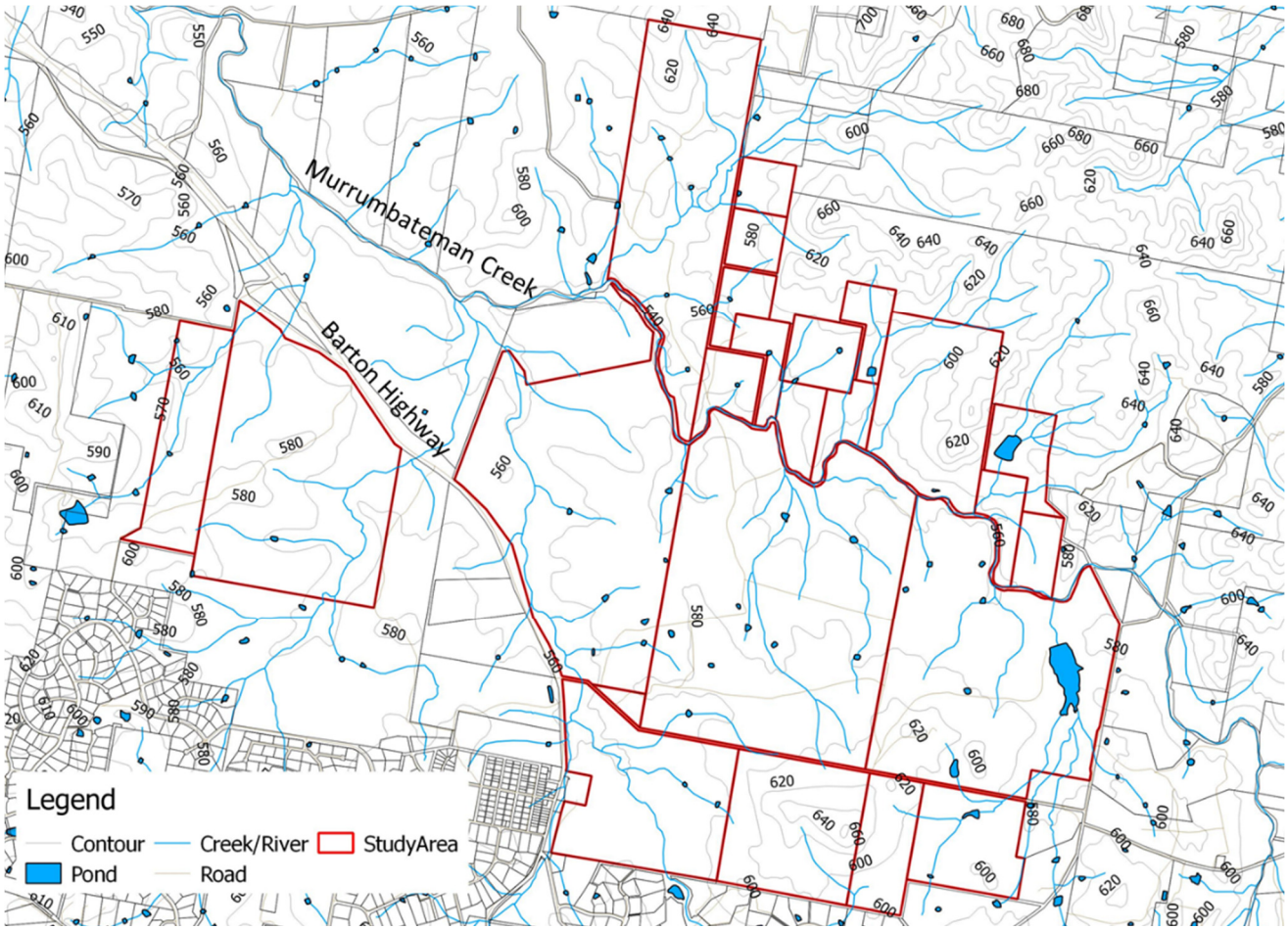


Figure 3 Existing Water Courses and Ponds within Murrumbateman Study Area

2.5 Electricity

Four existing 22kV overhead powerlines traverse the study area (refer to **Figure 4**). The Murrumbateman Masterplan 2031 indicates that a minimum of 50m wide easement (25m each side) will be required over these powerlines within any future urban development.

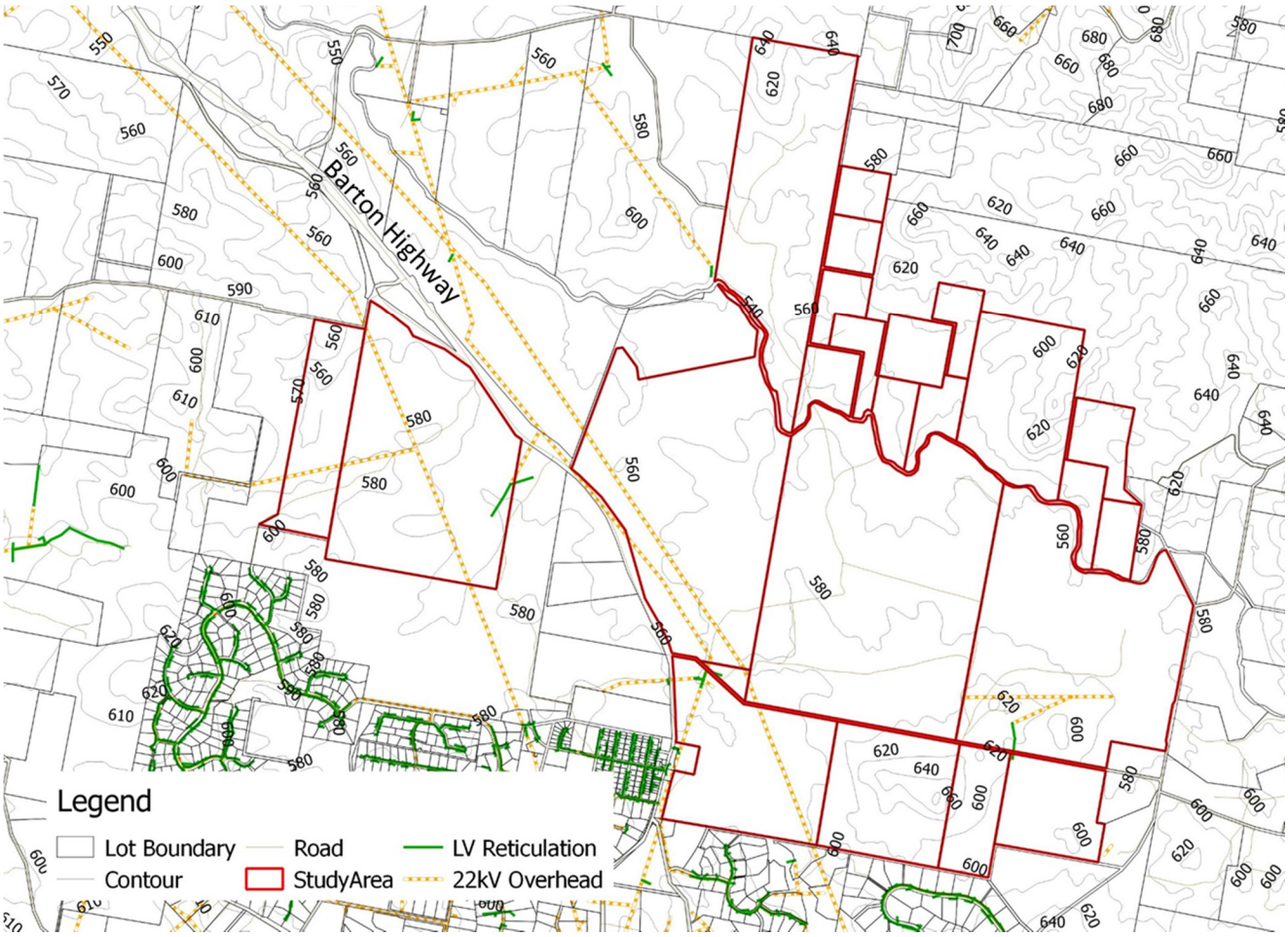


Figure 4 Existing Electrical Network within the Study Area

2.6 Telecommunications

There are existing Telstra small copper cables within the study area. Telstra advised that:

- The cable along Hillview Drive has 19 vacant pairs and along/near Barton Hwy has only 5 vacant pairs. These cables are direct buried and there is no conduit.
- Nearly half of the development area has poor or no mobile coverage.
- Major infrastructure upgrades will be required to service any proposed development.
- Any development with 100 lots or more requires connection to NBN network.

There is no existing NBN network within the study area and the current roll out map does not show any proposals for Murrumbateman or nearby areas.

