5. Key findings of geotechnical assessment

Key findings for this study include:

- The sites impacted by the bushfire occurred in steep terrain that requires any development to be sympathetic to the topography and adopt practices that will not degrade the stability of the area.
- Redevelopment of each site assessed is considered possible, provided the redevelopment takes into consideration the recommendations provided in this report.
- A list of geotechnical recommendations for redevelopment works for all sites are provided in Appendix A. These should be applied on a case by case basis to reduce the risk rating of identified hazards. Redevelopment works should follow good hillside practice guidelines which are outlined in Appendix A. In essence these practices recommend a reduction in planned cutting and filling and control of surface water.
- Post fire there are existing geotechnical hazards on the sites, which range from ‘Very High’ Risk to ‘Very Low’ Risk. The Very High Risk and High Risk hazards relate to burnt out retaining structures (most), high fill slopes and high cut slopes.
- All Very High Risk and High Risk hazards should be dealt with in the redevelopment work. In addition it is understood that it is COS policy to also deal with Moderate Risk hazards. The risk posed by burnt out retaining structures can be mitigated by reconstruction of the damaged retaining structures.

6. Key findings of land capability assessment

A key finding of the onsite wastewater containment assessment conducted as a part of the LCA is that 14 sites assessed within the study area are very highly constrained, 124 sites are highly constrained and 12 sites are moderately constrained in terms of their suitability to support onsite treatment and dispersal of wastewater.

Soil in Wye River and Separation Creek has a moderate potential to be dispersive. This indicates that the soil is susceptible to both erosion and structural degradation. Soil within the study area was also found to be sodic. This means that the percentage of exchangeable sodium is at a high enough level to adversely affect the stability and permeability of the soil under wastewater application. The depth to bedrock in the study area varies but is generally quite shallow.

Site slopes within the study area are steep with the average gradient for each site assessed in Wye River and Separation Creek being >12%. In accordance with the COS Domestic Wastewater Management Plan (2015) this indicates that the steepness of the slopes will highly constrain onsite wastewater management.

A range of measures can be adopted to potentially assist in mitigating constraints posed by the quality of the soil and steep slopes within the study area. These include measures to improve soil quality, level or terrace the land, and designing wastewater application systems to ensure an even distribution of effluent.

None of the sites assessed were found to be within the 1:100 year flood overlay area, being the available flood overlay for the area. Sites that are located within a 1 in 20 year flood inundation overlay are considered to be unsuitable for onsite dispersal of wastewater.

To minimise potential risks to the environment, onsite wastewater management systems must be installed with a sufficient ‘buffer’ or ‘setback’ distance between the boundary of a site and the surrounding environment (EPA Victoria, 2013). The majority of sites assessed were located at distances of over 100 m from surface water. EPA Publication 891.3 (EPA Victoria, 2013) requires that wastewater dispersal areas are sited at least 60 m from a stream or water body, and 100 m from a watercourse used for potable supply. The depth to the seasonal watertable also constrains the depth of soil that is available to receive and treat wastewater. Groundwater was not encountered in any of the test boreholes within the study area, indicating that it is not expected to pose a constraint. One groundwater well was identified at Wye River but is not indicated to constrain the location of onsite wastewater management systems at the fire affected properties.

The majority of sites assessed have a potentially available dispersal area larger than the maximum design dispersal area for primary treated effluent. However the assessment also found that other factors such as slope or depth of soil cover are constraining for the majority of sites. In such cases, a range of approaches may be feasible to mitigate the constraint (providing other factors such as lot size are not limiting) but would require individual assessment.

7. Key findings of wastewater management assessment

7.1. EPA certificates of approval

In Victoria, only onsite wastewater treatment systems that have been assessed and certified by the EPA can be sold and used. In this regard the Council can only issue a permit to install or alter and a certificate to use if the system that has been installed has an EPA Certificate of Approval (CA).

From 1 July 2016 EPA intends to remove the need for individual treatment systems to hold a CA. Instead, EPA will approve only types of systems, as required by the *Environment Protection Act 1970*. The four types of systems consistent with the Australian Standards will be:

- Septic tanks.
- Waterless composting toilets.
- Aerated wastewater treatment systems.
- Domestic greywater treatment systems*.

Currently all systems that hold a CA will fit one of these types with the exception of sand filters. In the interim, EPA will provide standards for sand filters and these will be included in a technical annex to EPA Publication 891.3.

