

REPORT

SMALL TOWN SEWER INVESTIGATIONS

TASK 2: REVIEW OF OPTIONS FOR BUNGAREE AND WALLACE

Prepared for Central Highlands Water

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Central Highlands Water

Small Town Sewer Investigations

Task 2 Review of Options for Bungaree and Wallace

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1 Executive Summary

Background

Moorabool Shire Council engaged AECOM in 2014 to undertake an options assessment and concept design for the provision of sewerage services to the townships of Bungaree and Wallace.

This work included the assessment of a range of options for sewerage collection including modified gravity, Low Pressure Sewerage System (LPSS), Septic Tank Effluent Pumping (STEP) and Septic Tank Effluent Drainage (STED).

A range of options for wastewater treatment and disposal were also assessed, including a local treatment plant with irrigation of effluent, and the alternatives of, transferring flows to either Ballarat or Gordon systems for treatment.

The options were evaluated using a multi-criteria assessment tool. Modified gravity sewerage collection with transfer of wastewater to the Ballarat system was identified as the preferred option; primarily due to the significantly lower overall cost.

MWH was engaged by CHW to undertake a review of the previous work and develop updated costs estimates for the provision of sewerage services for Bungaree and Wallace.

Options Assessed

Following discussions with Central Highlands Water it was agreed that the transfer of wastewater to Ballarat or Gordon was preferred over another local treatment plant and irrigation system.

CHW also advised that the maximum available capacity within the Ballarat network for flows from Bungaree and Wallace is the peak dry weather flows associated with 1,000 people. The remaining capacity within the Gordon WWTP is reserved for growth in Gordon and any transfer would require an upgrade to the WWTP and effluent disposal system.

Council has indicated a desire for Bungaree and Wallace townships to ultimately grow into a community with up to 2,000 homes, and that being a satellite of Ballarat, there would be considerable growth in Bungaree and Wallace if sewerage facilities are provided. This fact, together with the need for ongoing landowner management and maintenance for the existing septic tanks, suggested that a modified gravity collection or low pressure sewerage system would be a more suitable long term solution.

It was therefore agreed that for this review, the following options, which would ensure a robust servicing solution, would be assessed by MWH:

Sewerage Collection system:

- Modified gravity reticulation
- Low Pressure Sewerage System (LPSS)

Wastewater treatment and effluent disposal:

- Transfer to Ballarat system
- Transfer to Gordon WWTP

MWH developed modified gravity and LPSS reticulation layouts for Bungaree and Wallace and assessed the alternative transfer options for wastewater treatment and effluent disposal.

Options for servicing Bungaree and Wallace together, and Bungaree only, were considered.

LPSS OneBox technology

A LPSS collection system can incorporate the OneBox technology developed by South East Water. This technology uses a level sensor in the property pit, and smart controller linked to SCADA, to manage the pumping from each individual property. This system enables pumps to be operated in a range of modes, and utilises the available storage within each property pit to reduce instantaneous peak flows within the transfer system, thereby reducing overall design flowrates, pipe sizes and costs. Given the limitation in capacity of the Ballarat network, the provision of the OneBox technology was adopted for the LPSS system option.

Bungaree and Wallace servicing costs

The estimated costs for each option to service the existing Bungaree and Wallace townships are summarised in the following table.

Option	Capital Cost	Annual Operating Cost	NPC
Modified gravity & transfer to Ballarat	\$9.35M	\$97,000	\$11.05M
LPSS & transfer to Ballarat	\$7.29M	\$101,500	\$9.36M
Modified gravity & transfer to Gordon	\$11.02M	\$119,000	\$13.14M
LPSS & transfer to Gordon	\$9.89M	\$129,000	\$12.46M

These costs only provide for servicing of the existing dwellings, however to allow for some growth, the main trunk section of sewer and outfall pumping station and outfall rising main is sized to allow for populations of up to 500 in each township.

Operating costs exclude the costs for transfer through the Ballarat network and treatment at the Ballarat South WWTP.

Bungaree only servicing costs

The estimated costs for each option to service Bungaree only are summarised in the following table. As Bungaree is much closer to the Ballarat system than the Gordon WWTP, the options only include transfer to the Ballarat system.

Option	Capital Cost	Annual Operating Cost	NPC
Modified gravity & transfer to Ballarat	\$6.44M	\$68,000	\$7.63M
LPSS & transfer to Ballarat	\$4.03M	\$56,000	\$5.17M

These costs only provide for servicing of the existing dwellings, however to allow for some growth, the main trunk section of sewer and outfall pumping station and outfall rising main is sized to allow for population of up to 1,000.

These costs include a contingency allowance of 30% which is considered appropriate for the current level of detail and information regarding site and ground conditions.

Further design development and investigations are required to increase the confidence level of the estimates.

Community Consultation

Central Highlands Water (CHW) have confirmed that before a project for the sewerage of small towns such as Bungaree and Wallace could be taken forward as part of its Pricing Submission to the Essential Services Commission (ESC) that community consultation and support for the project would be required. Consultation would need to include an explanation of the costs and benefits of a scheme for the community.

To satisfy the ESC's requirements for inclusion in a pricing submission the further design will need to enable the contingency to be reduced to around 15%. Greater certainty regarding the capital costs will also enable better informed community consultation and the development of a business case for funding applications for the project.

The Moorabool Shire Council have acknowledged that further strategic planning in consultation with the community is required to develop structure plans for Bungaree and Wallace to inform further sewerage investigations.

It is therefore envisaged that community consultation will be ongoing to inform the required planning, sewerage scheme design and cost estimates and the funding considerations for sewerage Bungaree and Wallace.



2 Introduction

MWH, now part of Stantec, has been engaged by Central Highlands Water to evaluate the approach, technology and indicative costs for the provision of sewerage services to the townships of Bungaree and Wallace. This assignment is being undertaken in two stages:

1. Assess pressure sewerage system technology and in particular the potential application of the IOTA “One Box” for small town sewerage solutions.
2. Review and update options and cost estimates prepared by AECOM (2010-2014).

Subsequent to stages 1 and 2, CHW may elect to commence detailed cost investigations for possible submission to ESC in CHW’s PR2018.

This report provides the outcomes to stage 2 of the assignment.

3 Previous Assessment

3.1 Background

Bungaree and Wallace are two small rural townships located to the east of Ballarat as shown in Figure 1. Both townships are close to the western freeway and a short distance from Ballarat.

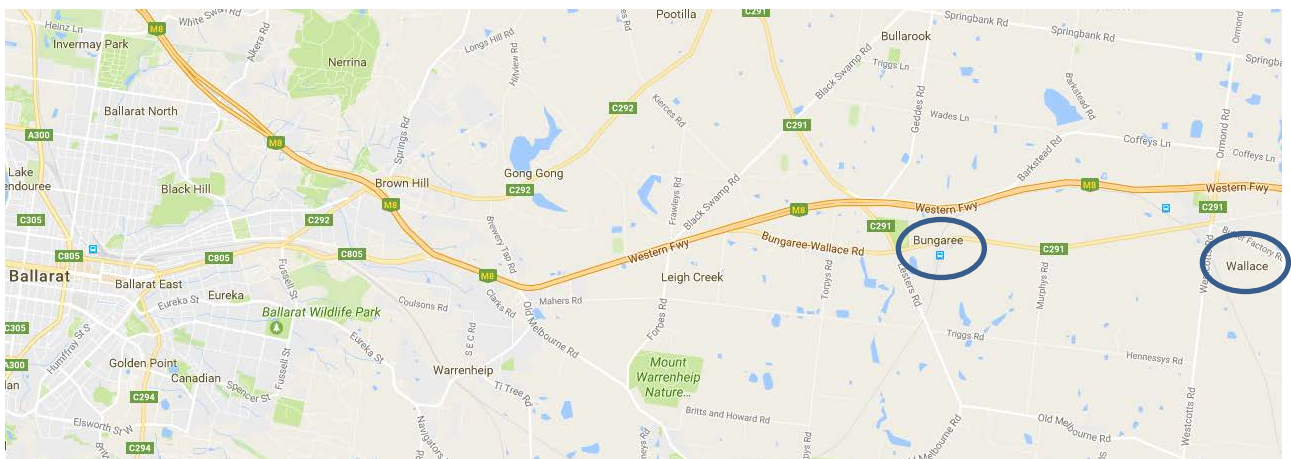


Figure 1 – Locality Plan – Bungaree and Wallace

Bungaree has approximately 143 dwellings and Wallace 116. However, within the main township areas, this is reduced to 56 and 67 respectively.

The Moorabool Shire Council is seeking to encourage future residential growth in Bungaree and Wallace to support the funding and viability of local community services and facilities. The townships are located within a Declared Water Supply Catchment that forms part of the Lal Lal Reservoir and Moorabool River catchments, and as such, development is primarily constrained by the absence of reticulated sewerage systems.

3.2 Previous investigations

AECOM undertook a small towns services study for the Moorabool Shire Council in September 2014. This study looked at the viability of the provision of sewerage services to Bungaree and Wallace, reticulated water supply to Dunnstown and gas to Bungaree, in order to sustainably develop land within these three townships.

3.2.1 Land Use Planning

AECOM’s land use and community facility analysis identified the potential population capacity of each town based on existing community facilities, and the potential areas where each town could grow. The analysis estimated that the community facilities in Bungaree and Wallace

could support a combined population of approximately 8,000 people before Council will need to expand these facilities. However, it was agreed that within the confines of the design life of the proposed infrastructure it was unreasonable for this study to use such a high figure for the estimation of servicing option requirements. A figure of 6,000 people was agreed for use within the high level servicing comparison.