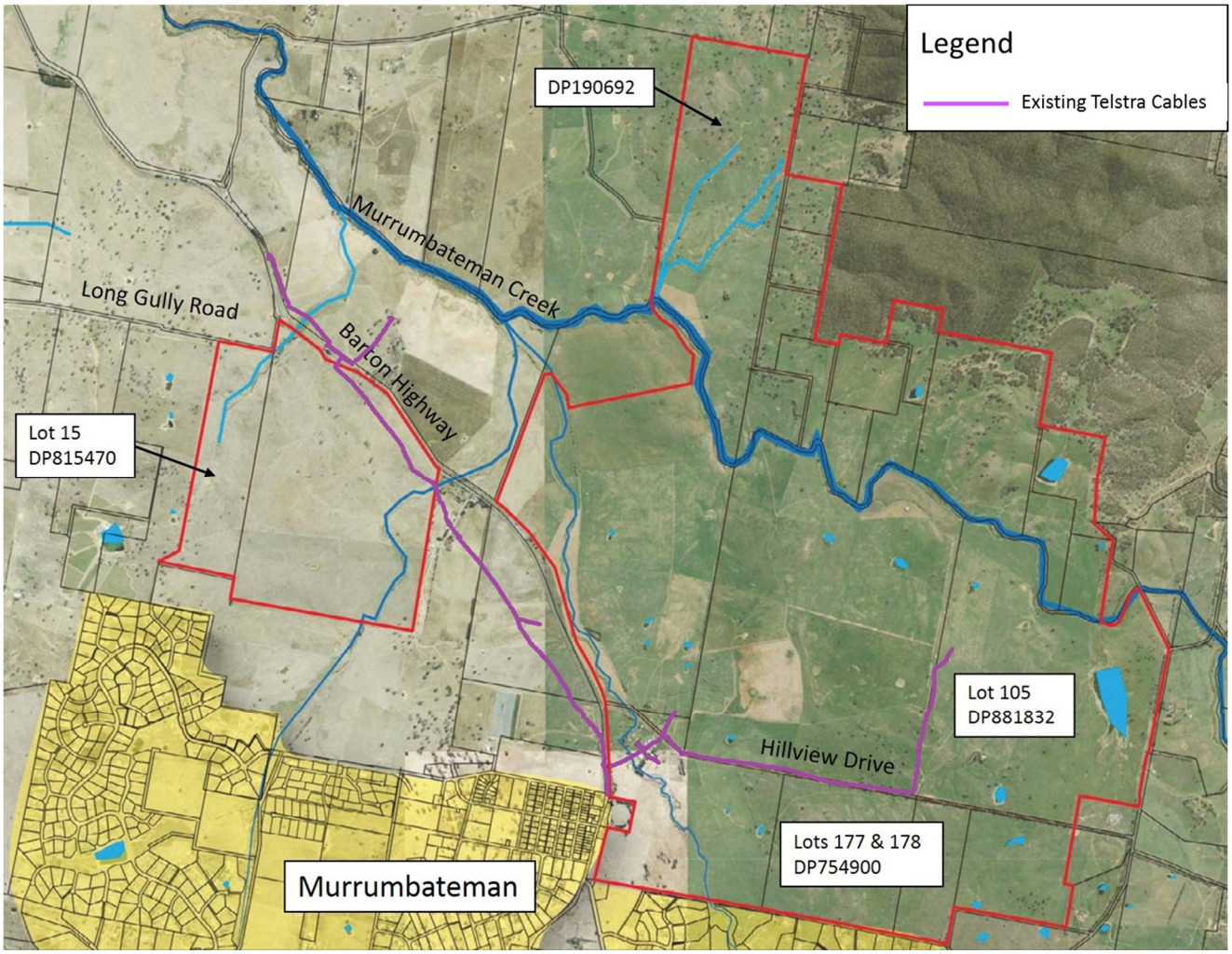


Figure 5 Existing Telstra Cables within the Study Area

2.7 Gas

There is no existing gas service within Murrumbateman. The nearest gas network is located in Canberra and Yass, which is 24km southeast and 20km northwest of the study area respectively.

3. POSSIBLE WATER SUPPLY INFRASTRUCTURE

3.1 General

YVC and ACTEW Water have been consulted to determine the potential opportunities and constraints to upgrading the water supply to Murrumbateman. Outcomes of the consultation and investigation are described in the following sections.

3.2 Water Demand

The water demand for potential urban development at Murrumbateman is calculated based on the following assumptions:

- Annual average water consumption – 300 kL/year/block (historical water consumption data provided by YVC)
- Peak day demand (PDD) – 1,600 L/s (as adopted for Googong Township, large block rural residential development)

Results of the water demand calculations for development scenarios from 3,000 to 13,000 blocks are summarised in **Table 2**.

Table 2 Water Demand for 3,000 to 13,000 Blocks

Blocks	PDD (ML/d)
3,000	5
6,000	10
9,000	15
13,000	22

Three options have been investigated and are described below.

3.3 Water from Canberra to Murrumbateman (C2M)

The Canberra to Yass Water Supply Pipeline Investigation report was prepared by ACTEW Water in 2006. The report investigated the opportunity for the construction of a Canberra to Yass water supply pipeline, with a design capacity of 5ML/day.

3.3.1 C2Y Pipeline Alignment

In order to deliver the water from Canberra to Yass, the report noted the following:

- Three pipeline alignments were investigated and Option 2, which runs along the Barton Highway and the existing 22kV electrical transmission easement was recommended for further investigation (refer to **Figure 6**).
- The pipeline would be approximately 50km long from Canberra to Yass and 24km from Canberra to Murrumbateman.

- A 300mm diameter gravity DICL pipe can supply 5ML/day and with a booster pump 8ML/day from Canberra (RL685) to Yass (RL561).
- The supply would require two connection points to the Canberra Water Supply Network, namely from :
  - 600mm diameter main off Nicholls Reservoir at the Barton Highway / Clarrie Hermes Drive intersection.
  - 900mm diameter main between the Kaleen Valve Farm and the Crace Reservoir (RL685) at the Barton Highway.
- The 600mm diameter main off Nicholls Reservoir has insufficient capacity on its own to supply 5ML/day to Yass. Thus, the second connection point is required to back up the system.
- The Gungahlin bulk supply may need to be upgraded by 2015 to supply 5 to 8ML/day to Yass and Murrumbateman.

3.3.2 ACT Water Availability

Brown Consulting met with ACTEW Water on 25 September 2014 to discuss the opportunities and constraints for supplying water to Murrumbateman from Canberra. ACTEW Water advised that:

- Canberra has high water supply security. The supply of water to Yass, Murrumbateman and Goulburn is included in ACTEW's Water long term development plans.
- The points of connection in the 2006 study were re confirmed.
- The existing Kaleen Valve Farm does not require upgrade to supply up to **8ML/day** to Yass/Murrumbateman. If water is supplied to Yass / Murrumbateman during off-peak time, approximately 15% more water (i.e. **9.2ML**) can be made available to Yass/ Murrumbateman. Therefore, no major infrastructure upgrade on the Canberra water supply system will be required to supply up to 9.2ML (equivalent of 5,700 blocks) to Yass / Murrumbateman. This will need to be reconfirmed with ACTEW Water prior to commencing any concept design.
- Potentially more water (>9.2ML/day) can be supplied to Murrumbateman due to a significant reduction in the land release areas in Gungahlin and lower water consumption from Canberra residents. Further to this advice, ACTEW Water has confirmed by email that up to 20ML/day (equivalent of 12,500 blocks) could be provided for the future development in Yass/Murrumbateman. However, supplying more than 9.2ML/day to Yass/Murrumbateman, as well as the potential major growth areas in Molonglo 3, West Belconnen and the northern parts of the ACT, will require significant Canberra bulk supply system upgrades in the next 10-15 years. Potential infrastructure upgrade will include one or combination of the following:
  - New Eastern Bulk Supply Main;
  - Booster pumping on Weetangera and Harcourt Hill Bulk Supply Main;
  - Augmentation/Duplication of Northern Bulk Supply Mains; and
  - Additional Nicholls Reservoirs.
- As policy, the developer is required to make contribution to the capital costs of these upgrades. ACTEW Water could not provide further details on what infrastructure would be required and the capital costs associated with the upgrades. Further investigation (including water modelling) will be required which would be triggered by a firm proposal.

» The developer is required to pay for all capital costs associated with the new pipeline construction and associated works to Murrumbateman.

» If required, ACTEW Water can operate and maintain the new pipeline outside ACT area.