Up until 1 July 2016, COS will be able to approve systems that have been certified by an accredited conformity assessment body (CAB) as conforming to the relevant Australian Standard or that have a current CA. After July 1 2016 all treatment systems will be required to be certified by a CAB as conforming to the relevant AS. The specific performance standards for effluent quality will be as specified in the relevant Australian Standards.

7.2. Alternative onsite wastewater treatment systems

There are potentially a range of non-EPA Certified wastewater treatment systems available in Australia and globally that may be suitable for Wye River and Separation Creek. In identifying these systems we have only considered secondary and higher standard treatment systems. A standard aerated wastewater treatment system (AWTS) is generally unable to provide a high standard of effluent without additional treatment processes. For this reason we have not identified additional AWTS unless they are incorporated in a process with additional treatment such as membrane filtration or trickling filters.

Membrane bioreactors (MBRs) despite being more energy intensive than attached growth systems, are becoming more popular for producing reclaimed quality water, particularly when site constraints restrict the use of more conventional systems. MBR and trickling filters can produce a relatively high standard of effluent, generally significantly better than primary treatment septic tanks and secondary treatment AWTS. Other technologies such as reverse osmosis, ultrafiltration and thermal evaporation also have potential for domestic wastewater management but currently these technologies are not well established. These alternative treatment processes are discussed in the sections below.

7.2.1. Membrane Bioreactors

Membrane Bioreactors (MBR) can produce very high quality effluent suitable for surface irrigation, surface and groundwater discharge and recycling. It is commonly used in municipal sewage treatment plants, but more recently has been applied to onsite domestic wastewater management.

An MBR is a combination of several wastewater treatment technologies (AWTS and membrane filtration), generally combining a pre-treatment settlement tank, followed by an aerobic bioreactor and finally a filter membrane. A pressure pump is generally required to force effluent through the membrane.

MBR systems generally have a small footprint and are tolerant to variable wastewater flow and contaminant loads. They also produce relatively low sludge volumes compared to other systems. The low TSS and turbidity of treated effluent makes it suitable for UV disinfection. However, MBR systems can be limited by clogging of the membrane surface leading to greater hydraulic resistance, increased energy demand and the need to replace the membrane. MBR systems often have greater maintenance requirements than other onsite systems.

Capital costs of MBR systems have typically been higher than for other systems, however the installation costs may be lower as in some circumstances they can be installed above ground.

Effluent from an MBR process is generally of very high quality. Removal efficiencies for TSS may be greater than 99% and for BOD greater than 95%. As the filter membrane pores are smaller than many bacteria and viruses removal rates for these microorganisms are very good (between 6-8 log reduction for bacteria and 3-5 log reduction for viruses). The MBR process can also remove organic and pharmaceutical compounds.

There are currently three MBR systems with EPA Certificates of Approval (Table 7.1). Only one of these is approved for all-waste treatment. The greywater systems are required to meet the 10/10/10 standard when used for toilet flushing and washing machine supply. It is likely that effluent quality from these greywater systems would be below the 10/10/10 standard. The all waste option is only approved for subsurface and surface irrigation (20/30 or 20/30/10 standard), however it is likely that this system would produce effluent closer to, below the 10/10/10 standard.

It is likely that any properly designed and maintained MBR system with UV disinfection will produce effluent that meets the 10/10/10 standard. The major constraint to the effective use of these systems is the limitations placed on recycling of treated blackwater or all-waste within the Code.

Table 7.1 MBR systems with EPA certificate of approval

Manufacturer	Model	Certificate of Approval	Waste approved for	Approved for	Disinfection
Aqua Clarus Holdings P/L	Super Natural	094.1/10	All waste	Subsurface and surface	UV
Aqua Clarus Holdings P/L	M800	099.1/12	Greywater	Subsurface, surface, recycling	UV
Wastewater Australia P/L	ultraGTS	120/11	Greywater	Subsurface, surface, recycling	UV

In addition to the systems with EPA certificates of approval there are a range of other systems available in Australia and overseas that use MBR technology (Table 7.2).