Council further considered the shorter term population and population growth rates for Bungaree and Wallace, with initial development to be designed to accommodate a total of 1,000 people, either totally within Bungaree, or split equally between Bungaree and Wallace. Subject to development uptake population growth would be encouraged to increase up to a limit of 1,000 people per town.

This aligns with CHW's current infrastructure constraints and future upgrades. Using a design horizon of 50 years it was agreed that the relevant sections of the sewer servicing infrastructure be sized as follows:

- Reticulation systems within each town – maximum 1,000 per town (to be further upgraded in future should additional development occur)
- Wallace to Bungaree rising main and pump station – 3,000 people
- Bungaree to Ballarat rising main and pump station – 6,000 people

3.2.2 Desktop geotechnical study

AECOM undertook a desktop geotechnical review which concluded that the ground conditions across the study area are expected to comprise Newer Volcanics which cover the majority of the study area. This unit typically comprises 1 to 4m of clay soil overlying basaltic rock of variable strength/weathering.

The overlying soil is likely to have a high seasonal shrink/swell potential. Pipelines and/or trenches should therefore be designed to accommodate or mitigate against this ground movement.

Excavation through the soil horizon should be possible with conventional earthmoving equipment, although a rock breaker may be required to remove floaters where they are encountered within the residual soils. Where large slightly weathered boulders are encountered or less fractured high strength (or greater) rock is encountered, trenching will not be possible without rock rippers, hydraulic breakers and possibly blasting. Where the rock horizon comprises a floater field, an allowance for considerable over-break should be made as trench walls are opened up. It's possible that due to the presence of cobbles and boulder fragments, the trench spoil would need to be processed if it is to be re-used as trench backfill.

Construction in recent river alluvium, swamp and colluvial deposits is expected to be more complex than in other areas and can be expected to encounter challenges related to:

- Possible perched groundwater;
- Soft and saturated soils;
- Excessive ground settlements, and
- Differential movement of the trench/pipe across different geological units.

3.2.3 Treatment

CHW advised that their sewer infrastructure (e.g. rising main, pump station) located downstream of Bungaree did not have spare capacity to cater for a projected population of 3,000 in both Bungaree and Wallace. However, the downstream infrastructure has spare capacity to handle the projected dry weather flow for a total population of 1,000 in Bungaree/Wallace. A storage tank was therefore proposed near the Bungaree main pump station for the purpose of storing wet weather flow for a period of up to three (3) days. This storage tank may prove redundant in the future when CHW infrastructure is upgraded.

3.2.4 Options identified and evaluated

AECOM assessed five alternative types of collection system and five options for treatment and disposal.

Collection options:

- Modified conventional gravity sewerage
- Septic Tank Effluent Disposal (STED)
- Septic Tank Effluent Pumping (STEP)
- Low Pressure Sewerage Scheme (LPSS)
- Vacuum Sewerage

Treatment and disposal options:

- Local treatment and reuse (Class A)
- Local treatment and reuse (Class B)
- Local treatment and reuse (Class C)
- Transfer to Ballarat
- Transfer to Gordon

Following an assessment of the options using a multi-criteria analysis the modified conventional gravity collection system ranked highest and the LPSS ranked second. Transfer of the wastewater to the Ballarat system ranked the highest of the treatment options, with a local WWTP and land disposal ranked second.

Preliminary cost estimates were in the order of \$70M to \$80M for a scheme to service the ultimate development of 6,000 people within Bungaree and Wallace with transfer to Ballarat.

Preliminary cost estimates were \$9.2M for the smaller scale scheme to service 500 people in Bungaree and 500 people in Wallace with transfer to Ballarat. This included:

- Collection system in Bungaree to cater for a population of 500 initially, with capacity to be extended to service up to 1,000 in future as development progresses.
- Collection system in Wallace to cater for a population of 500 initially, with capacity to be extended to service up to 1,000 in future as development progresses.
- A transfer pump station at Wallace and a 100mm rising main from Wallace to Bungaree for a population of 1,000 and capacity to upgrade to 3,000 in future.
- A transfer pump station at Bungaree and a 200mm rising main from Bungaree to Ballarat for a population of 2,000 and capacity to upgrade to 6,000 in future as development progresses.
- An 855m³ off-line sewage holding tank at Bungaree to balance wet weather flows for up to 3 days for a population of 1,000.

4 MWH Assessment

4.1 Options Development

MWH has undertaken an assessment of the two preferred collection system options for Bungaree and Wallace, being modified conventional gravity sewers and LPSS. Collection systems have been designed to extend to service existing dwellings only. New growth areas (subdivisions) within the townships would require additional sewers to be constructed in order to be serviced.

The wastewater collection and transfer system has been sized for a population of 500 in Bungaree and 500 in Wallace. Transfer to the Ballarat system for treatment and disposal has been adopted as the base case and the gravity sewer reticulation and LPSS layouts for each township have been developed on this basis.

The alternative of transfer to the existing WWTP at Gordon has also been assessed.

In addition, the option to service Bungaree only with transfer back to the Ballarat system has been assessed.

4.2 Gravity Sewerage Option - Bungaree and Wallace

Modified gravity sewer reticulation layouts have been prepared for Bungaree and Wallace (refer to Appendix A). The differences between a modified gravity sewer layout and a conventional gravity sewer layout are:

- ability to use 100mm dia. diameter pipes when servicing one or two properties
- long length PVC sewer pipes;
- increased spacing between manholes;
- less use of manholes and increased use of alternative access methods (inspection shafts etc);
- curved sewers;
- flatter grades and reduced pipe cover where appropriate, and
- only servicing the dwelling rather than the entire property where the property is controlling the overall depth of a sewer line.

4.2.1 Wallace

Wallace is located approximately 17km from the centre of Ballarat and is 4km east of Bungaree. The area is generally quite flat with a natural fall from NW to SE. The town is bisected by the Ballarat – Melbourne Rail Corridor. There are a few smaller allotments of around 1,000m² in the centre of town with larger properties of 2,000m² to 4,000m² to the north and east of the railway line and on Westcotts Road.

A gravity sewer layout for the township is included in Appendix A. The layout comprises 150mm dia sewers servicing properties off the Bungaree Wallace Road, and a 225mm diameter sewer along Westcotts Road to a pump station site on McIvor Road, adjacent to the railway line.

A 100mm diameter rising main from the pump station will traverse along Westcotts Road and the Bungaree Wallace Road to discharge into the proposed sewer network at Bungaree.

The sewers are expected to be generally relatively shallow with the majority of the sewers between 1.5 and 2 metres deep. The ground is very flat in the centre of town and the sewers are expected to be between 3-4m deep in this location.

Piles of broken rock were observed on the side of the Bungaree Wallace Road east of the Wallace township, which are assumed to be left over from recent excavation. It is anticipated that sewers in excess of 2m deep will encounter some rock during construction and all sewers over 4m deep will be in the basalt.

4.2.2 Bungaree

The community of Bungaree is located in two areas along Bungaree-Wallace Road (running east-west). The majority of the community is clustered around the intersection of Bungaree-Wallace Road and Bungaree-Creswick Road, and a second smaller cluster of houses are located near the Ballarat – Melbourne Rail Corridor, approximately 700 metres further to the east.

Property sizes within the township vary in size, from approximately 1,000 to 1,500m² in the centre of town (along Bungaree-Wallace Road), up to 1.6 hectares on the town fringes.

The township is relatively flat with a number of drainage lines crossing the Bungaree Wallace Road running southward which appear to have the potential to flood the surrounding land.

A gravity sewer layout for the township is included in Appendix A. The layout comprises 150mm dia sewers servicing properties off the Bungaree - Wallace Road and a 225mm sewer along Bungaree - Wallace Road, connecting the easterly part of the town to the proposed main pump station site. The rising main from Wallace will discharge into this 225mm gravity sewer.

The depth of the sewers will vary with some smaller branch sewers only 1.5 to 2 m deep. However the 225mm dia sewer will increase in depth due to the flat topography and will be up to 5 m deep in the section west of the Creswick Road.

As with Wallace, it is anticipated that sewers in excess of 2m deep will encounter some rock during construction and all sewers over 4m deep will be in basalt.

4.2.3 Pump Stations

The main pump stations in Wallace and Bungaree would comprise 3m diameter pump wells with duty and standby submersible pumps. The local pump station in Lesters Road Bungaree would have a 2.4m diameter well with duty and standby submersible pumps.

An emergency storage with the provision of 3 hours capacity at peak dry weather flow will be provided at each pump station. At the pump station in Wallace and also at the Lesters Road pump station in Bungaree this would be included within the overall pump well capacity. Due to the depth of the pump well and likely poor ground conditions at the site, a separate emergency storage would be provided for the main pump station at Bungaree. This would comprise a section of large diameter in-ground GRP pipe which could be augmented to meet future capacity.

The pump stations will include local external switchboard, access road, drainage and fencing. The Wallace pump station will include a chemical storage and dosing facility for septicity control in the discharge rising main. The main Bungaree pump station will include a biofilter.

4.2.4 Outfall to Ballarat Network

The outfall to Ballarat from the Bungaree pump station is proposed along Bungaree Wallace Road, Torpys Road, Reidys Road and Mahers Road as shown in Figure 2. A 130mm ID HDPE pipeline is proposed with an pumped flowrate of 13.89 litres/sec, based on a population of 1,000 and a peak wet weather flowrate of 1,200 litres/person/day. The section of pipeline between Bungaree and the balance tank would need to be duplicated if additional capacity was required in future.