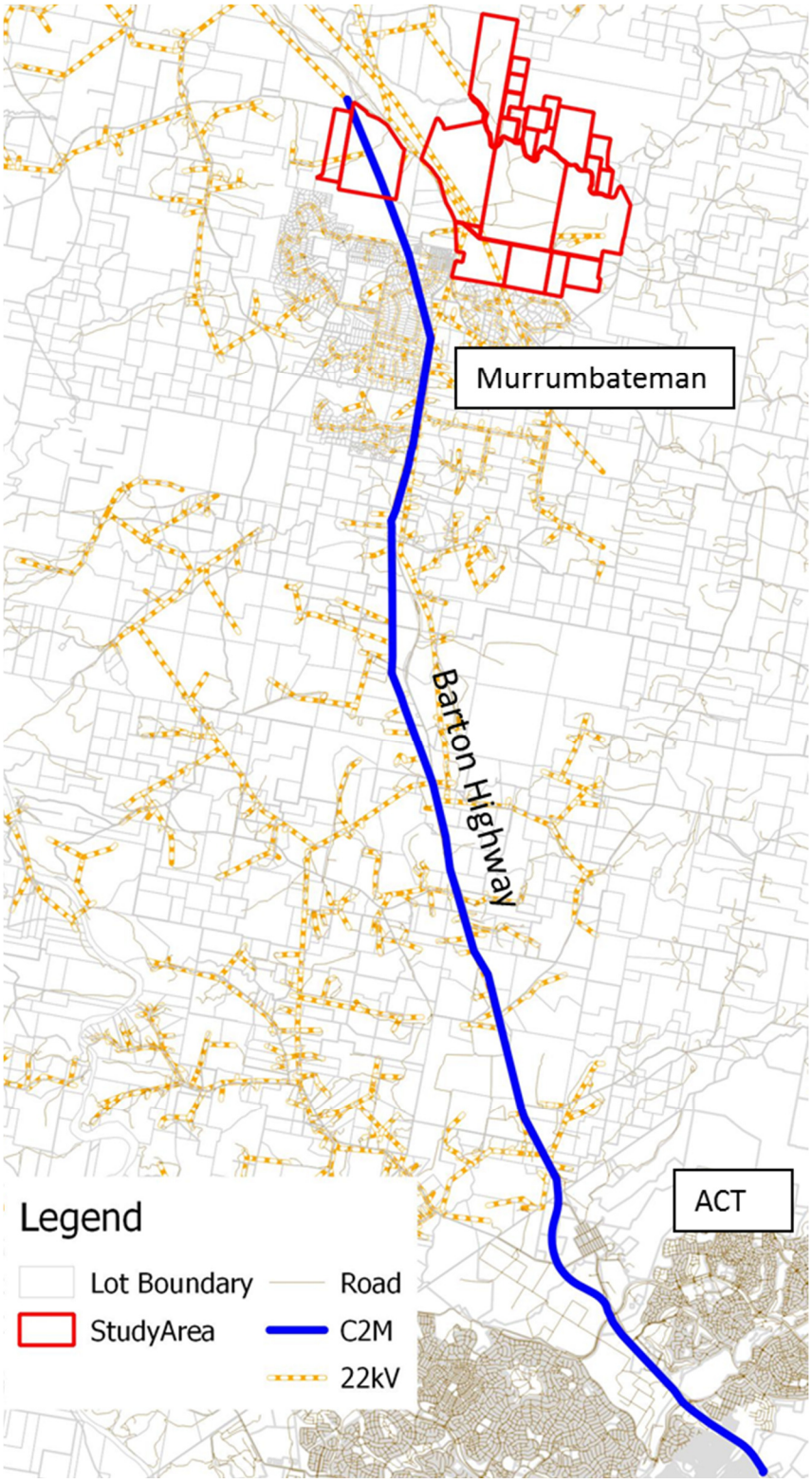


Figure 6 C2M Water Pipeline Alignment

3.3.3 C2M Pipeline Size

The Canberra to Yass Water Supply Pipeline Investigation was prepared based on 5 to 8ML/day of water being made available and supplied to Yass and Murrumbateman. A 300mm diameter DICL pipe will be required to deliver 5ML/day to Murrumbateman by gravity, which can service up to 3,000 blocks. The 300mm diameter pipeline can deliver up to 8ML/day to Murrumbateman with a booster pump in place. 8ML/day can service up to 5,000 blocks in the proposed development.

ACTEW Water advised that they are keen to provide water supply to service Murrumbateman, subject to confirmation on the infrastructure upgrades required in ACT. **Table 3** shows the proposed pipe size to service different scales of development by gravity. The pipe size was calculated based on static water head from RL585 to RL604 (20m head at the intersection of Hillview Drive/Barton Highway at RL 584). The head gradient is 0.42% over 24km long alignment.

Areas located higher than RL584 within the study area can be serviced a pump or header tank/reservoir. Alternatively, bigger pipe size will be required to service these areas.

A discussed in Section **3.3.2**, ACTEW Water can supply up to 9.2ML/day to Yass / Murrumbateman without major infrastructure upgrades. A 375mm diameter pipe will be required to supply 9.2ML/day, which can service up to 5,700 blocks by gravity. Once major infrastructure upgrades are undertaken, ACTEW Water can supply up to 20ML/day water to Yass/Murrumbateman. A 450mm diameter pipe will be required to supply 20ML/day to service up to 12,500 blocks by gravity. The proposed pipe size needs to be reviewed if and when a development layout is confirmed and site survey is made available.

Table 3 C2M Pipeline Size

Blocks	Water Demand (ML/d)	Pipe Size (mm)	ACT Water Supply Infrastructure Upgrade
3,000	5	300	N
5,000	8	375	N
5,700	**9.2**	**375**	**N**
6,000	**10**	**375**	**Y**
9,000	15	450	Y
12,500	20	450	Y
13,000	22	525	Y

3.3.4 Preliminary Cost Opinion for C2M

The costs to construct the Canberra to Yass (C2Y) water pipeline (300mm diameter DICL) was estimated at approximately $18 million in 2006, which is equivalent to approximately $26 million in 2014 dollar terms (assuming 5% increase per year). The costs for the Canberra to Murrumbateman (C2M) water pipeline was approximately $10 million in 2006, which is equivalent to approximately $15 million in 2014 dollar terms. The costs included the following:

» Pipeline construction (including 100m long microtunnelling under roads)

- Engineering design and construction supervision
- Planning approvals
- Land resumptions
- Survey, environmental controls and restoration
- Contingency (15%)

The above cost estimates excluded any costs associated with the water supply infrastructure required in ACT and any reservoirs required in the Yass/Murrumbateman region.

A breakdown of the costs is shown in **Table 4**.

In May 2014, YVC updated the cost estimates for the C2M pipeline based on the latest market rates. The revised costs for the construction of the C2M pipeline is now estimated at $28.1 million.

Table 4 Comparison of Cost Estimates for C2M Pipeline (300mm diameter DICL)

Items	ACTEW Water C2M 2006 Study ($2014)	Yass Valley Council C2M May 2014 Cost Estimates
Construction		
Construction	$11.0	$17.2
Design	$0.7	$2.0
Owners Cost		
Planning Approvals	$0.4	$0.7
Land Resumptions	$0.3	$0.5
Others	$0.6	$1.2
Contingency[1]	$2.0	$6.5
Total	**$15.0**	**$28.1**

1. Contingency is 15% for C2M 2006 Study and 30% for C2M 2014 Cost Estimates.

YVC's cost estimate is 87% higher than that of ACTEW Water's cost estimates for the C2M works. The significant cost increase is due to the factors listed below:

- Detailed cost item breakdown for two Canberra Offtakes works.
- Detailed quantity and cost estimates for all pipe fittings, including valves, thrust blocks, hydrants, flow meters etc.
- Rock excavation (assuming 30% of rock in trench), road crossings and top soil – these items were excluded from the 2006 study. Costs for rock excavation should be allowed for (as a contingency), especially with lack of information on ground condition.

- Design cost has been increased from 6% to 11% of the overall construction costs. This is considered to be reasonable due to uncertainty on the pipeline alignment, geotechnical, environmental and heritage issues, survey, public consultation, legal issues with change of land use, coordination with other service authorities and accommodation of possible gas main in the trench, etc.
- Overall contingency has doubled from 15% to 30% in the latest cost estimate. This is considered to be reasonable due to the uncertainty in design, ground condition, pipeline alignment and pipe material costs (DICL is currently only sourced from overseas).

Brown Consulting considers that YVC's latest cost estimates are adequate for preliminary planning and design purpose. Therefore, these cost estimates have been used as the basis to calculate the construction costs for 375mm, 450mm and 525mm diameter pipes, which would be required to service larger scales of development. The pipe supply and construction rate for each pipe size has been extracted and interpreted from the latest tender price for the Googong Integrated Water Management project.