Table 7.2 Selection of other MBR systems available in Australia and overseas

Manufacturer	Website	Description
Busse	www.busse-gt.com	Busse manufacture a range of membrane bioreactor package plants suitable for domestic, commercial and small scale community wastewater management. The units are self-contained and designed to be installed above ground. These systems do not currently have approval in any Australian states or territories.
Taylex	www.taylex.com.au	Taylex manufacture a range of MBR systems that have approval in some Australian states and territories.
Advanced Enviro-Septic	www.enviro-septic.com.au	Advanced Enviro-Septic sell a proprietary pipe based system that uses an aerobic process and filtration for treatment. Although not a typical MBR system it does use the combined process of AWTS and filtration to achieve a high quality effluent.
Aqua Clarus Holdings	www.aquaclarus.com	In addition to the model with EPA Certificate of Approval, Aqua Clarus produces a range of MBR systems.
Everhard Industries	www.aquanova.com.au	In addition to the model with EPA Certificate of Approval, Everhard Industries produces a range of MBR systems.

7.2.2. Trickling filters

Trickling filters can also produce very high quality effluent suitable for surface irrigation and possibly recycling. They are commonly used in municipal sewage treatment plants as a tertiary or polishing process. Trickling filters use aerobic biological processes and mechanical filtration to treat effluent. Many trickling filters fail because they are inadequately sized and effluent ponds on the surface of the filter substrate creating anaerobic conditions.

There are currently three trickling filter systems with EPA certificates of approval (Table 7.3), including the generic approval for sand filters. These systems incorporate an initial settling or septic tank after which the effluent is applied to the filter. These systems can generally provide a high effluent standard that meets 10/10/10 after disinfection. As TSS and turbidity removal efficiencies are relatively high the effluent can generally be disinfected with UV.

Trickling filters can be very simple systems with low, or zero, energy requirements. Maintenance is relatively simple and involves the intermittent removal of the biomat on the surface of the filter substrate. Compared to MBR systems they are likely to be considered more reliable, require less maintenance, but may not provide as high a standard of effluent treatment.

Table 7.3 Trickling filter systems with EPA certificate of approval

Manufacturer	Model	Certificate of Approval	Waste approved for	Approved for	Disinfection
Diston Waste Water Technology P/L	Trickling Contactor Models	004/12	All waste	Subsurface	Chlorine (probably suitable for UV)
Innoflow Australia P/L	Advantex AX20	117.1/10	All waste	Subsurface, surface	UV
EPA	Sand Filters – Generic	001.3/03	All waste	Subsurface, surface	Dependent on system (generally suitable for UV)

In addition to the systems with EPA certificates of approval there are a range of other systems available in Australia and overseas (Table 7.4).

Table 7.4 Selection of other trickling systems available in Australia and overseas

Manufacturer	Website	Description
BioRock	www.biorock.com.au	BioRock manufacture a range of trickling filter based systems that do not require electricity.
H_2O Pure Plus	www.h2opureplus.com	H_2O Pure Plus manufacture a range of systems designed for domestic and commercial water recycling. A standard domestic system consists of a 10,000 L primary treatment tank and then two trickling sand filter pods fed by gravity. After the trickling filters the treated effluent is stored in a storage tank or well. The final effluent is suitable for UV disinfection and meets the 10/10/10 standard. The system uses only one electrical component, a pump to lift the treated effluent from the storage tank or well. The systems require very little maintenance and have a very low energy requirement.
Orenco Systems	www.orenco.com	Orenco Systems manufacture a range of trickling media filter treatment systems.

7.2.3. Other treatment systems

Reverse osmosis

Reverse osmosis is effectively a physical membrane filtration process that uses a semi-permeable membrane to remove contaminants (including dissolved ions) and pathogens from wastewater. Reverse osmosis is used in industrial and occasional municipal wastewater treatment, but is not commonly used in domestic wastewater treatment. It is capable of producing high purity potable water. Capital and operational costs can be relatively high for reverse osmosis systems and currently there are not suitable systems available for domestic wastewater management. As a result, we have not considered them further in our assessment.

Thermal evaporation

Thermal evaporator systems convert the liquid based portion of the effluent to water vapour, leaving a small quantity of solid or sludge material for offsite disposal (or possibly onsite composting). Systems are available in a wide range of capacities, including those sufficiently small for individual dwellings. In some systems there is potential to recover the water vapour or steam and condense it to collect high purity distilled water. Systems can be powered by electricity, gas or diesel. Capital costs and energy consumption are relatively high compared to alternative treatment and disposal technologies. In most situations a vent stack will be required to dispose of water vapour to the atmosphere.

Urine diversion toilets

In addition to the waterless toilets with EPA approval there are a range of urine diversion models available in Australia. Urine diversion toilets use various processes to separate the solid and liquid waste streams at the time of use. Urine waste is then directed to an existing wastewater treatment system or diluted and used for garden watering. Solid waste is removed from the system and composted. Urine diversion toilets are uncommon in Australia, but are widely accepted in Europe.