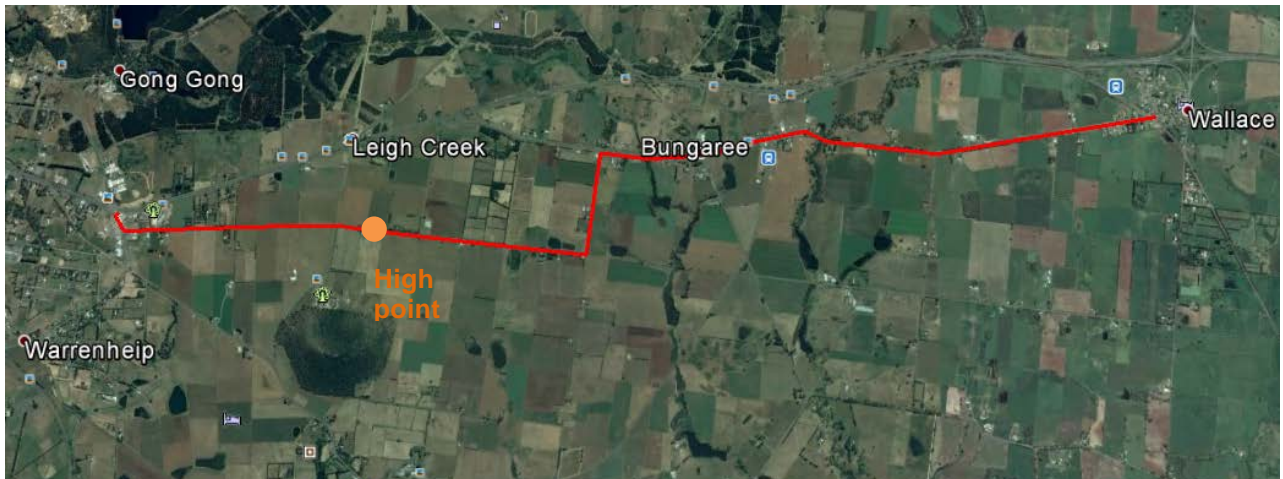


Figure 2 – Outfall to the Ballarat Network

The Ballarat system currently only has capacity for dry weather flows for up to 1,000 people. A wet weather storage tank would be provided at the high point along the rising main on Mahers Road, approximately 250m west of the Reidys Road intersection. This tank has an assumed capacity of 855m³. The storage is proposed at the high point as it can then be a simple above ground tank rather than a deep in-ground tank if located at the Bungaree pump station site as proposed in the AECOM study. The balance tank will be fitted with a mixer and include mechanical ventilation, biofilter, chemical storage and dosing system.



Figure 3 High point on Mahers Road (looking east)

The 130mm pipeline between the balance tank and Ballarat would flow under induced head from the balance tank. It has a maximum capacity of 19 litres/sec which will cater for the future peak wet weather flow for a population of up to 1,350, before augmentation is required. Alternatively a 100mm pipeline could be adopted if the flow was limited to the peak dry weather flow for 1,000 population, i.e. 7 litres/sec.

An actuated outlet control valve would be provided at the connection to the Ballarat network. This valve would have a maximum opening setting to achieve scouring velocity but still limit the overall peak flow. The control valve would open and closed based on the level in the balance tank.

4.3 Pressure Sewerage Option – Bungaree and Wallace

4.3.1 Wallace

A LPSS layout was developed for the township of Wallace. The layout is provided in Appendix A and includes 50mm, 63mm and 80mm dia HDPE pressure pipelines located within the road reserves. LPSS layouts typically differ from gravity layouts in that the pressure pipelines discharge to a booster pump station that is located at a high point rather than the lowest point in the township. In this way the pipelines remain fully pressurised at all times which prevents air being drawn in and subsequently expelled from the pipes, which can otherwise result in odour emissions at the air valve installations.

4.3.2 Bungaree

A LPSS layout was developed for the township of Bungaree. The layout is provided in Appendix A and includes 50mm, 63mm, 80mm and 100mm dia HDPE pressure pipelines located within the road reserves.

4.3.3 Outfall to Ballarat Network

For outfall to the Ballarat network, the flows from Wallace are transferred to Bungaree and then onward to Ballarat via booster pump stations at Wallace and Bungaree.

The booster pump station for Wallace would be located at the western end of the township on the Bungaree Wallace Road. This will comprise a 10m³ above ground balance tank and pumps located in a small building for security and noise control. The facility would also include access road, security fencing, biofilter, chemical storage and dosing facility. It is assumed that a small parcel of land will be acquired for the facility.

An 80mm diameter rising main would transfer the flows from Wallace to Bungaree at a rate of 3.5 litres/second. This rising main would discharge into the pressure sewer pipe network at the eastern end of the Bungaree township near the railway line. This flowrate is equivalent to that for a population of 500 and a peak flowrate of 600 litres/person/day (or if wet weather inflows are managed and peak flows are balanced through the individual property pump pits this could equate to a population of 666 at 450 litres/person/day). The proposed rising main is rated PN16 and increased booster pumping head could also be provided if additional capacity was required in future.

A booster pump station for Bungaree would be located at the western end of the township in Torpys Road. This would comprise an above ground pressure vessel and pumps located in a small building for security and noise control. The facility would also include access road, security fencing, biofilter and chemical storage and dosing facility. A 10m³ pressure vessel is proposed for the balance tank so that the pressure in the reticulation layout remains above 590mRL. This should keep the rising main between Wallace and Bungaree full at all times and reduce the residual head required to pump to Ballarat. It is assumed that a small parcel of land will be acquired for the facility.

The outfall rising main to Ballarat from the Bungaree booster pump station is proposed along the same route as the outfall rising main for the gravity sewerage option. A 100mm ID HDPE pipeline is proposed with an pumped flowrate of 7 litres/sec which provides a velocity of 0.9 m/sec for scouring and slime shearing. This flowrate is equivalent to that for a population of 1,000 and a peak flowrate of 600 litres/person/day (or if wet weather inflows are managed and peak flows are balanced through the individual property pump pits this could equate to a population of 1,333 at 450 litres/person/day). The proposed outfall pipeline is rated PN16 and increased booster pumping head could also be provided if additional capacity was required in future.

The Ballarat system currently only has capacity for dry weather flows for up to 1,000 people. It is recognised that the LPSS system would limit wet weather inflows and the OneBox control system developed by South East Water (SEW) also enables peak flows to be balanced through

the use of the individual property pump pits. Depending on the actual peak instantaneous capacity available at Ballarat, it is likely that a LPSS system using the OneBox control technology could be accommodated without the need for any flow balancing storage.

For current estimating purposes it is assumed that the OneBox control technology would be adopted and a balancing storage is not required. A 50m³ break pressure tank would be provided at the high point along the rising main on Mahers Road, approximately 250m west of the Reidys Road with an outlet control valve at the discharge point to the Ballarat system for downstream flow control. The break tank would be located within the road reserve and include a small passive biofilter.

The 100mm pipeline between the balance tank and Ballarat would have a maximum capacity of about 10 litres/sec. This would cater for the future peak wet weather flow for a population of between 1,400 and 1,900 before augmentation is required, depending on actual LPSS peak per capita flows.

If a balance tank was ultimately required, this could increase the cost of the LPSS option by \$250,000 to \$500,000, depending on the actual size required.

4.4 Outfall to Gordon

Central Highlands has a WWTP which services the township of Gordon which is approximately 6km south east of Wallace. This plant was constructed in 2013 for 280 properties with an average flowrate of 500L/property/day and comprises an aerated 4.2ML capacity primary lagoon and a 38ML maturation/winter storage lagoon. Effluent disposal is by irrigation with a design maximum land application rate of 550mm/year.

At the time of commissioning there were 141 existing developed properties and there has been 20-30 new houses constructed since then. The balance of the plant capacity is reserved for growth at Gordon. Augmentation of the plant would be required to service Bungaree and Wallace.

For outfall to the Gordon WWTP, the flows from Bungaree would be transferred by rising main to the gravity reticulation system at Wallace and then onward to Gordon via the main pump station at Wallace.

Three alternative alignments are shown in Figure 4 for transfer of wastewater from Wallace to the Gordon WWTP. The shortest route is 7.6km running alongside the Western Freeway. This alignment is likely to require the removal of some trees through the vegetated section north of Gordon township unless the pipeline can be constructed within the freeway reserve. The alternative alignments to the north and south run along local roads. The southern route through Gordon is 10.0km long and the northern route is 11.2 km long. All of the alignments have highpoints approximately midway along the route at around RL630m. A header tank would need to be located at the high point linking the control to an actuated control valve at the outlet of the rising main at the Gordon WWTP. This will enable the falling section of the transfer pipeline to remain full at all times and maintain a constant velocity for solids transport and slime shearing.

For a gravity collection system at Bungaree and Wallace a 130mm ID HDPE pipeline would be required with a pumped flowrate of 13.89 litres/sec, based on a population of 1,000 and a peak wet weather flowrate of 1,200 litres/person/day. If a LPSS scheme was adopted a 100mm ID HDPE pipeline would be used with a flowrate of 7 litres/sec.

The transfer system would need to have a chemical dosing facility at Wallace and a biofilter at the header tank.



Figure 4- Alternative alignments for transfer of wastewater to Gordon WWTP

The Gordon WWTP would need to be duplicated and additional land identified for irrigation of the treated effluent.

4.5 Servicing Bungaree Only

An alternative option of just servicing Bungaree at this stage has been assessed. In this instance the wastewater would be transferred to Ballarat, being the closest point for discharge.

Modified conventional gravity sewerage and a LPSS scheme have been assessed on the basis of a future population of 1,000 for Bungaree. As with the combined Bungaree and Wallace servicing options, the LPSS property pumps and the gravity and pressure reticulation systems only include existing dwellings and allowance for vacant properties fronted by the sewer pipes. Some limited additional capacity has been provided, but it is expected that additional reticulation would be constructed when future development proceeds.