A summary of the cost estimates for each pipe size is shown in **Table 5**.

Table 5 Cost Estimates for C2M Pipeline - 300mm to 525mm diameter DICL

Items	300mm Dia. 3000 Blocks	375mm Dia. 5,700 Blocks	450mm Dia. 9000 Blocks	525mm Dia. 13000 Blocks
Water Supply	5ML/day	9.2ML/day	15ML/day	22ML/day
Construction				
Construction	$17.2	$18.4	$22.0	$24.3
Design	$2.0	$2.25	$2.8	$3.1
Owners Cost				
Planning Approvals	$0.7	$0.75	$0.9	$1.0
Land Resumptions	$0.5	$0.5	$0.6	$0.7
Others	$1.2	$1.35	$1.7	$1.9
Contingency[1]	$6.5	$7.0	$8.4	$9.3
Total	**$28.1**	**$30.3**	**$36.4**	**$40.3**
Difference from 300mm Diameter Pipe		**+8%**	**+30%**	**+44%**
Cost/Block	**$9353**	**$5,311**	**$4,040**	**$3,105**
ACT Water Supply Infrastructure Upgrade Costs Contribution*	**N**	**N**	**Y**	**Y**

*ACTEW Water advised that further investigation will be required to confirm potential upgrades and the costs contribution from the developer required to supply more than 9.2ML/day to Yass / Murrumbateman.

The above table above shows that the cost to construct a 375mm diameter pipe to supply up to 9.2ML/day is 8% more expensive than that of a 300mm diameter pipe. However, a 375mm diameter can service an additional 2,700 blocks, which makes the cost per block for this pipe size is 43% cheaper than that of a 300mm diameter pipe.

As discussed in Section **3.3.2**, major infrastructure upgrades will be required for the ACT water supply system if more than 9.2ML/day is to be supplied to Yass/Murrumbateman.

The above cost estimates will need to be further refined during design should a project proceed.

3.3.5 C2M Pipeline Issues

The following issues were identified in the report:

- Pipeline ownership was not addressed in the ACTEW Water report. It is assumed that ACTEW Water would own the asset to the ACT Border, similar to the Googong development arrangement.
- The existing electrical easement may need to be widened to accommodate the new pipeline.
- ACTEW Water advised that 20ML/day can be made available to Yass/Murrumbateman. However, there may be non-technical issues, e.g. political, financial and climate change, which may impact on the availability of water.
- The long detention time for water to travel from Canberra to Murrumbateman may cause increase in pH of the water. pH adjustment (top up at the header tank) and water quality test will be required at Murrumbateman.

3.4 Water from Yass to Murrumbateman (Y2M)

In 2012, YVC raised the existing Yass Dam wall from 12m to 15m to provide up to 2466 ML storage capacity. The upgraded Yass Dam is expected to service 13,000 people in Yass and 2,500 people in Murrumbateman. The study area at Murrumbateman has not been considered in this water supply scheme.

Water from Yass Dam will be delivered to a new 2.5ML reservoir at Murrumbateman via a 200mm or 250mm diameter pipe and a new pump station. The proposed pipeline will cost approximately $12 million.

YVC has already applied funding from “Water Security for Region” to undertake design of the new pipeline and pump system. It is expected to construct the pipeline by 2020.

3.5 Reservoirs

New reservoirs can be constructed to service the proposed development. Reservoir size is calculated based on Peak Day Demand from the development plus a 30% safety factor, which was adopted in the Googong Township reservoir design. The reservoirs will need to be fed by water from Canberra or Yass (i.e. C2M or Y2M pipeline).

Table 6 Possible Water Reservoirs for 3,000 to 13,000 Blocks

Blocks	PDD (ML/d)	Reservoir Size (ML)
3,000	5	7
6,000	10	14
9,000	15	21
13,000	22	30

The new reservoir(s) can be located between RL620 and RL640, which are the highest level within the study area. Three possible reservoir sites are identified and are shown on **Figure 7** Size of the pipeline and reservoir need to be reviewed at design stage.

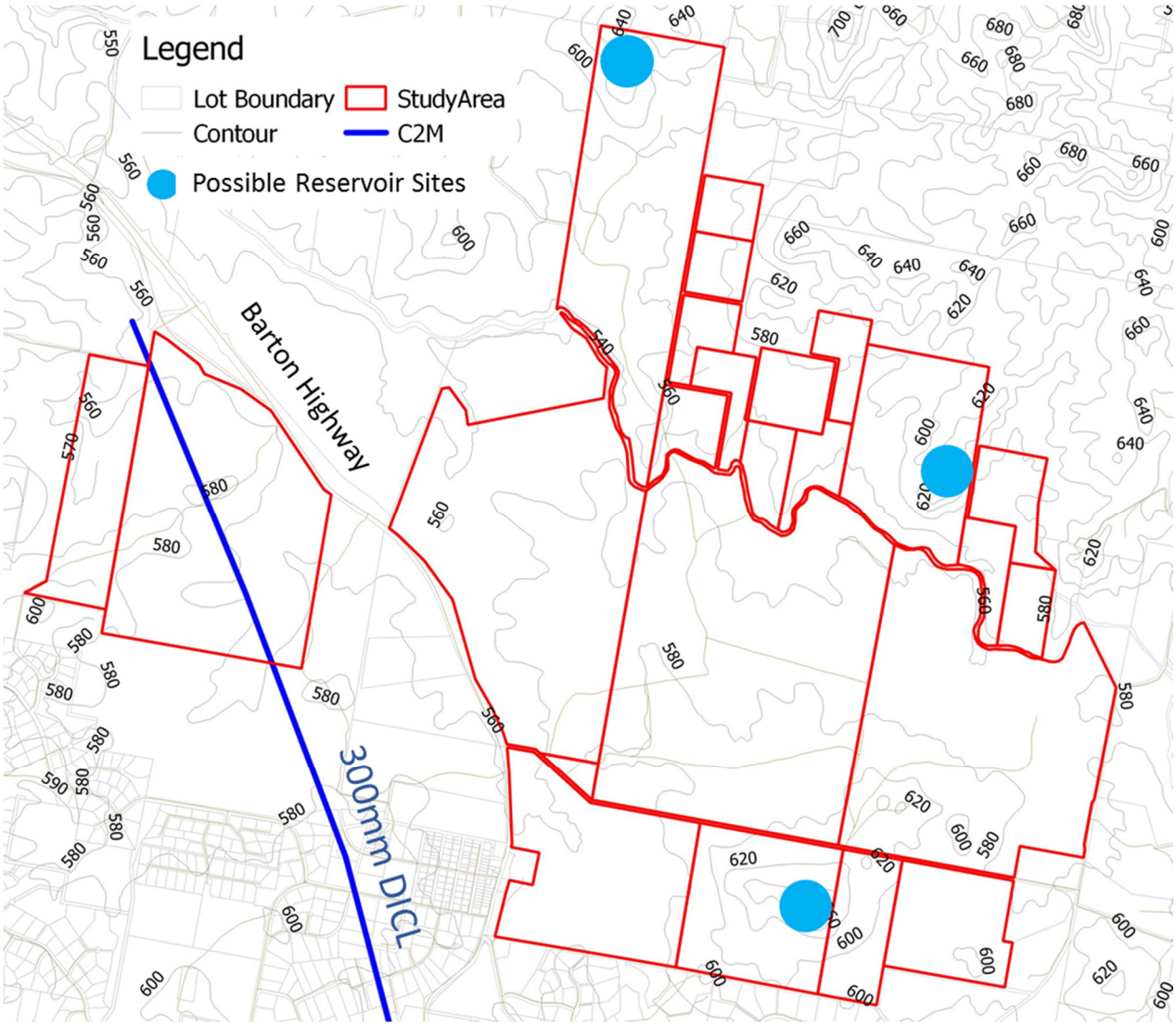


Figure 7 Possible Water Reservoir Sites

3.6 S64 Developer Charges

YVC advised that the current developer charges for water supply in Murrumbateman is approximately $23,000 per lot. This is not applicable to the study area as it is excluded from the current Developer Charges area. The applicability (or otherwise) of water supply charges to the subject site would be dependent on whether any development of the subject land directly funds all or part of the water supply infrastructure. If for example the developer funded all of the required C2M infrastructure for a project at Murrumbateman YVC would be unlikely to be entitled to levy additional water supply charges, but this would need to be negotiated as part of a Planning Agreement.

3.7 Further Investigation

Detailed water modelling will be required to analyse and review the size of the bulk pipeline from Canberra or Yass and reservoir/on site storage. Pipeline alignment needs to be reviewed based on detailed site survey and geotechnical investigation. Consultation with relevant stakeholders and services authorities will be required to discuss the easement width and change of land use. Other studies (e.g. environmental and heritage) will be required during the design process.