Mycofiltration

In-stream mycofiltration systems are another very adaptable option that would be appropriate for conveyances where flows are intermittent. They are well suited to providing additional treatment for offsite discharged to stormwater systems or surface water. Mycofiltration provides multiple removal processes which rely on the inherent characteristics of the fungal organism. The decomposition of organic pollutants is primarily performed by the secretion of enzymes that break down complex carbon chains into non-toxic molecules, many of which the fungus can then absorb as food. The remediation of metals occurs through fungal uptake and storage. Pathogenic bacteria removal by fungi, however, is a multi-faceted process that includes physical, chemical, and biological removal mechanisms.

7.2.4. Options for onsite disposal and recycling

Land disposal

A range of technologies exist for disposing of treated wastewater to land. They differ in their compatibility with treatment standards, application area requirements, potential for evapotranspiration, suitability for different soils and physical landscapes and other factors.

EPA Publication 891.3 provides guidance on the types of wastewater management systems that are compatible with different disposal options (Table 7.5).

Table 7.5 Compatibility of treatment and land disposal options

	Effluent standard	Subsurface (absorption trenches and beds, ETA trenches and beds, mounds)	Low pressure effluent distribution	Subsurface irrigation	Surface irrigation	Garden watering (hand held purple hose)	Indoor recycling (toilet flushing and washing machine)
Primary treatment							
Dry composting toilets	NA	✓	✓	x	x	x	x
Wet composting toilets	NA	✓	✓	x	x	x	x
Incinerating toilets	NA	NA	✓	x	x	x	x
Septic tanks (all waste systems)	NA	✓	✓	x	x	x	x
Septic tanks (grey water only systems)	NA	✓	✓	x	x	x	x
Secondary treatment							
All waste systems	20/30	✓	✓	✓	x	x	x
	20/30/10	✓	✓	✓	✓	x	x
Grey water only systems	20/30	✓	✓	✓	x	x	x
	20/30/10	✓	✓	✓	✓	✓	✓
Advanced secondary treatment							
All waste systems	10/10	✓	✓	✓	x	x	x
	10/10/10	✓	✓	✓	x	x	x
Grey water only systems	10/10	✓	✓	✓	x	x	x
	10/10/10	✓	✓	✓	✓	✓	✓

Land disposal also acts as a treatment process. A range of physical and chemical processes occur in the soil and groundwater system that attenuate effluent contaminants, including filtration, adsorption and dispersion and aerobic and anaerobic biological processes. Different land disposal techniques have differing capacities to attenuate contamination, and the potential for contamination attenuation increases with the thickness of suitable soil.

Where groundwater is shallow or intermittent flooding occurs, the capacity for soil attenuation may be limited. In these situations, a higher treatment standard may be required than for situations where there is an adequate unsaturated zone for soil attenuation.

One of the key requirements for land disposal systems on sites with slope instability risk, is minimising effluent drainage beneath the land application area. This can be achieved by reducing the design loading rate (DLR) and maximising the potential evapotranspiration. The DLR is the depth of water that can be disposed of a disposal area each day. DLRs are specified in both AS/NZS 1547 and EPA Publication 891.3. For some disposal methods, different DLRs are provided for primary and secondary treated effluent, due to the need to provide increased conservatism for primary effluent disposal.

Evapotranspiration can be maximised by encouraging the growth of appropriate vegetation over the land application area (if the land application system is compatible). In some circumstances surface irrigation has the potential to result in greater evaporative losses than subsurface disposal, particularly because a proportion of the effluent will be lost to wind drift and evaporation. However, surface irrigation has greater potential to result in surface runoff of effluent during rain and storm events.

Irrigation requires a significantly larger disposal area (almost ten times the bed area) than high rate land disposal structures such as absorption trenches, beds and mounds. This can provide a constraint on the use of irrigation on small properties with limited space available for disposal. However, this constraint needs to be weighed up against the increased nutrient removal and reduction in land stability risks that can be achieved with irrigation.

Installing high rate land disposal structures on steep slopes also presents construction challenges and will generally require extensive excavation to create level areas for the structures, potentially contributing to land stability risks.

Subsurface irrigation systems are sometimes prone to clogging due to high effluent TSS and biological growth. A clogged subsurface irrigation system may need full replacement, which is costly and creates significant land disturbance. In this regard, surface irrigation offers advantages in terms of maintenance and reliability.