Wallace could be sewered in future and connected back to Bungaree or alternatively could be transferred to the Gordon wastewater system.

4.5.1 Gravity Collection system

The gravity collection system option would have a similar reticulation layout as for the combined Bungaree and Wallace option. There would be some minor reductions in the pipe sizes at the eastern end of the town as there will be no transfer coming from Wallace. However, but as the land is very flat, the use of 225mm dia sewers has been maintained to allow flatter sewer grades to keep the sewers shallower and potentially out of the solid rock.

The Bungaree pump stations and the transfer system to Ballarat with the intermediate flow balance tank would be maintained on the basis that the design flow is the same at 13.89 litres/sec (1,000 population at PWWF of 1,200 L/person/day).

4.5.2 LPSS Sheme

The LPSS collection system would have the same overall layout as for the combined Bungaree and Wallace option except that all 80mm dia pressure pipes would be reduced to 63mm diameter, and the 100mm diameter pressure pipes would be reduced to 80mm diameter, as there is no transfer coming into the system from Wallace. The booster pump station on the

western outskirts of Bungaree and the transfer system to Ballarat with break pressure tank would be maintained on the basis that the design flow is the same at 7 litres/sec (1,000 population at PWWF of 600 L/person/day).

4.6 Comparison of Options

4.6.1 Advantages and Disadvantages

The relative advantages and disadvantages of the two alternative collection systems and the two alternative transfer options for treatment and disposal are summarised in the following Tables 3-1 and 3-2.

Table 4-1: Advantages and Disadvantages – Collection Options

Collection Option	Advantages	Disadvantages
Modified Gravity	<ul style="list-style-type: none"> • Low maintenance • Easy to operate • Little customer interaction required • Reliable 	<ul style="list-style-type: none"> • Upsized trunk sewer lines required from day 1 to accommodate future growth • Disruptive during construction (open trenches) • Long gravity drains required to connect larger properties making sewers deep • Excavation at depth – OH&S • High levels of infiltration to sewers and manholes in wet weather • Access to deep manholes – OH&S • Root intrusions/blockages • Possible ex-filtration to groundwater • Risk of encountering rock during construction
LPSS	<ul style="list-style-type: none"> • No exfiltration • Very low infiltration (property services) • Less impact during construction • Rapid installation • Easier to accommodate new growth • Staged upfront costs based on rate of installation of property pumps 	<ul style="list-style-type: none"> • Increased maintenance activities • More failures and call-outs • Greater customer impact with more interactions with CHW staff • Reputational risk if equipment is unreliable • Reduced asset life/more replacements • Customer impacts on system – shutting power off, failure to report alarms, pump blockages

Table 4-2: Advantages and Disadvantages – Transfer Options

Transfer Option	Advantages	Disadvantages
Ballarat	<ul style="list-style-type: none"> • Closer to Bungaree 	<ul style="list-style-type: none"> • Limitation on capacity until Ballarat network augmented • Septicity and odour risks in existing Ballarat network
Gordon	<ul style="list-style-type: none"> • Closer to Wallace • Transfer direct to the WWTP and not via existing gravity sewer network 	<ul style="list-style-type: none"> • WWTP requires duplication and additional land for irrigation • Shortest alignment for transfer pipeline is alongside the Western Freeway • Greater impacts on vegetation

4.6.2 Cost Estimates

4.6.2.1 Capital Costs

The following sources have been used as the basis for cost estimates:

- Previous estimates prepared by AECOM
- Pressure sewer costing data provided by SEW and South Gippsland Water (SGW)
- Indicative rates from relevant contractors (Comdain, Downer)
- NSW Reference Rates Model June 2014, NSW Department of Primary Industries
- Discussions with suppliers
- MWH in-house expertise

Capital costs estimates include investigations, design, approvals, construction administration and Authority costs together with a contingency allowance of 30% of the estimated construction cost.

4.6.2.2 Operating costs

The following assumptions have been made in the development of operating cost estimates:

Operations and Maintenance (annual cost)

- Gravity collection system – 0.5% of capital cost
- Pressure pipe system – 2% of capital cost
- LPSS property pumps - \$200 each including SEW hosting, vodaphone datapac etc
- Main pump stations – 1% of capital cost on civil and building, 3% on M&E plus power and chemicals
- Tanks – 1% of capital cost on civil and building, 3% on M&E
- Rising mains – 1% of capital cost
- Power cost 12 cents per kWhr
- Chemical cost – Ferric chloride \$1,000/m³, with 60-100mg/L dosage

No allowance has been included for treatment costs at Ballarat or Gordon WWTP.

4.6.2.3 Net Present Cost estimates

50 year NPC calculations using a discount rate of 4% have been prepared based on the above capital and operating cost estimates.

The following asset lives have been adopted in the analysis:

- Gravity sewers 80 years
- LPSS pressure pipes and transfer rising mains 50 years
- LPSS property pits 50 years
- LPSS pumps and level sensors 15 years - \$3500 replacement cost
- Balance Tank 25 years (but it is assumed that there will be sufficient capacity in the Ballarat network and a replacement will not be required)
- Pump station building and civils 50 years
- Pump stations mechanical and electrical 25 years
- Pressure break tank – 25 years

4.6.2.4 Summary of Costs - Bungaree and Wallace

The estimated costs for each option to service Bungaree and Wallace (500 population in each township) are summarised in Table 3-3. Detailed estimates are included in Appendix B.

Table 4-3: Summary of Costs – Bungaree and Wallace

Option	Capital Cost	Annual Operating Cost	NPC
Gravity - Ballarat	\$9.35M	\$97,000	\$11.05M
LPSS - Ballarat	\$7.29M	\$101,500	\$9.36M
Gravity - Gordon	\$11.02M	\$119,000	\$13.14M
LPSS - Gordon	\$9.89M	\$129,000	\$12.46M

The LPSS property pumps and the gravity and pressure reticulation systems only include existing dwellings and allowance for vacant properties fronted by the sewer pipes. Some limited additional capacity has been provided, but it is expected that additional reticulation would be constructed when future development proceeds. These costs are excluded from the capex and NPC calculations.

Operating costs exclude the costs for transfer through the Ballarat network and treatment at the Ballarat South WWTP.

4.6.2.5 Summary of Costs - Bungaree Only

The estimated costs for each option to service Bungaree only (1,000 population) are summarised in Table 3-4. Detailed estimates are included in Appendix A. Both the modified gravity and LPSS collection system options include transfer to the Ballarat system.

Table 4-4: Summary of Costs – Bungaree only

Option	Capital Cost	Annual Operating Cost	NPC
Gravity - Ballarat	\$6.44M	\$68,000	\$7.63M
LPSS - Ballarat	\$4.03M	\$56,000	\$5.17M

The difference in capital costs between the two Bungaree only options is primarily due to the larger transfer system capacity and flow balancing tank required for the gravity collection system to manage wet weather inflows.

5 Community Consultation / Essential Service Commission

Central Highlands Water (CHW) have confirmed that before a project for the sewerage of small towns such as Bungaree and Wallace could be taken forward as part of its Pricing Submission to the Essential Services Commission (ESC) that community consultation and support for the project would be required. Consultation would need to include an explanation of the costs and benefits of a scheme for the community.

It is understood that the ESC will have an expectation that level of investigation into the capital costs will be extensive enough that the contingency rate would be no greater than 15% and the funding sources for the works will also need to have been identified.

Whilst CHW's ongoing tariffs are known and the plumbing costs to connect can be put into a typical range, the costs of the capital works are less certain and further engineering investigations are required to reduce the contingency that is currently set at 30%. With a better understanding of the likely final costs of such a project and informed community support obtained, the securing of funding assistance through a business case could then be explored.

The Moorabool Shire Council have acknowledged that further strategic planning in consultation with the community is required to develop structure plans for Bungaree and Wallace to inform further sewerage investigations.

It is therefore envisaged that community consultation will be ongoing to inform the required planning, sewerage scheme design and cost estimates and the funding considerations for sewerage Bungaree and Wallace.

6 Next Steps

In order to provide greater cost certainty for the provision of sewerage services to the townships of Bungaree and Wallace, the following activities are recommended:

1. Moorabool Shire Council shall review the town planning and develops a draft precinct structure plan for each community, to enable the identification and sizing of key infrastructure, and the likely staging requirements for additional infrastructure to service the proposed new growth areas within the townships. This should confirm the minimum allowable allotment sizes for effective on-site wastewater treatment and disposal, identify the likely demand for rural residential, urban residential and commercial property, and identify the level of interest from existing property owners/developers to undertake subdivisions within the townships.
2. CHW shall confirm the impact and potential capacity to manage increased flows from populations of 1,000, 2,000 and up to 6,000 on the Ballarat network from Bungaree and Wallace.
3. Site investigations shall be completed, to better inform the proposed design and cost estimate. These investigations comprise:
 - Topographic survey to confirm key elevations and inform a hydraulic assessment, and review the need for booster pump stations to transfer flows to Ballarat.
 - Geotechnical investigation to assess the prevalence of rock, including the likelihood of shallow floaters, which would affect the ability to construct small diameter pressure pipelines using drilling and/or trenching.