4. POSSIBLE SEWERAGE INFRASTRUCTURE

4.1 General

Yass Valley Council has been consulted in order to determine the adequacy of existing sewerage services at or near the study area to meet the likely estimated demands associated with the potential development. The sewerage infrastructure required to service a significant project at Murrumbateman is described in the following sections.

4.2 Sewage Flow

The sewage flow calculation for the proposed development is based on the following assumptions adopted from the *Murrumbateman Sewerage Scheme*:

- 3 EP per block
- 210 L/EP/day
- Peak Wet Weather Flow (PWWF) equals to 4 times of Average Dry Weather Flow (ADWF)

Details of sewage flow calculations for a 35 year planning horizon are summarised in **Table 7**.

Table 7 Sewage Flows (Yass Valley Council Standards)

Blocks	EP	ADWF (ML/d)	PWWF (ML/d)
3,000	9,000	1.9	7.6
5,700	17,100	3.6	14.4
6,000	18,000	3.8	15.1
9,000	27,000	5.7	22.7
13,000	39,000	8.2	32.8

The provision of reticulated wastewater service to any significant urban expansion of Murrumbateman (beyond YVC's current projections) will require centralised wastewater treatment and disposal. Preliminary assessment has been undertaken to identify a conceptual wastewater treatment strategy, taking into account the sewerage scheme augmentation proposed by YVC.

4.3 Sewerage Infrastructure Proposed by YVC

In 2013, YVC has engaged NSW Public Works to investigate the Murrumbateman Sewerage Scheme Augmentation. The sewerage scheme proposes to service the existing and future development area, west of Hillview Drive (refer **Figure 8**). The scheme consists of two stages and details of each stage are shown in **Table 8**.

Table 8 Murrumbateman Village Sewerage Scheme

Stage	Capacity	System Components	Construction Start
1	1500 EP	» 1.7km long reticulation mains within the village. » A new sewage pluming station (SPS). » 2.3km long rising main from SPS to STP. » A new oxidation type STP. » A new effluent pumping station, recycled wet weather water storage pond and irrigation system	April 2015
2	3000 EP	» New reticulation mains for Stage 2 development. » A new conventional sewage treatment plant.	> 2030

Treated effulent is dispearsed by irrigation to adjacent lands rather than discharge into Murrumbateman Creek.

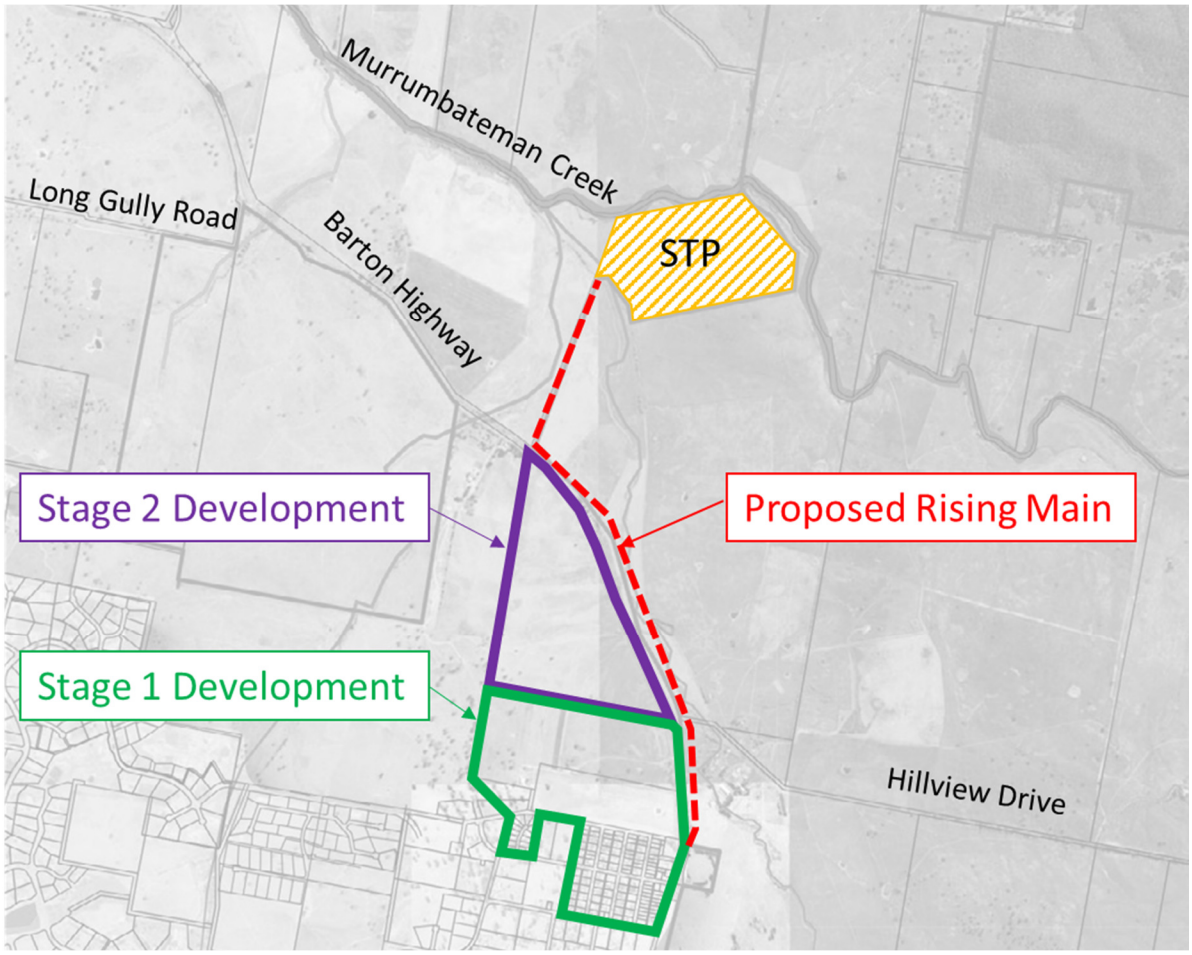


Figure 8 Murrumbateman Village Sewerage Scheme Augmentation 2013

As detailed within the Yass Valley Council Murrumbateman Sewerage Scheme Report No.DC13141, Stage 1 of the development will require a treatment plant to service the initial 1,500 EP. YVC have indicated their

preference is for an oxidation pond treatment process such as an Intermittently Decanted Aerated Lagoon. Treatment of wastewater through oxidation lagoons generally produces treated effluent of a lower quality, which is only suitable for controlled irrigation.

As identified within Table 5-7 of the Sewerage Scheme Report, an ADWF up to 0.24ML/day (1,119 EP) will require a minimum irrigation area of 30 ha. Land use access restrictions will remain subject to the quality of effluent treatment achieved and irrigation methods (i.e. Spray Irrigation vs Sub-surface). Additional tertiary treatment would be required to achieve an effluent quality suitable for non-potable reuse within households and industrial processes as well as unrestricted/uncontrolled irrigation.

The Murrumbateman Sewerage Scheme proposes to reuse most of the treated effluent for controlled irrigation. However, irrigation is not required during winter period. Excess treated effluent will need to be discharged to the Murrumbateman Creek (refer to Section 4.1.5 of the Murrumbateman Sewerage Scheme Report). The report notes that tertiary level of sewage treatment would be required for this option to be acceptable to the EPA. The EPA has advised that "Sensitive Waters" standard would be required for discharge to Murrumbateman Creek. Based on our past experiences on similar size projects, an IDAL treatment plant will be unable to achieve the treated effluent criteria nominated by EPA.

Expansion of the currently proposed YVC STP to service development beyond 3,000 EP would require significantly more irrigation area. Assuming land availability, over a thousand hectares would be required to irrigate treated effluent for the ultimate Murrumbateman development of 39,000 EP. This is not deemed to be feasible. The proposed Murrumbateman Development is located south of Yass River and northeast of Murrumbidgee River. All tributaries around the development flows towards these two rivers, which are the main source of water supply to Yass and Murrumbidgee Irrigation Area. Therefore, secondary treated effluent from the Murrumbateman Development cannot be discharged directly to nearby tributaries. An alternative wastewater disposal method would be required, which has not been determined at this time. On this basis a higher level of treatment (MBR) is deemed to be required to allow effluent reuse and/or discharge to the Murrumbateman Creek.

4.4 Treated Effluent Quality Requirements

Typically, EPA license requirements determine the minimum quality and quantity of wastewater treatment required. Licensing requirements generally stipulate the volume of treated effluent that is allowed to be discharged into the local environment during normal operation. In wet weather events where flows exceed the nominated minimum treatment capacity they typically bypass the STP and discharge directly to the nominated water course.