Alternative land disposal systems

Most land disposal systems are unlined and rely on both soil drainage and evapotranspiration losses to dispose of effluent. An exception to this is amended soil mounds which are often installed with an impervious liner, making them solely reliant on evapotranspiration. Amended soil mounds generally use an industrial by-product which is high in iron and aluminium sesquioxides with high phosphorus adsorption characteristics. As all effluent is contained within the system there is no contribution to soil drainage and land stability risk. These systems require careful management to ensure they are not overloaded with effluent, resulting in deterioration of growing conditions.

In cases where soil thickness or properties limit the potential for land disposal on a property, mitigation may be possible by amending existing soil or importing more soil for incorporation into a design disposal system. In most situations at Wye River and Separation Creek previous land disposal trenches have required terracing.

Constraints to land disposal

In situations where there are constraints to land disposal, it may be possible to design systems that can contain water on site. Table 7.6 provides guidance on the range of options that may be suitable.

Table 7.6 Site selection for constrained land

	Onsite system selection	Mitigation
Small lot size	All systems may be suitable if DLR is appropriate. In the case of primary treated effluent Section 4.2.3.4 of AS/NZS 1547:2012 requires a reserve area of 100% of the design area. This is to cater for future expansion, resting of the land application system or duplication if unforeseen circumstances arise. The reserve area may be reduced or eliminated in some circumstances.	• Reduce water consumption. • Increase evapotranspiration. • Improve effluent quality.
Steep slope	Surface irrigation may be unsuitable for slopes >6%.	• Reduce water consumption. • Increase evapotranspiration. • Benching may be suitable if land stability is not a constraint. • Reduce potential for runoff and increased infiltration by installing interceptor drains or vegetation border at top of slope.
Land instability	Onsite land application may be unsuitable.	• Consider offsite land-application. • Reduce water consumption. • Reduce DLR (increase land application area). • Seek geotechnical advice.
Susceptible ecological areas or water bodies down slope at risk of surface runoff	All subsurface disposal systems may be appropriate.	• Reduce DLR (increase land application area). • Reduce potential for runoff by installing interceptor bunds or drains. • Increase evapotranspiration.
Groundwater quality at risk	Secondary treatment, advanced secondary and or disinfection may be required.	• Reduce DLR (increase land application area). • Reduce potential for runoff by installing interceptor bunds or drains. • Increase evapotranspiration.

Offsite disposal from onsite systems

Section 2.3.6 of EPA Publication 891.3 states that offsite discharge from onsite systems in new developments is prohibited:

> *The State Environment Protection Policy, Waters of Victoria (Clause 32) and the Victorian Planning Provisions prohibit off site discharge of wastewater from on site wastewater systems to stormwater drains, waterways or beaches for all new developments. The Victorian Planning Provisions require that, in Township Zones (Cl.32.03-2), Rural Living Zones (Cl.32.05-2), Farming Zones (Cl.35.03-2), Rural Activity Zones (Cl.35.07-2) and Low Density Residential Zones (Cl.35.08-2):*

> *Each dwelling must be connected to reticulated sewerage, if available. If reticulated sewerage is not available, all wastewater from each dwelling must be treated and retained within the lot in accordance with the State Environment Protection Policy (Waters of Victoria) under the Environment Protection Act 1970.*
>
> *Therefore, a new dwelling may only be built if it will be connected to a reticulated sewerage scheme or where the wastewater can be treated and contained on the lot in a Township, Rural Living, Farming, Rural Activity or Low Density Residential Zone.*

However, EPA Publication 891.3 also contains provisions for the consideration of existing offsite discharges (Section 2.3.6.1):

> *Premises with an existing off site discharge of wastewater (untreated greywater or treated sewage) to a waterway or stormwater drain should connect to reticulated sewerage when it is available. Eliminating off site flows of wastewater and raw greywater to stormwater drains will improve the health and quality of our waterways and the local amenity of suburbs and towns.*
>
> *For existing off site discharges in unsewered areas, it is recommended that wastewater management systems are upgraded and the effluent utilised in a land application system on site. Where a land capability assessment indicates that a property with an existing off site discharge is too small to contain all the effluent on site throughout the year, it is preferable to find a practicable solution [as per Clause 12 of SEPP (WoV)] that reduces the impact or risk e.g.:*
>
> *• discharge a smaller quantity of higher quality effluent to the stormwater drain in wet weather than continue to discharge all untreated greywater or treated sewage off site all year round*
>
> *or*
>
> *• install a pump-out tank and periodically transport the excess wastewater to a centralised sewage treatment plant.*
>
> *This will prevent further impact to the local environment and waterways as well as protect public health.*

If permitted to continue offsite discharge on these properties, mitigation would be required to reduce the impact or risk of the offsite discharge further. EPA Publication 891.3 provides two examples above, however there may still be uncertainty about what is required to fulfil the requirement. We recommend that a suitable approach and criteria for approving offsite discharges should be confirmed with the EPA before Council processes such permit applications.