- Site assessment to identify key flora and fauna risks, permitting requirements and potential native vegetation removal offsets.
 - A desktop cultural heritage assessment, to determine whether there are any areas of high significance, and the potential requirement for a CHMP.
4. Revise the concept design and cost estimate for servicing the townships based on LPSS, including:
- Further development of the LPSS layouts for each township, sizing of pressure pipes to service existing development, and identify the future pipework and connection points to service growth.
 - Evaluate the size of the outfall rising mains to connect the townships to Ballarat, and the pros and cons of a staged (two pipeline) outfall rising main. Identify an alignment and indicative longitudinal section, based on survey, to identify air valve and scour requirements.
 - Prepare layouts for a break/balance tank on the outfall rising main, including the extent of land required to be acquired, tank dimensions and material, and requirements for mixing and odour control.
 - Prepare layouts for booster pump stations, including building and site layout requirements, and areas for land acquisition.
 - Determine power supply requirements for the booster pump station and break/balance tank, and indicative connection costs.
 - Assess the impacts of initially servicing Bungaree only, followed by the future connection of Wallace.
 - Update the project cost estimates for the Bungaree only and the Bungaree/Wallace servicing schemes.

Appendices

Appendix A Drawings



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SR209 2018 SMALL TOWN SEWERAGE	Status Stamp Date Stamp Working Plot
BUNGAREE GRAVITY SEWER RETICULATION PLAN	Scale Drawing No. 83503879-01-001-C003 Rev A

Client: 



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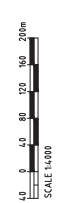
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Rev.	A

Client:  CENTRAL
HIGHLANDS
WATER



SURVEYED	
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DESIGN CHECK	
DESIGN REVIEW	
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Appendix B Cost Estimates

Bungaree and Wallace Cost Estimates

Bungaree Wallace LPSS Option - Discharge to Ballarat

Capital Cost

	Units	Rate	Quantity	Price	
Property pumps and connections					
Wallace	No.	13,500	67	904,500	
Bungaree	No.	13,500	56	756,000	
40mm road crossings	No.	1,000	7	7,000	
Wallace network					
50mm pressure pipe	m	70	1,420	99,400	
63mm pressure pipe	m	80	1,460	116,800	
80mm pressure pipe	m	90	680	61,200	
Air valves	No.	3,500	4	14,000	
Flushing connections/scours	No.	5,000	3	15,000	
Bungaree Network					
50mm pressure pipe	m	70	1,560	109,200	
80mm pressure pipe	m	90	860	77,400	
100mm pressure pipe	m	100	1,320	132,000	
Air valves	No.	3,500	3	10,500	
Flushing connections/scours	No.	5,000	3	15,000	
Wallace Booster Pumpstation					
Land	m2	40	1,000	40,000	500 pop at 600L/day PWWF 3.5L/sec Instantaneous Peak = 4xADWF
Power	Item	10,000	1	10,000	
Balance Tank	Item	15,000	1	15,000	10m3 Poly
Building & Civil	Item	85,000	1	85,000	Small colourbond building, access road, drainage
Pumps and Pipework	Item	30,000	1	30,000	3.7kW pumps duty standby
Electrical	Item	100,000	1	100,000	Pumps chemicals and odour facility
Chemical dosing facility	Item	40,000	1	40,000	Bulky box system
Biofilter	Item	50,000	1	50,000	Bark bed biofilter
Rising Main to Bungaree 80mm dia	m	100	3,380	338,000	
Air valves	No.	5,000	4	20,000	
Isolation/scours	No.	5,000	2	10,000	
Bungaree Booster Pumpstation					
Land	m2	40	1,000	40,000	1000 pop at 600L/day PWWF 7L/sec Instantaneous Peak = 4xADWF
Power	Item	10,000	1	10,000	
Balance Pressure Vessel	Item	100,000	1	100,000	10m3 Steel
Building & Civil	Item	85,000	1	85,000	Small colourbond building, access road, drainage
Pumps and Pipework	Item	60,000	1	60,000	7.5kW pumps duty standby
Electrical	Item	100,000	1	100,000	Pumps chemicals and odour facility
Chemical dosing facility	Item	40,000	1	40,000	Bulky box system
Biofilter	Item	50,000	1	50,000	Bark bed biofilter
Outfall Bungaree to Ballarat					
Pipeline 125mm SDR11 HDPE pipe	m	125	5,700	712,500	101.5mm ID 1.05m/sec PN 16
Header Tank 50kL	Item	50,000	1	50,000	Located within road reserve
Biofilter	Item	30,000	1	30,000	Bark bed biofilter
Outlet control valve	Item	50,000	1	50,000	
Air valves	No.	5,000	6	30,000	
Isolation/scours	No.	5,000	3	15,000	
Total Construction Cost					
				\$ 4,428,500	Reduced geotech for shallow pipes
Contingency	30.0%			1,328,550	
Authority Administration Costs	10.0%			442,850	
Design	8.0%			354,280	
Project Management	3.0%			132,855	
Construction Management	4.0%			177,140	Reduced construction period, Outfall is longest item
Clerk of Works Administration	2.0%			88,570	Reduced construction period for network, assume pumps installed by sub-contractor
Planning and Approvals	3.0%			132,855	
Community Consultation	2.0%			88,570	
Legal	1.0%			44,285	
Surveying	0.5%			22,143	
Geotechnical	1.0%			44,285	
Total Capital Cost					
				\$ 7,284,883	
O&M Cost					
		Unit O&M cost	Construction	Total	O&M % Annual Cost
Collection system	Civils		657,500	1,081,588	2.00% 21,632
LPSS pumps	M&E	200	1,660,500	2,731,523	2.00% 24,600
Rising mains	Civils		1,125,500	1,851,448	1.00% 18,514
Header tank	Civils		50,000	82,250	1.00% 823
Header tank	M&E		80,000	131,600	2.00% 2,632
Pumpstation	Civils		285,000	468,825	1.00% 4,688
Pumpstation	M&E		490,000	806,050	3.00% 24,182
Land			80,000	131,600	0.00% -
Total Cost					
			4,428,500	7,284,883	97,070
Power					
	kW	Hrs/day	kWHr/yr	Power cost \$/kWHr	2,943
Bungaree booster pump	7.5	6	16425	0.12	
Wallace booster pump	3.7	6	8103		
Chemicals					
	mg/L	L/day		Supply cost \$/kL	
Ferric chloride	100	4.0		1000	1,443
TOTAL					
				\$ 101,457	

Bungaree Wallace Gravity Option - Discharge to Ballarat

Capital Cost

	Units	Rate	Quantity	Price	
Property connections					
Wallace	No.	500	67	33,500	
Bungaree	No.	500	56	28,000	
100mm road crossings	No.	2,500	12	30,000	
Wallace network					
150mm sewer 0-2m deep	m	175	1,990	348,250	
150mm sewer 2-3m deep	m	200	200	40,000	
150mm sewer 3-4m deep	m	250	100	25,000	
225mm sewer 0-2m deep	m	225	420	94,500	
225mm sewer 2-3m deep	m	275	530	145,750	
225mm sewer 3-4m deep	m	350	200	70,000	
Manholes 0-2m deep	No.	3,500	14	49,000	
Manholes 2-3m deep	No.	4,500	2	9,000	
Manholes 3-4m deep	No.	6,000	1	6,000	
Inspection Points	No.	1,000	8	8,000	
Special refill	m	200	100	20,000	
Main Road Crossings	No.	10,000	3	30,000	
Allowance for excavation in rock	m3	200	155	31,000	Assume 50% of 3-4 and 25% 2-3m
Bungaree Network					
150mm sewer 0-2m deep	m	175	1,420	248,500	
150mm sewer 2-3m deep	m	200	450	90,000	
150mm sewer 3-4m deep	m	250	-	-	
225mm sewer 0-2m deep	m	225	455	102,375	
225mm sewer 2-3m deep	m	275	250	68,750	
225mm sewer 3-4m deep	m	350	185	64,750	
225mm sewer 4-5m deep	m	450	440	198,000	
300mm sewer 3-4 m deep	m	475	60	28,500	
Manholes 0-2m deep	No.	3,500	13	45,500	
Manholes 2-3m deep	No.	4,500	6	27,000	
Manholes 3-4m deep	No.	6,000	2	12,000	
Manholes 4-5m deep	No.	9,000	3	27,000	
Inspection Points	No.	1,000	6	6,000	
Special refill	m	200	350	70,000	
Main Road Crossings	No.	10,000	3	30,000	
Minor Road crossings	No.	2,500	1	2,500	
Allowance for excavation in rock	m3	200	612	122,400	Assume 100% 4-5m, 50% of 3-4 and 25% 2-3m
Wallace Main Pumpstation					
Land	m2	40	1,000	40,000	500 pop at 1200L/day PWWF 7L/sec Instantaneous Peak = 8xADWF
Power	Item	10,000	1	10,000	
Pumpwell	Item	60,000	1	60,000	3m dia 4m deep
Civil works, road, drains, fencing	Item	50,000	1	50,000	No building
Emergency Storage	Item	20,000	1	20,000	3hrs (20m3)
Pumps and Pipework	Item	40,000	1	40,000	7.5kW pumps duty standby
Electrical	Item	80,000	1	80,000	
Rising Main to Bungaree 100mm dia	m	300	5,350	535,000	Pipeline 125mm SDR11 HDPE pipe
Air valves	No.	5,000	4	20,000	
Isolation/scours	No.	5,000	2	10,000	
Chemical dosing facility	Item	40,000	1	40,000	Bulky box system
Bungaree Local Pumpstation					
Land	m2	40	1,000	40,000	3L/sec Instantaneous Peak
Power	Item	10,000	1	10,000	
Pumpwell	Item	20,000	1	20,000	2m dia 3m deep
Civil works, road, drains, fencing	Item	30,000	1	30,000	No building
Pumps and Pipework	Item	20,000	1	20,000	0.75kW pumps duty standby
Electrical	Item	60,000	1	60,000	
Rising Main 73mm dia	m	90	360	32,400	Pipeline 90mm SDR11 HDPE pipe
Bungaree Main Pumpstation					
Land	m2	40	1,000	40,000	1000 pop at 1200L/day PWWF 13.89L/sec Instantaneous Peak = 8xADWF
Power	Item	10,000	1	10,000	
Pumpwell	Item	60,000	1	60,000	3m dia 4m deep
Civil works, road, drains, fencing	Item	50,000	1	50,000	No building
Emergency Storage	Item	20,000	1	20,000	3hrs (20m3)
Pumps and Pipework	Item	60,000	1	60,000	22kW pumps duty standby
Electrical	Item	80,000	1	80,000	
Biofilter	Item	40,000	1	40,000	Bark bed biofilter
Outfall					
Pipeline 160mm SDR11 HDPE pipe	m	150	6,283	942,450	130mm ID 1.05m/sec PN 16
Outlet control valve	Item	50,000	1	50,000	
Air valves	No.	5,000	6	30,000	
Isolation/scours	No.	5,000	3	15,000	
Balance Tank					
Land	m2	40	2,500	100,000	
Power	Item	10,000	1	10,000	
Civil works, road, drains, fencing	Item	150,000	1	150,000	RC tank base, access road, fencing, drainage
Balance Tank 855m ³	Item	500,000	1	500,000	Glass lined bolted steel tank and pipework
Mixer	Item	30,000	1	30,000	3kW
Electrical	Item	60,000	1	60,000	
Chemical dosing facility	Item	40,000	1	40,000	Bulky box system
Biofilter	Item	50,000	1	50,000	Bark bed biofilter
Total Construction Cost					
				\$	5,566,125
Contingency	30.0%				1,669,838
Authority Administration Costs	10.0%				556,613
Design	8.0%				445,290
Project Management	3.0%				166,984
Construction Management	5.0%				278,306
Clerk of Works Administration	3.0%				166,984
Planning and Approvals	3.0%				166,984
Community Consultation	2.0%				111,323
Legal	1.0%				55,661
Surveying	1.0%				55,661
Geotechnical	2.0%				111,323
Total Capital Cost					
				\$	9,351,090