It is expected that the Murrumbateman STP will have a minimum capacity that is equivalent to three times the ADWF of the relevant development stage. The quality and quantity of the proposed STP remains subject to the quality of the receiving waterway and EPA requirements.

Through previous treated effluent disposal investigations undertaken in accordance with EPA specifications, it is understood that the parameters detailed within **Table 9** are generally acceptable for discharge to natural creek environments.

Table 9 Parameters to be monitored for Effluent Discharge to Murrumbateman Creek

Parameter	Unit	Value
pH	pH	6.0 - 9
Free Chlorine Residual	mg/L	≤0.2
Faecal Coliforms	Coliform Forming Units/100mL	≤10
Chemical Oxygen Demand (COD)	mg/L	≤25
Suspended Solids	mg/L	≤5
Total Dissolved Solis	mg/L	80th percentile ≤ 1000
Total Nitrogen	mg/l	≤15
Total Phosphorous	mg/l	≤0.2
Nitrogen to phosphorous Ratio	-	≥12:1
Turbidity	Nephelometric Turbidity Units (NTU)	<2
Helminth	Helminth/L	<1
Protoza	Protoza/50L	<1
Virus	Virus/50L	<1

These values have been adopted for the purpose of this preliminary investigation however they will require revision once EPA licensing requirements have been nominated for the Murrumbateman development.

Where treated effluent is to be disposed via irrigation, additional effluent parameters must be satisfied. **Table 10** details these additional effluent parameters specified within the Wastewater Reuse for Irrigation Environmental Protection Policy (ACT 1999).

Table 10 Effluent Parameters for Surface Irrigation

Parameter	Unit	Value
Thermotolerant Coliforms	cfu/100 ml	<10
Free Chlorine Residual	mg/L	≥1 mg/L OR equivalent level of pathogen removal

To achieve the above quality of treated effluent a high level of tertiary treatment will be required.

4.5 Proposed STP

4.5.1 Sewage Treatment Plant Options

An initial review of potential Sewage Treatment processes was undertaken to identify secondary treatment processes capable of processing large volumes of wastewater from the Murrumbateman Development, whilst

maintaining high quality treated effluent suitable for reuse. The following secondary treatment processes has been reviewed during the study:

- Membrane Bioreactor (MBR);
- Sequencing Batch reactor (SBR);
- Rotating Biological Contactor (RBC);
- Conventional Activated Sludge;
- Constructed Wetlands;
- Surface Aerated Lagoons; and
- Intermittently Decanted Aerated Lagoons (IDAL).

YVC proposes to use an oxidation pond treatment process such as an Intermittently Decanted Aerated Lagoon (IDAL) to service the Stages 1 and 2 development identified in the current LEP as shown on **Figure 8**.

The table below summarises the advantages and disadvantages of the IDAL and Membrane Bioreactor (MBR) sewage treatment technology associated with the proposed Murrumbateman Development.

Table 11 Comparison of IDAL and MBR Technology

Treatment Technology	Advantages	Disadvantages
Intermittently Decanted Aerated Lagoon (IDAL)	» Lower capital costs than a MBR treatment plant of same capacity. » Lower operational and maintenance costs than a MBR treatment plant of same capacity. » Lower energy costs than a MBR treatment plant of same capacity.	» Lower quality of treated effluent which is generally suitable for controlled irrigation practices only. » Large irrigation area required. Over 1000 ha for ultimate Murrumbateman development (39,000 EP). » Unlikely to be able to achieve EPA effluent quality parameters for discharge to Murrumbateman creek. » Additional tertiary treatment required to achieve effluent quality suitable for non-potable household reuse or discharge to Murrumbateman creek. » Larger footprint required that than a MBR treatment plant of same capacity. » Larger volume of sludge by-product which need appropriate treatment and disposal.

Treatment Technology	Advantages	Disadvantages
Membrane Bioreactor (MBR)	» High quality treated effluent produced which is suitable for reuse within households, industrial processes and uncontrolled irrigation. » Available as a package treatment plant which can be easily transported and installed at the proposed treatment plant location. » Easy to expand and increase treatment capacity to match development growth. Allows offset of ultimate treatment plant as package plants can be staged as necessary. » Smaller volume of sludge by-products than that of IDAL process. » Easier to manage odour and reduce buffer zones.	» Higher capital cost than an IDAL treatment plant of same capacity. » Higher operational and maintenance costs than an IDAL treatment plant of same capacity.

MBR technology is recommended to service the proposed Murrumbateman Development due to the following reasons:

1. Available in transportable package treatment plants with small footprint;
2. Easy to duplicate and increase capacity to match development growth; and
3. Capable of treating large volumes of wastewater to a high standard of quality suitable for reuse (i.e. non-potable household, industrial processed, open space/farmland irrigation).

The following activities should be undertaken during concept design stage to refine requirements for the treatment technology:

» Raw wastewater quality has been estimated;

» The existing Murrumbateman creek quality has been assessed; and

» Effluent quality requirements have been defined by the EPA.

Figure 9 below provides a general process flow chart for selecting appropriate sewage treatment technology once site specific information has been defined.

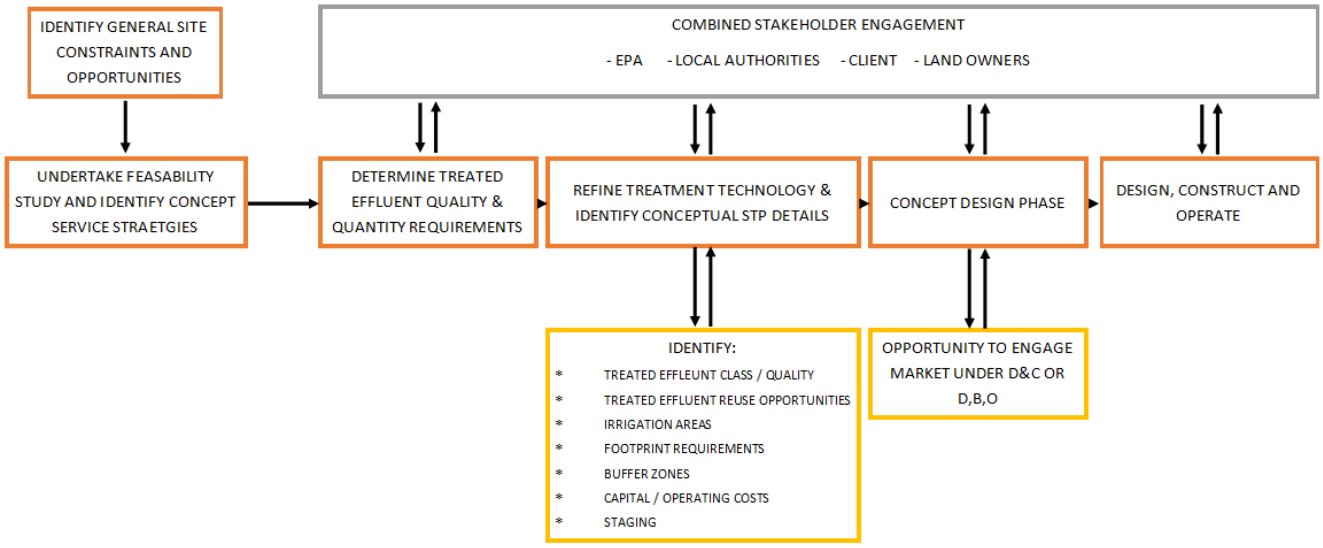


Figure 9 Sewage Treatment Plant Selection and Design Process Flow Chart

4.5.2 MBR Staging Strategy

With the Murrumbateman development projected to grow by approximately 3,000 lots every 10 years over the next 35 years, it is proposed that the MBR treatment facility be staged in a similar fashion. With the capacity MBR package plants easily expanded, it is proposed that duplication of the facility occur in line with the population growth across the following 35 years. Subject to the rate of development, duplication of the treatment facility may be staged to occur every 5 to 10 years over the life of the development, effectively spreading the capital cost of the ultimate facility across the ultimate development period. **Table 12** details the STP minimum capacity requirements to match the projected growth of the Murrumbateman development.

Table 12 MBR Staging Strategy

Blocks	EP	PWWF (ML/d)	STP Minimum Capacity (ML/day)*
3,000	9,000	7.6	5.7
6,000	18,000	14.4	10.8
9,000	27,000	22.7	17
13,000	39,000	32.8	24.6

* STP minimum capacity adopted as 3 x ADWF

4.5.3 Preliminary Opinion of Costs

A preliminary opinion of cost has been prepared for the proposed MBR sewage treatment plant required to service the four stages of the Murrumbateman development. The following opinion of cost has been produced in accordance with similar scale projects, with the minimum capacity of the STP assumed to be three times the ADFW produced for each stage of development. The preliminary costs detailed within **Table 13** include the following:

» Civil Construction Work;

- Mechanical Construction Work;
- Electrical & Telemetry Construction Work;
- On-Costs (20%); and
- Contingency (30%).