In the case of *discharging a smaller quantity of higher quality effluent* it may be appropriate to:

- Require water efficiency fixtures and appliances.
- Not installing baths, spas or swimming pools.
- Limit occupancy.
- Replace previous onsite wastewater management system with a higher standard of treatment (e.g. if the existing system was a primary treatment septic tank, a replacement may consist of an AWTS with UV disinfection).

In some situations where offsite discharge may occur, it may also be appropriate to require a higher standard of effluent quality monitoring and consider the requirement for monitoring offsite impacts.

In most situations it is likely that an improvement to effluent quality can be made by ensuring the system is compliant with EPA Publication 891.3 and AS/NZS 1547:2012.

In situations where offsite discharge is determined to be appropriate there may be a range of options for disposal. Previously, offsite discharges at Wye River and Separation Creek were commonly to stormwater drainage. However, this approach minimises the potential for the treatment benefits of land disposal and contributes to increased stormwater flows. There is also potential to discharge to small watercourses if treatment is to a sufficient standard, and other approval requirements are met.

If a property has sufficient land area there is potential that it could be used for land disposal from an adjoining, or nearby property. However, the land access negotiations required for this approach are likely to be complicated and we consider it unlikely that such scenarios would be practicable.

Reserve areas

EPA Publication 891.3 requires that a reserve area of equal size to the disposal area is provided for all primary and secondary treated effluent high rate disposal structures (including trenches, beds and LPED systems), unless the Council is satisfied that there is a low risk of negative impact on the environment or public health. AS/NZS 1547 states that the equal sized reserve area generally relates to primary treated effluent and that the reserve area may be reduced or eliminated if a higher treatment standard was applied or if the system was dose loaded. Based on the available information, it is likely that introducing a higher standard of treatment may be the best approach to overcoming the requirement for reserve areas.

7.3. Recycling and reuse

There are various opportunities and options for reuse and recycling of treated effluent on a domestic scale including (Table 7.7):

- Subsurface or covered-surface drip irrigation.
- Surface spray or drip irrigation.
- Hand garden hose (purple hose).
- Toilet flushing.
- Washing machine.
- Storage.
- Fire fighting (recycled greywater can be used).

EPA Publication 891.3 provides limited options for recycling of all-waste and greywater effluent. The recycling of treated all-waste or blackwater is highly regulated due to the much greater potential for human health risks to occur. Recycling of all-waste or blackwater is not covered by EPA Publication 891.3 and reference needs to be made to EPA Publication 464.2. Although this guideline generally relates to the reuse of effluent from municipal sewage treatment plants it may have some applicability to domestic wastewater.

Table 7.7 Options for recycling of effluent of different quality standards (from EPA Publication 891.3)

	Sub surface irrigation		Surface irrigation		Toilet flushing and cold water supply to washing machine		Hand held 'purple' hose	
	Single dwelling	Multi dwelling residential, business and community	Single dwelling	Multi dwelling residential, business and community	Single dwelling	Multi dwelling residential, business and community	Single dwelling	Multi dwelling residential, business and community
Primary treatment	No	Yes	No	No	No	No	No	No
Secondary treatment all-waste	Yes	No	Yes (with disinfection)	No	No	No	No	No
Untreated shower and washing machine greywater	Yes	No	Yes	No	No	No	No	No
Secondary treatment greywater 10/10/10 standard	Yes	Yes	Yes	No	Yes	No	Yes	No
Secondary treatment greywater 10/10, 20/30/10, 20/30 standards	Yes	Yes	Yes	No	Yes	No	Yes	No

Currently the only recycling option available for a multi-dwelling residential situation, such as would be a cluster wastewater management system, is subsurface irrigation. All other forms of recycling are restricted to single dwellings. All-waste effluent cannot be recycled for any purpose other than subsurface or surface irrigation.