O&M Cost

		Construction	Total	O&M %	Annual Cost
Collection system	Civils	2,111,275	3,546,942	0.50%	17,735
Rising mains	Civils	1,584,850	2,662,548	1.00%	26,625
Balance tank	Civils	650,000	1,092,000	1.00%	10,920
Balance tank	M&E	240,000	403,200	2.00%	8,064
Pumpstation	Civils	310,000	520,800	1.00%	5,208
Pumpstation	M&E	450,000	756,000	3.00%	22,680
Land		220,000	369,600	0.00%	-
Total Cost		5,566,125	9,351,090		91,232
Power					
Mixer	kW	Hrs/day	kWhr/yr	Power cost \$/kWhr	4,901
	3	1	1095	0.12	
Bungaree main pump	22	3.6	28908		
Bungaree local pump	0.75	3.6	985.5		
Wallace pump	7.5	3.6	9855		
Chemicals					
Ferric chloride	mg/L	L/day	Supply cost \$/kL		1,039
	60	2.8	1000		
TOTAL				\$	97,172

Capital Cost

O&M Cost

		Unit	O&M cost	Construction	Total	O&M %	Annual Cost
Collection system	Civils			657,500	1,081,588	2.00%	21,632
LPSS pumps	M&E		200	1,660,500	2,731,523		24,600
Rising mains	Civils			1,780,000	2,928,100	1.00%	29,281
Header tank	Civils			50,000	82,250	1.00%	823
Header tank	M&E			80,000	131,600	2.00%	2,632
WWTP	Civils			564,000	927,780	1.00%	9,278
WWTP	M&E			240,000	394,800	2.00%	7,896
Pumpstation	Civils			200,000	329,000	1.00%	3,290
Pumpstation	M&E			500,000	822,500	3.00%	24,675
Land				280,000	460,600	0.00%	-
Total Cost				6,012,000	9,889,740		124,106
Power	kW	Hrs/day		kWhr/yr	Power cost \$/kWhr		3,600
Bungaree booster pump	3.7	6		8103	0.12		
Wallace booster pump	10	6		21900			
Chemicals	mg/L	L/day			Supply cost \$/kL		
Ferric chloride	100	4.0			1000		1,443
				TOTAL	\$	129,149	

Bungaree Wallace Gravity Option - Discharge to Gordon

Capital Cost

	Units	Rate	Quantity	Price	
Property connections					
Wallace	No.	500	67	33,500	
Bungaree	No.	500	56	28,000	
100mm road crossings	No.	2,500	12	30,000	
Wallace network					
150mm sewer 0-2m deep	m	175	1,290	225,750	
150mm sewer 2-3m deep	m	200	-	-	
150mm sewer 3-4m deep	m	250	100	25,000	
225mm sewer 0-2m deep	m	225	860	193,500	
225mm sewer 2-3m deep	m	275	730	200,750	
225mm sewer 3-4m deep	m	350	200	70,000	
300mm sewer 0-2 m deep	m	300	260	78,000	Mcvor Road
Manholes 0-2m deep	No.	3,500	14	49,000	
Manholes 2-3m deep	No.	4,500	2	9,000	
Manholes 3-4m deep	No.	6,000	1	6,000	
Inspection Points	No.	1,000	8	8,000	
Special refill	m	200	100	20,000	4550m
Main Road Crossings	No.	10,000	3	30,000	
Allowance for excavation in rock	m3	200	155	31,000	Assume 50% of 3-4 and 25% 2-3m

Bungaree Network					
150mm sewer 0-2m deep	m	175	1,660	290,500	
150mm sewer 2-3m deep	m	200	450	90,000	
150mm sewer 3-4m deep	m	250	-	-	
225mm sewer 0-2m deep	m	225	215	48,375	
225mm sewer 2-3m deep	m	275	250	68,750	
225mm sewer 3-4m deep	m	350	185	64,750	
225mm sewer 4-5m deep	m	450	440	198,000	
300mm sewer 3-4 m deep	m	475	60	28,500	
Manholes 0-2m deep	No.	3,500	13	45,500	
Manholes 2-3m deep	No.	4,500	6	27,000	
Manholes 3-4m deep	No.	6,000	2	12,000	
Manholes 4-5m deep	No.	9,000	3	27,000	
Inspection Points	No.	1,000	6	6,000	
Special refill	m	200	350	70,000	
Main Road Crossings	No.	10,000	3	30,000	
Minor Road crossings	No.	2,500	1	2,500	
Allowance for excavation in rock	m3	200	612	122,400	Assume 100% 4-5m, 50% of 3-4 and 25% 2-3m

Wallace Main Pumpstation					
Land	m2	40	1,000	40,000	500 pop at 1200L/day PWWF 7L/sec Instantaneous Peak = 8xADWF
Power	Item	10,000	1	10,000	
Pumpwell	Item	60,000	1	60,000	3m dia 4m deep
Civil works, road, drains, fencing	Item	50,000	1	50,000	No building
Emergency Storage	Item	20,000	1	20,000	3hrs (20m3)
Pumps and Pipework	Item	60,000	1	60,000	22kW pumps duty standby
Electrical	Item	80,000	1	80,000	
Biofilter	Item	40,000	1	40,000	Bark bed biofilter
Chemical dosing facility	Item	40,000	1	40,000	Bulky box system

Bungaree Local Pumpstation					
Land	m2	40	1,000	40,000	3L/sec Instantaneous Peak
Power	Item	10,000	1	10,000	
Pumpwell	Item	20,000	1	20,000	2m dia 3m deep
Civil works, road, drains, fencing	Item	30,000	1	30,000	No building
Pumps and Pipework	Item	20,000	1	20,000	0.75kW pumps duty standby
Electrical	Item	60,000	1	60,000	
Rising Main 73mm dia	m	90	360	32,400	Pipeline 90mm SDR11 HDPE pipe

Bungaree Main Pumpstation					
Land	m2	40	1,000	40,000	1000 pop at 1200L/day PWWF 13.89L/sec Instantaneous Peak = 8xADWF
Power	Item	10,000	1	10,000	
Pumpwell	Item	60,000	1	60,000	3m dia 4m deep
Civil works, road, drains, fencing	Item	50,000	1	50,000	No building
Emergency Storage	Item	20,000	1	20,000	3hrs (20m3)
Pumps and Pipework	Item	40,000	1	40,000	7.5kW pumps duty standby
Electrical	Item	80,000	1	80,000	
Rising Main to Wallace 100mm dia	m	100	4,550	455,000	Pipeline 125mm SDR11 HDPE pipe
Air valves	No.	5,000	4	20,000	
Isolation/scours	No.	5,000	2	10,000	
Chemical dosing facility	Item	40,000	1	40,000	Bulky box system

Outfall - Wallace to Gordon WWTP					
Pipeline 160mm SDR11 HDPE pipe	m	150	8,825	1,323,750	130mm ID 1.05m/sec PN 16
Outlet control valve	Item	50,000	1	50,000	
Air valves	No.	5,000	10	50,000	
Isolation/scours	No.	5,000	5	25,000	
Header Tank	Item	50,000	1	50,000	Located within road reserve
Trenchless	m	200	600	120,000	
Special refill	m	200	400	80,000	
Freeway Crossing	m	1,000	100	100,000	Sleeved bore
Biofilter	Item	40,000	1	40,000	Bark bed biofilter

WWTP					
Land	Ha	20,000	10	200,000	10 Ha for irrigation
Primary Pond	Item	200,000	1	200,000	
Aeration equipment	Item	100,000	1	100,000	
Effluent Storage	ML	10,000	40	400,000	40ML storage
Effluent Disposal	Item	110,000	1	110,000	Travelling irrigator and pump 11Ha at \$10,000/ha
Electrical	Item	40,000	1	40,000	
Fencing	m	40	1,600	64,000	