Table 13 Preliminary Opinion of Costs for Murrumbateman STP

Items	3,000 Blocks 5.7 ML/Day	6,000 Blocks 10.8 ML/Day	9,000 Blocks 17 ML/Day	13,000 Blocks 24.6 ML/Day
Construction				
Civil Work	$14.7M	$24.4M	$36.8M	$51.6M
Mechanical Work	$8.8M	$14.7M	$22.1M	$31.0M
Electrical & Telemetry Work	$5.9M	$9.8M	$14.7M	$20.7M
[1]**On-Costs**	$5.9M	$9.8M	$14.7M	$20.7M
[2]**Contingency**	$10.6M	$17.6M	$26.45M	$37.2M
Total	$45.9M	$76.2M	$114.7M	$161M
Difference from STP for 3,000 Blocks		+$30.3M	+$68.8M	+$115.1M
Cost / Block	$15,300	$12,700	$12,739	$12,385

Table 13 shows that the capital costs to construct a MBR STP for the various development scenarios from 6,000 to 13,000 blocks is significantly higher than the scenario for 3,000 blocks. However, the cost per block for a MBR STP is generally similar for the development scenarios from 6,000 to 13,000 blocks.

4.5.4 Location of STP

The previous report Murrumbateman Sewerage Scheme, Review of Environmental Factors (December 2013, Yass Valley Council) proposed a treatment plant site adjacent to Murrumbateman Creek and the Yass River on a 35ha site. An area of this size is considered suitable for either package treatment plants or a conventional treatment plant. If land is at a premium a conventional plant footprint is expected to fit within a 5ha area with a 10ha overall site. This does not include irrigation area for effluent disposal by irrigation.

Further analysis is required to determine flood levels and confirm treatment plant location constraints.

Discussion with Yass Valley Council referred heavily to the Murrumbateman Sewerage Scheme (2013) which identifies a buffer of 50m from the boundary. However the YVC is under the impression that the proposed STP location is to be located in a rural area and that setback requirements would not be critical.

As a gauge, a review of the NSW DPI Development Control identifies sewerage works have a recommended minimum buffer of 400m from residential areas. It is recommended that further liaison with YVC and authorities is undertaken to confirm surrounding land use and minimum buffer distances.

An odour impact assessment is required which could result in a requirement for odour controls with potential to reduce the buffer requirements. Best practice recommends treatment facilities are located in an Industrial Zoned area.

4.5.5 Opportunities and Constraints

The closest point to discharge effluent would be Murrumbateman Creek or the Yass River. A very high level of sewage treatment would be required for this option of effluent disposal to be acceptable to the EPA. The EPA has advised that a "Sensitive Waters" standard would be required for discharge to Murrumbateman Creek. Recycled water reuse for irrigation could be utilised to minimise discharge of effluent to the creek. Availability of a suitable irrigation area is a constraint which requires further investigation to determine if effluent can be irrigated on site, or if it will need to be discharged to a water course. This in turn will impact the treatment technology used and costs.

When irrigation is utilised to dispose of effluent wet weather attenuation storage will be required. It is anticipated that the size of tanks for a 39,000 EP treatment plant will be significant and requires large footprint.

Opportunity exists for dual reticulation to be utilised to dispose of treated effluent. A water balance analysis is required to confirm if effluent can be recycled and used within the development, or if surplus effluent will be discharge to a water course. The costs of a reticulated recycling scheme will be significant and would require further investigation. At Googong the extra over cost of the recycled water reticulation within the subdivision is about $3,000 per block.

While the Murrumbateman Sewerage Scheme (2013) discusses a 100 year ARI flood levels, the recommended flood level was determined to be 552.8m AHD and YVC has adopted a design level of 554m AHD. It should be noted that the STP may be classified as critical infrastructure, and thus more robust flood immunity may be required

Ideally a treatment plant should be located in an industrial zoned area or rural area. If there are minimum industrial zoning requirements for the development they should be located near the proposed plant. If residential areas are proposed adjacent to the STP there may be land wastage due to minimum required buffers.

4.6 S64 Developer Charges

YVC advised that the current developer charges for sewerage services in Murrumbateman is approximately $14,000 per lot. This is not applicable to the study area as it is excluded from the current Developer Charges area. The applicability (or otherwise) of sewer service charges to the subject site would be dependent on whether any development of the subject land directly funds all or part of the required infrastructure. If for example the developer funded all of the required sewerage infrastructure required for a project at Murrumbateman, YVC would be unlikely to be entitled to levy additional sewer service charges, but this would need to be negotiated as part of a Planning Agreement.

4.7 Further Investigation

Further investigation will be required to address the following issues:

- Effluent quality and nutrient loading requirements for discharge to water courses and irrigation.
- Feasibility of recycled water reticulation.
- How much of the 35ha site previously identified is suitable for a treatment plant site.
- Odour impact assessment
- Possible projection of the plant use beyond 2050.
- Community Consultations.

5. POSSIBLE UTILITIES INFRASTRUCTURE

5.1 Electrical

Essential Energy advised that:

- Arrangements with the specific requirements needs to be confirmed as part of a progressive service planning, design and installation process.
- In NSW, the capital contribution and contestable work arrangements impose requirements on both the developer and the Distribution Network Service Provider (DNSP) in the provision of electricity supply to residential developments.
- The developer is responsible, through the use of Accredited Service Provider's (ASP), for the installation of the required Medium Voltage and Low Voltage electricity supply infrastructure leading up to and within the development in accordance with design requirements provided by Essential Energy (EE).
- The DNSP (EE) is responsible for the provision of shared assets (head works) required to provide the primary supply capacity needed to service the development load demand.
- The existing loads in the vicinity of Murrumbateman are supplied from the EE Murrumbateman Zone Substation via a 22kV distribution network with the available capacity constrained by construction design ratings limiting supply capacity to 750 lots (approx.) for Murrumbateman without network upgrade.
- The existing EE distribution network assets will require expansion and capacity augmentation to supply the demand resulting from any development at Murrumbateman beyond approximately 750 lots. The works include establishment of a new EE supply point from the 132kV transmission system in the study area or provision of additional 22kV feeders (1 feeder per 2500 lots approx.) to provide the required capacity from the existing distribution network and zone substation. It should be noted that supply from the existing network would also require eventual upgrade of the existing Murrumbateman zone substation. Consideration should also be given for the required lead times to achieve these network upgrades that could be two to three years (approx.) for a new EE supply point and one to two years for an additional 22kV feeder and upgrade of the existing zone substation.

It is assumed from the above advice and cognisant of the Googong experience that EE will be responsible for the provision and cost of trunk power infrastructure to support any development. The developer is required to pay for the medium and low voltage infrastructure (i.e. the reticulation in the subdivision). This is typically in the order of $6,000 per lot. Relocation of any local medium and low voltage services would also be at the developer's expense and in addition to the per lot cost.

5.2 Telecommunications

NBN Co advised that they will service any proposed development with submission of a formal application. NBN's online rollout maps shows that there is a Building Preparation area in Yass. The new NBN network can be provided from Yass or Canberra subject to further investigation.

Other communications (e.g. Telstra) authorities may choose to provide services to the development and should be consulted during the Development Application phase of the development. It is noted that NBN are able to provide the full service to the entire development.

Although NBN will provide communications at no cost, the Developer is required to design and construct the pit and pipe network to accommodate the network. This is typically $1,200 per lot. Relocation of any affected local service would be in addition.

5.3 Gas

Brown Consulting met with ZNX and ActewAGL on 28 October 2014 to discuss the opportunities and constraints for providing gas services to the proposed development from Canberra. ZNX advised that significant development at Murrumbateman can be serviced by construction of a new gas main from Canberra to Murrumbateman or a new Compressed Natural Gas Station in Murrumbateman.