A cluster system may be able to use the provisions outlined in the Use of Reclaimed Water Guidelines (EPA Publication 464.2), however for use for toilet flushing and washing machine supply, effluent is required to meet Class A Recycled Water Standard. Class A is the quality of recycled water required for high exposure uses including those in residential developments. EPA Publication 464.2 applies to wastewater management systems with a design capacity and flow greater than 5,000 L/day and thus may not necessarily apply to an individual dwelling.

However these guidelines may apply to a cluster system in which several or more properties contribute wastewater to a combined system in excess of 5,000 L/day. As cluster systems are relatively uncommon additional investigation will be required to determine the specific requirements in relation to the guidelines.

7.4. Pump out

A pump out tank is a holding tank that receives and contains effluent from a dwelling for period of time before it is pumped out and removed from the property by a sewage truck. It is then transported to a connection point within an existing sewerage scheme or directly to a sewage treatment plant.

EPA Publication 891.3 considers a pump out system to be an option of last resort because the economic and environmental costs of pump out, transport and licences to discharge the effluent to a sewerage system are high and unsustainable.

EPA Publication 891.3 provides the following guidance:

- They may be installed for existing premises on a small block to rectify the impacts of an offsite discharge or a failing system.
- They cannot be installed for a new development or a new building.
- The property owner is required to have a suitable management program, including a contract with a sewage pump out operator and a strategy for sending the receipt for each pump-out to Council.
- The tank should be fitted with an alarm which alerts the premises occupier when the tank is 75% full.

However, in the absence of an alternative solution, pump out tanks may be the best option for small lots that are unable to dispose all effluent on-site. EPA Publication 891.3 rules out this option for new developments or new buildings, however, in the case of Wye River and Separation Creek we understand that the bushfire affected dwellings would be considered existing developments and pump out options can only be considered as an option of last resort.

7.5. Cluster systems

Because smaller cluster systems require less area for treatment and effluent dispersal, it is often easier to find suitable sites (as opposed to trying to find one large site to handle effluent generated by the entire community). Additionally, these treatment/dispersal sites are often closer to the areas where wastewater is being generated, which means that the collection and conveyance system can be smaller (both pipe diameters and lengths), making it easier to avoid problem areas (e.g., landslide areas). This characteristic also reduces energy demands for conveyance.

Cluster systems offer several advantages over individual onsite systems. The primary advantage (and most frequent driver) is that the best soils in an area can be prioritised for dispersal using cluster systems. Instead of trying to find suitable soil on each lot (which can be challenging when lots are small or for existing lots without a sufficient area of suitable soil), good soil on a nearby property can be used to meet the effluent dispersal needs of multiple lots.

From an economic perspective, offsite dispersal typically requires buying or leasing additional land. Therefore, all else being equal, costs will typically be higher to the user than for an individual onsite option. On the other hand, cluster systems are commonly used to make advanced treatment more affordable. Economies of scale are typically significantly greater for pre-treatment (e.g., biological filters, aerated treatment units) than for dispersal systems. Actual cluster system costs are a function of many factors, including number of homeowners connected, density of homes connected, topography, dispersal system land costs, and cluster treatment and dispersal system type and installation costs.

Cluster systems have previously been identified as a possible wastewater management solution at Wye River and Separation Creek, but have not been assessed in detail. The Whitehead and Associates (2015a) report provides a brief discussion of cluster systems:

> *Where local conditions (including dwelling density and layout) allow, it may be feasible for small groups of properties to enter into a decentralised serving arrangement whereby raw wastewater or primary-treated effluent is collected from each property/parcel in a common pipe, for off site treatment and discharge, or treatment and discharge on one or more of the serviced properties/parcels. Systems include pressure sewer, vacuum sewer and Common Effluent Discharge (CED) systems.*
>
> *This option is unlikely to be further explored by landowners due to the complexity involved. This option would be classified as a commercial wastewater system and would require investigations and approvals by a range of stakeholders. (including, but not limited to, Council and relevant Water Corporations). Off site treatment and/or disposal is likely to trigger the regulatory involvement of the EPA. EPA Works Approvals and licencing is discussed below. Options for connection to reticulated sewerage or a decentralised cluster system are typically more expensive when compared to on site alternatives.*

The report did not include any specific discussion about the suitability of cluster systems for Wye River and Separation Creek. Options for the inclusion of properties in cluster systems are outlined in Table 7.8 including a preliminary assessment of their likely feasibility.