Total Construction Cost				\$	6,558,925
Contingency	30.0%				1,967,678
Authority Administration Costs	10.0%				655,893
Design	8.0%				524,714
Project Management	3.0%				196,768
Construction Management	5.0%				327,946
Clerk of Works Administration	3.0%				196,768
Planning and Approvals	3.0%				196,768
Community Consultation	2.0%				131,179
Legal	1.0%				65,589
Surveying	1.0%				65,589
Geotechnical	2.0%				131,179

Total Capital Cost				\$	11,018,994
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O&M Cost

			Construction	Total	O&M %	Annual Cost
Collection system	Civils		2,168,775	3,643,542	0.50%	18,218
Rising mains	Civils		2,216,150	3,723,132	1.00%	37,231
Header tank	Civils		50,000	84,000	1.00%	840
Header tank	M&E		90,000	151,200	2.00%	3,024
Pumpstation	Civils		310,000	520,800	1.00%	5,208
Pumpstation	M&E		490,000	823,200	3.00%	24,696
WWTP	Civils		664,000	1,115,520	1.00%	11,155
WWTP	M&E		250,000	420,000	3.00%	12,600
Land			320,000	537,600	0.00%	-

Total Cost			6,558,925	11,018,994		112,972
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Power					
Bungaree main pump	kW	Hrs/day	kWhr/yr	Power cost \$/kWhr	4,770
Bungaree local pump	7.5	3.6	9855	0.12	
Wallace pump	0.75	3.6	985.5		
	22	3.6	28908		

Chemicals					
Ferric chloride	mg/L	L/day		Supply cost \$/kL	
	60	2.8		1000	1,039

TOTAL				\$	118,781
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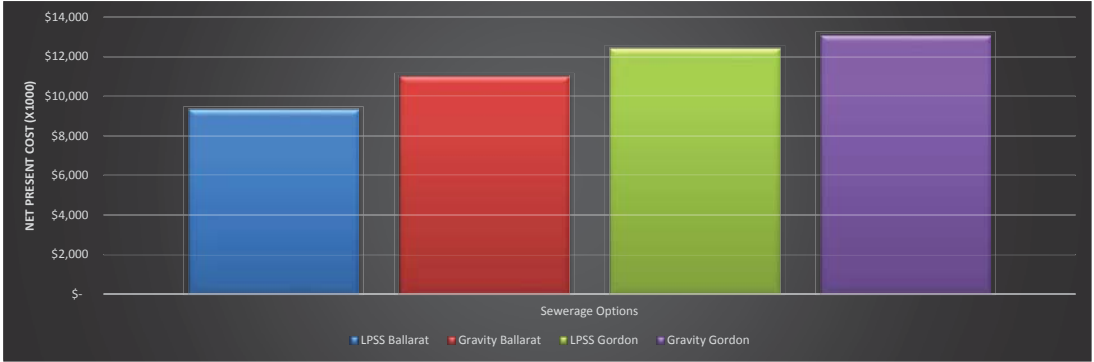
Notes

Bungaree - Wallace Sewerage Servicing Options

Sewerage Options	Option 1: LPSS sewerage and connection to Ballarat
	Option 2: Gravity sewerage and connection to Ballarat
	Option 3: LPSS sewerage and connection to Gordon
	Option 4: Gravity sewerage and connection to Gordon

Summary of Comparable Net Present Cost between options

	LPSS Ballarat	Gravity Ballarat	LPSS Gordon	Gravity Gordon
Sewerage Options	\$ 9,362,831	\$ 11,054,104	\$ 12,457,737	\$ 13,139,172



APPROVAL DATE		OPTION		YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5		YEAR 6		YEAR 7		YEAR 8		YEAR 9		YEAR 10		YEAR 11		YEAR 12		YEAR 13		YEAR 14		YEAR 15		YEAR 16		YEAR 17		YEAR 18		YEAR 19		YEAR 20		YEAR 21		YEAR 22		YEAR 23		YEAR 24		YEAR 25		YEAR 26		YEAR 27		YEAR 28		YEAR 29		YEAR 30		YEAR 31		YEAR 32		YEAR 33		YEAR 34		YEAR 35		YEAR 36		YEAR 37		YEAR 38		YEAR 39		YEAR 40		YEAR 41		YEAR 42		YEAR 43		YEAR 44		YEAR 45		YEAR 46		YEAR 47		YEAR 48		YEAR 49		YEAR 50		YEAR 51		YEAR 52		YEAR 53		YEAR 54		YEAR 55		YEAR 56		YEAR 57		YEAR 58		YEAR 59		YEAR 60		YEAR 61		YEAR 62		YEAR 63		YEAR 64		YEAR 65		YEAR 66		YEAR 67		YEAR 68		YEAR 69		YEAR 70		YEAR 71		YEAR 72		YEAR 73		YEAR 74		YEAR 75		YEAR 76		YEAR 77		YEAR 78		YEAR 79		YEAR 80		YEAR 81		YEAR 82		YEAR 83		YEAR 84		YEAR 85		YEAR 86		YEAR 87		YEAR 88		YEAR 89		YEAR 90		YEAR 91		YEAR 92		YEAR 93		YEAR 94		YEAR 95		YEAR 96		YEAR 97		YEAR 98		YEAR 99		YEAR 100		YEAR 101		YEAR 102		YEAR 103		YEAR 104		YEAR 105		YEAR 106		YEAR 107		YEAR 108		YEAR 109		YEAR 110		YEAR 111		YEAR 112		YEAR 113		YEAR 114		YEAR 115		YEAR 116		YEAR 117		YEAR 118		YEAR 119		YEAR 120		YEAR 121		YEAR 122		YEAR 123		YEAR 124		YEAR 125		YEAR 126		YEAR 127		YEAR 128		YEAR 129		YEAR 130		YEAR 131		YEAR 132		YEAR 133		YEAR 134		YEAR 135		YEAR 136		YEAR 137		YEAR 138		YEAR 139		YEAR 140		YEAR 141		YEAR 142		YEAR 143		YEAR 144		YEAR 145		YEAR 146		YEAR 147		YEAR 148		YEAR 149		YEAR 150		YEAR 151		YEAR 152		YEAR 153		YEAR 154		YEAR 155		YEAR 156		YEAR 157		YEAR 158		YEAR 159		YEAR 160		YEAR 161		YEAR 162		YEAR 163		YEAR 164		YEAR 165		YEAR 166		YEAR 167		YEAR 168		YEAR 169		YEAR 170		YEAR 171		YEAR 172		YEAR 173		YEAR 174		YEAR 175		YEAR 176		YEAR 177		YEAR 178		YEAR 179		YEAR 180		YEAR 181		YEAR 182		YEAR 183		YEAR 184		YEAR 185		YEAR 186		YEAR 187		YEAR 188		YEAR 189		YEAR 190		YEAR 191		YEAR 192		YEAR 193		YEAR 194		YEAR 195		YEAR 196		YEAR 197		YEAR 198		YEAR 199		YEAR 200		YEAR 201		YEAR 202		YEAR 203		YEAR 204		YEAR 205		YEAR 206		YEAR 207		YEAR 208		YEAR 209		YEAR 210		YEAR 211		YEAR 212		YEAR 213		YEAR 214		YEAR 215		YEAR 216		YEAR 217		YEAR 218		YEAR 219		YEAR 220		YEAR 221		YEAR 222		YEAR 223		YEAR 224		YEAR 225		YEAR 226		YEAR 227		YEAR 228		YEAR 229		YEAR 230		YEAR 231		YEAR 232		YEAR 233		YEAR 234		YEAR 235		YEAR 236		YEAR 237		YEAR 238		YEAR 239		YEAR 240		YEAR 241		YEAR 242		YEAR 243		YEAR 244		YEAR 245		YEAR 246		YEAR 247		YEAR 248		YEAR 249		YEAR 250		YEAR 251		YEAR 252		YEAR 253		YEAR 254		YEAR 255		YEAR 256		YEAR 257		YEAR 258		YEAR 259		YEAR 260		YEAR 261		YEAR 262		YEAR 263		YEAR 264		YEAR 265		YEAR 266		YEAR 267		YEAR 268		YEAR 269		YEAR 270		YEAR 271		YEAR 272		YEAR 273		YEAR 274		YEAR 275		YEAR 276		YEAR 277		YEAR 278		YEAR 279		YEAR 280		YEAR 281		YEAR 282		YEAR 283		YEAR 284		YEAR 285		YEAR 286		YEAR 287		YEAR 288		YEAR 289		YEAR 290		YEAR 291		YEAR 292		YEAR 293		YEAR 294		YEAR 295		YEAR 296		YEAR 297		YEAR 298		YEAR 299		YEAR 300		YEAR 301		YEAR 302		YEAR 303		YEAR 304		YEAR 305		YEAR 306		YEAR 307		YEAR 308		YEAR 309		YEAR 310		YEAR 311		YEAR 312		YEAR 313		YEAR 314		YEAR 315		YEAR 316		YEAR 317		YEAR 318		YEAR 319		YEAR 320		YEAR 321		YEAR	
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* A minus sign in these rows denotes a Net Present Value rather than a Net Present Cost

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Bungaree Only – Cost Estimates