5.3.1 Option 1 – High Pressure Steel Main from Canberra to Murrumbateman

ZNX advised that:

- The existing Canberra gas network has sufficient capacity to service the proposed development
- A 150mm diameter high-pressure trunk steel main (1,050 kPa) extension is required to service the proposed development. The new gas main will be approximately 30km long, from the existing steel main adjacent to the intersection of Gundaroo Drive and Barton Highway to Murrumbateman.
- The new gas main can be accommodated in the proposed bulk water main easement, which could save up to 30% construction costs if constructed at the same time. ACTEW has been consulted and agree with this arrangement.
- The gas main can be designed to avoid electrical interference from the existing overhead or underground powerlines.
- Capital contribution to the construction of the gas main will be required from the developer. ZNX were not able to quantify actual cost at this early stage. At Googong the Developer was required to make a $2.0million contribution to the cost of providing the 5km trunk connection from Queanbeyan. In the Murrumbateman context this would be in the order of $15 million assuming similar conditions. This excludes any potential savings from a shared alignment.
- ZNX will be responsible for ongoing operation and maintenance of the new gas main.
- ZNX will be responsible for the design and documentation of the new gas main, with cost contribution from the developer. The cost contribution will be determined during concept design stage.
- This option is considered to be more cost effective and reliable than Option 2 in the long term.

5.3.2 Option 2 – Compressed Gas Station

ZNX advised that:

- A new compressed natural gas station can be built within the development. The gas station will be fed by compressed gas transported (via truck) from Fyshwick to Murrumbateman.
- Gas can be reticulated to the Murrumbateman residents from the station.
- The gas station can be expanded to suit the staging of the development.
- The gas station location will need to be designed to minimise impact to the future residents. A safety zone will be required around the station.

- There is no existing gas station in ACT. However, there is similar ones in Victoria.
- ZNX will be responsible for the design and documentation of the new gas station, with cost contribution from the developer. The cost contribution will be determined during concept design stage.

5.3.3 Project Issues

ZNX advised that the gas supply costs will be increased in the future. However, the magnitude of the cost increase is unknown and unpredictable. This should be considered as the potential financial risks to the project. In addition, gas consumption has been reduced due to the improved efficient in appliances. This will result in gas cost increase in the development.

ActewAGL will require a 10 year cashflow for the proposed works to apply for funding. Developer contribution to the project costs will be determined in design stage.

6. BARTON HIGHWAY DUPLICATION

6.1 Overview

In 2007, the Barton Highway was noted as the worst highway on the Auslink Network in NSW. The Australian Government is funding planning for the future duplication of the existing carriageway sections of the Barton Highway, between the ACT border and the dual carriageways north of Murrumbateman. The total length of the road duplication is approximately 33km, including an eastern bypass of Murrumbateman.

6.2 Current Status

The Australian Government committed a total of $40 million to the Barton Highway Safety Works Package only. Details on the funding allocation to the Safety Works Package are shown in **Table 14**.

Table 14 National Partnership Agreement on Land Transport Infrastructure Projects - Barton Highway Safety Works Package

Barton Highway Safety Works Package	2013-2014	2014-2015
Planning and land acquisition for duplication and safety works	$3.5 million	-
Preconstruction	$2.56 million	$1.31 million
Gounyan Curves Realignment	$20.32 million	$0.23 million
Murrumbateman Road Intersection and Curve Improvements	$4.08 million	$0.55 million
McIntosh Circuit Intersection Improvement	$0.32 million	$4.28 million
Barton Highway Improvement Strategy	-	$0.15 million

During the roundtable discussion held on 5 September 2014, State MP's Katrina Hodgkinson and Pru Goward, and Federal Member for Hume Angus Taylor, met with Yass Valley Mayor Rowena Abbey, YVClors and RMS regional manager Lindsay Tanner to discuss the Barton Highway Duplication project. YVC advised that Barton Highway duplication will not commence in 15 years (i.e. Year 2029).

7. FINDINGS AND CONCLUSIONS

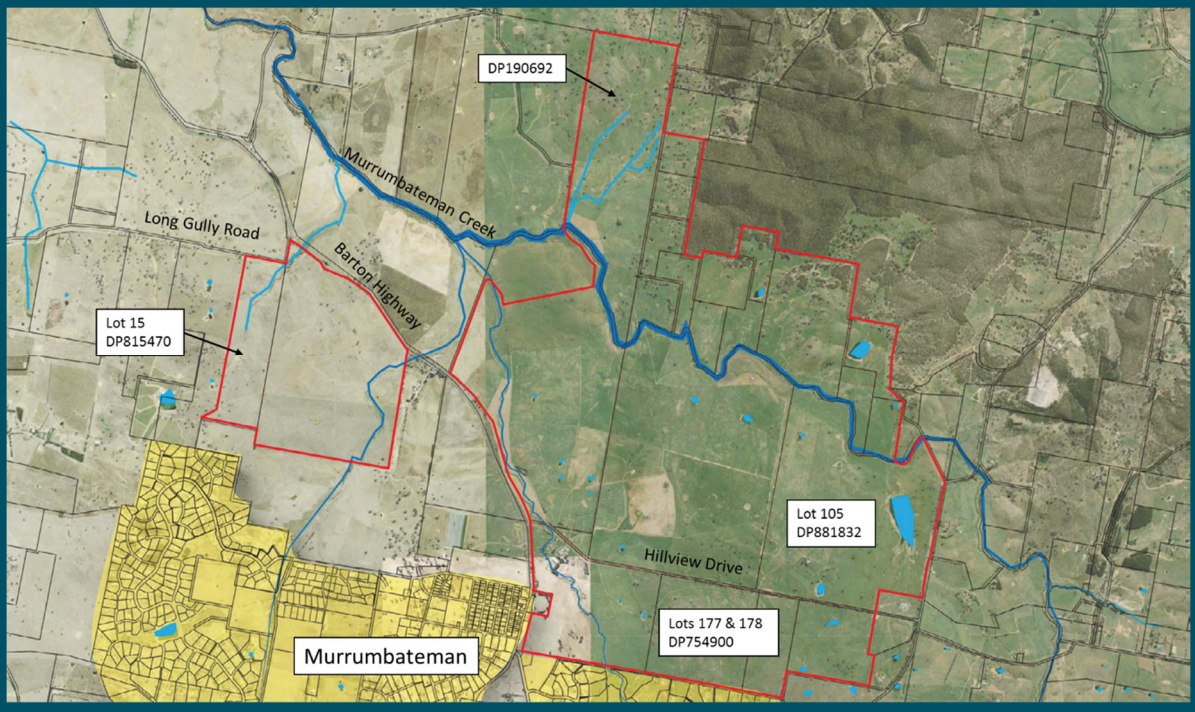
The outcomes of the feasibility study are summarised below:

Table 15 Summary of Study Outcomes

Services	Existing Infrastructure	Proposed Trunk Infrastructure
Water Supply	Water supply for the existing Murrumbateman Village Core is sourced from two bores and two reservoirs. Areas outside the Village Core is supplied by individual rainwater tanks. Groundwater is untreated and has high hardness and elevated nitrate levels, which does not meet the Australian Drinking Water Guidelines. The existing water supply infrastructure has insufficient capacity to service future development in Murrumbateman.	A new 24km long DICL pipeline from Canberra to Murrumbateman (C2M). Up to 9.2ML (approximately 5,700 blocks) can be supplied from the existing ACT Water network without major upgrades. The proposed pipe size ranges from 300mm to 525mm diameter, for development scenarios from 3,000 to 13,000 blocks. The cost to construct the new pipeline is between $28.1M to $40.3M to service 3,000 to 13,000 blocks respectively. Extra costs will be required to upgrade the ACT water supply infrastructure if supply more than 9.2ML to Murrumbateman.
Sewerage	There is currently no existing centralised sewage treatment plant nor sewage pipe network in Murrumbateman. A majority of the residences are serviced by the individual septic tanks or aerated wastewater treatment systems with onsite effluent disposal via trench absorption systems. Septic systems are not recommended for any future development in Murrumbateman. The existing sewerage infrastructure is inadequate for the proposed development.	A new Membrane Bioreactor Sewage Treatment Plant to service the proposed development. Capacity of the proposed MBR STP ranges from 5.7ML/day to 24.6 ML/day to service various development scenarios from 3,000 to 13,000 blocks. The costs to construct the MBR STP ranges from $45.9M to $161M to service 3,000 to 13,000 blocks respectively.
Electricity	Four existing 22kV overhead powerlines traverse the study area. The existing electrical network needs to be upgraded to service the proposed development.	New supply point from 132kV network or new 22kV feeder for every 2,500 blocks and upgrade existing substation. The developer is required to pay for the reticulation network.

Services	Existing Infrastructure	Proposed Trunk Infrastructure
Telecommunications	There are existing Telstra small copper cables within the study area. The existing telecommunication infrastructure needs to be upgraded to service the proposed development.	New NBN network will be required to service the development.
Gas	There is no gas services within the study area.	A new 150mm diameter high pressure steel main from the ACT gas network. Cost contribution from the developer to the construction of the trunk gas main is to be determined at concept design stage.

BROWN



Appendices

Appendix A

Previous Studies

Appendix B

Correspondence with Services Authorities