Bungaree only LPSS Option - Discharge to Ballarat

Capital Cost

	Units	Rate	Quantity	Price	
Property pumps and connections					
Bungaree	No.	13,500	56	756,000	
Bungaree Network					
50mm pressure pipe	m	70	1,560	109,200	
63mm pressure pipe	m	80	860	68,800	
80mm pressure pipe	m	90	1,320	118,800	
Air valves	No.	3,500	3	10,500	
Flushing connections/scours	No.	5,000	3	15,000	
Bungaree Booster Pumpstation					
Land	m2	40	1,000	40,000	1000 pop at 600L/day PWWF 7L/sec Instantaneous Peak = 4xADWF
Power	Item	10,000	1	10,000	
Balance Pressure Vessel	Item	100,000	1	100,000	10m3 Steel
Building & Civil	Item	85,000	1	85,000	Small colourbond building, access road, drainage
Pumps and Pipework	Item	60,000	1	60,000	7.5kW pumps duty standby
Electrical	Item	100,000	1	100,000	Pumps chemicals and odour facility
Chemical dosing facility	Item	40,000	1	40,000	Bulky box system
Biofilter	Item	50,000	1	50,000	Bark bed biofilter
Outfall Bungaree to Ballarat					
Pipeline 125mm SDR11 HDPE pipe	m	125	5,700	712,500	101.5mm ID 1.05m/sec PN 16
Header Tank 50kL	Item	50,000	1	50,000	Located within road reserve
Biofilter	Item	30,000	1	30,000	Bark bed biofilter
Outlet control valve	Item	50,000	1	50,000	
Air valves	No.	5,000	6	30,000	
Isolation/scours	No.	5,000	3	15,000	
Total Construction Cost				\$ 2,450,800	Reduced geotech for shallow pipes
Contingency	30.0%			735,240	
Authority Administration Costs	10.0%			245,080	
Design	8.0%			196,064	
Project Management	3.0%			73,524	
Construction Management	4.0%			98,032	Reduced construction period, Outfall is longest item
Clerk of Works Administration	2.0%			49,016	Reduced construction period for network, assume pumps installed by sub-contractor
Planning and Approvals	3.0%			73,524	
Community Consultation	2.0%			49,016	
Legal	1.0%			24,508	
Surveying	0.5%			12,254	
Geotechnical	1.0%			24,508	
Total Capital Cost				\$ 4,031,566	

O&M Cost

		Unit	O&M cr Construction	Total	O&M %	Annual Cost
Collection system	Civils		322,300	530,184	2.00%	10,604
LPSS pumps	M&E	200	756,000	1,243,620		11,200
Rising mains	Civils		757,500	1,246,088	1.00%	12,461
Header tank	Civils		50,000	82,250	1.00%	823
Header tank	M&E		80,000	131,600	2.00%	2,632
Pumpstation	Civils		185,000	304,325	1.00%	3,043
Pumpstation	M&E		260,000	427,700	3.00%	12,831
Land			40,000	65,800	0.00%	-
			2,450,800	4,031,566		53,593
Power	kW	Hrs/day	kWHr/yr	Power cost \$/kWHr		1,971
Bungaree booster pump	7.5	6	16425	0.12		
Chemicals	mg/L	L/day		Supply cost \$/kL		
Ferric chloride	100	1.8		1000		657
				TOTAL	\$	56,221

Bungaree Only Gravity Option - Discharge to Ballarat

Capital Cost

	Units	Rate	Quantity	Price	
Property connections					
Bungaree	No.	500	56	28,000	
Bungaree Network					
150mm sewer 0-2m deep	m	175	1,660	290,500	
150mm sewer 2-3m deep	m	200	450	90,000	
150mm sewer 3-4m deep	m	250	-	-	
225mm sewer 0-2m deep	m	225	215	48,375	
225mm sewer 2-3m deep	m	275	250	68,750	
225mm sewer 3-4m deep	m	350	185	64,750	
225mm sewer 4-5m deep	m	450	440	198,000	
Manholes 0-2m deep	No.	3,500	60	210,000	
Manholes 2-3m deep	No.	4,500	6	27,000	
Manholes 3-4m deep	No.	6,000	2	12,000	
Manholes 4-5m deep	No.	9,000	3	27,000	
Inspection Points	No.	1,000	6	6,000	
Special refill	m	200	350	70,000	
Main Road Crossings	No.	10,000	3	30,000	
Minor Road crossings	No.	2,500	1	2,500	
Allowance for excavation in rock	m3	200	612	122,400	Assume 100% 4-5m, 50% of 3-4 and 25% 2-3m
Bungaree Local Pumpstation					3L/sec Instantaneous Peak
Land	m2	40	1,000	40,000	
Power	Item	10,000	1	10,000	
Pumpwell	Item	20,000	1	20,000	2m dia 3m deep
Civil works, road, drains, fencing	Item	30,000	1	30,000	No building
Pumps and Pipework	Item	20,000	1	20,000	0.75kW pumps duty standby
Electrical	Item	60,000	1	60,000	
Rising Main 73mm dia	m	90	360	32,400	Pipeline 90mm SDR11 HDPE pipe
Bungaree Main Pumpstation					1000 pop at 1200L/day PWWF 13.89L/sec Instantaneous Peak = 8xADWF
Land	m2	40	1,000	40,000	
Power	Item	10,000	1	10,000	
Pumpwell	Item	60,000	1	60,000	3m dia 4m deep
Civil works, road, drains, fencing	Item	50,000	1	50,000	No building
Emergency Storage	Item	20,000	1	20,000	3hrs (20m3)
Pumps and Pipework	Item	50,000	1	50,000	22kW pumps duty standby
Electrical	Item	80,000	1	80,000	
Biofilter	Item	40,000	1	40,000	Bark bed biofilter
Outfall					
Pipeline 160mm SDR11 HDPE pipe	m	150	6,283	942,450	130mm ID 1.05m/sec PN 16
Outlet control valve	Item	50,000	1	50,000	
Air valves	No.	5,000	6	30,000	
Isolation/scours	No.	5,000	3	15,000	
Balance Tank					
Land	m2	40	2,500	100,000	
Power	Item	10,000	1	10,000	
Civil works, road, drains, fencing	Item	150,000	1	150,000	RC tank base, access road, fencing, drainage
Balance Tank 855m ³	Item	500,000	1	500,000	Glass lined bolted steel tank and pipework
Mixer	Item	30,000	1	30,000	3kW
Electrical	Item	60,000	1	60,000	
Chemical dosing facility	Item	40,000	1	40,000	Bulky box system
Biofilter	Item	50,000	1	50,000	Bark bed biofilter
Total Construction Cost				\$ 3,835,125	
Contingency	30.0%			1,150,538	
Authority Administration Costs	10.0%			383,513	
Design	8.0%			306,810	
Project Management	3.0%			115,054	
Construction Management	5.0%			191,756	
Clerk of Works Administration	3.0%			115,054	
Planning and Approvals	3.0%			115,054	
Community Consultation	2.0%			76,703	
Legal	1.0%			38,351	
Surveying	1.0%			38,351	
Geotechnical	2.0%			76,703	
Total Capital Cost				\$ 6,443,010	

O&M Cost

			Construction	Total	O&M %	Annual Cost
Collection system	Civils		1,295,275	2,176,062	0.50%	10,880
Rising mains	Civils		1,019,850	1,713,348	1.00%	17,133
Balance tank	Civils		650,000	1,092,000	1.00%	10,920
Balance tank	M&E		240,000	403,200	2.00%	8,064
Pumpstation	Civils		180,000	302,400	1.00%	3,024
Pumpstation	M&E		270,000	453,600	3.00%	13,608
Land			180,000	302,400	0.00%	-
Total Cost			3,835,125	6,443,010		63,630
Power	kW	Hrs/day	kWhr/yr	Power cost \$/kWhr		3,719
Mixer	3	1	1095	0.12		
Bungaree main pump	22	3.6	28908			
Bungaree local pump	0.75	3.6	985.5			
Chemicals	mg/L	L/day		Supply cost \$/kL		
Ferric chloride	60	1.3		1000		473
TOTAL						\$ 67,821

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A

[illegible]

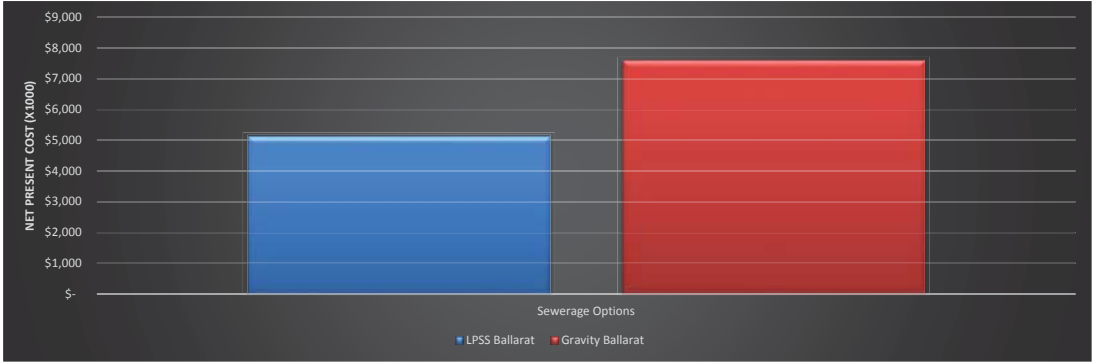
Notes

Bungaree only Sewerage Servicing Options

Sewerage Options	Option 1: LPSS sewerage and connection to Ballarat
	Option 2: Gravity sewerage and connection to Ballarat

Summary of Comparable Net Present Cost between options

	LPSS Ballarat	Gravity Ballarat
Sewerage Options	\$ 5,168,347	\$ 7,626,435



[illegible]

^a A minus sign in these rows denotes a Net Present Value rather than a Net Present Cost

[illegible]

^c A minus sign in these rows denotes a Net Present Value rather than a Net Present Cost



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