Table 7.8 Options for inclusion of properties in cluster systems

Properties incorporated into scheme	Description	Feasibility	Reason
All properties – all waste	All properties in Wye River and Separation Creek would be incorporated into a series of clusters. Each cluster would treat and dispose of its own wastewater.	Possibly feasible, but unlikely to provide any benefit over a sewerage scheme.	It is feasible to incorporate all properties into clusters; however this may not offer any significant human health or environmental risk benefit when compared to other options.
All properties – blackwater only	All properties in Wye River and Separation Creek would be incorporated into a series of clusters. Each cluster would treat and dispose of its own blackwater. Greywater would be treated to 20/30 or 10/10/10 standard (depending on disposal or recycling method) for onsite land disposal recycling. If a property could not contain all greywater on site it could be contributed to the blackwater cluster system or offsite disposal considered.	Possibly feasible, but unlikely to provide any benefit over a sewerage scheme.	It is feasible to incorporate all properties into clusters; however this may not offer any significant human health or environmental risk benefit when compared to other options. This option would ensure that all blackwater was treated to a high standard and discharged appropriately. There may still be properties that cannot dispose of greywater on site and these would then need to contribute greywater to the blackwater cluster system or consider offsite disposal.

Table 7.8 Options for inclusion of properties in cluster systems (cont'd)

Properties incorporated into scheme	Description	Feasibility	Reason
Properties that cannot contain wastewater on site – all waste	Only properties that cannot contain wastewater on site would be incorporated into a cluster system (properties that can contain wastewater on site would do so, or if appropriate join an adjacent cluster).	Possibly feasible	Feasibility is dependent on the spatial distribution of properties that cannot contain wastewater on site.
Properties that cannot contain wastewater on site – blackwater only	Only properties that cannot contain wastewater on site would be incorporated into a blackwater only cluster system (properties that can contain wastewater on site would do so, or if appropriate join an adjacent cluster). Greywater would be treated to 20/30 or 10/10/10 standard (depending on disposal or recycling method) for onsite land disposal or recycling. If a property could not contain all greywater on site it could be contributed to the blackwater cluster system or offsite disposal considered.	Possibly feasible	Feasibility is dependent on the spatial distribution of properties that cannot contain wastewater on site and an appropriate management and owner participation arrangement is in place. This option would ensure that all blackwater was treated to a high standard and discharged appropriately. There may still be properties that cannot dispose of greywater on site and these would then need to contribute greywater to the blackwater cluster system or consider offsite disposal.

7.5.1. Properties suitable for inclusion in a cluster system

Properties suitable for inclusion in a cluster system may be identified in various ways. The ideal scenario for cluster system suitability would be a group of adjacent properties that are unable to dispose of effluent on site or an isolated group of properties that are either unable to dispose of effluent on site or wish to enter into a cluster system for cost, maintenance or other efficiencies.

In situations where properties that are unable to dispose of effluent on site are not located adjacent to each other, or where they are located adjacent to each other, but separated from the required cluster treatment and disposal area, cluster systems may not be ideal. In these scenarios it may be difficult to justify why additional properties along the pipeline route are not also included in the cluster system, or that a centralised system isn't considered for the inclusion of all properties.

In the Wye River and Separation Creek area previous land capability assessments (Whitehead and Associates, 2015) have suggested that all but 29 of the properties have a high risk for onsite disposal. As there was no clear spatial pattern of clustering of properties with higher sensitivity or the identification of properties that are unable to accommodate wastewater disposal on site, this data was of little use in determining the suitability of properties to enter to into cluster systems.

Although overland flow of ponded effluent during storm events was the primary identified cause of water quality impacts relating to onsite systems the SKM (2014) risk assessment study also identified that for properties where the unsaturated zone is relatively thin and the property is relatively close to the receiving water body, pathogens may survive, enter the receiving water body, and pose a risk to human health. This scenario would only be relevant to a small number of properties in the flat, low lying areas around Wye River and Separation Creek. Such properties could be considered for inclusion in a cluster system based on their increased potential to pose a human health risk and the ability for a cluster treatment system to ensure adequate treatment and discharge. However, the impact on pathogen and nutrient loads from imposing a higher standard of wastewater treatment or using a cluster system for these properties may only be marginal. Detailed groundwater assessment and modelling would be required to determine the likely influence.

7.5.2. Cluster system planning

In addition to identifying the suitability of properties to enter into a cluster arrangement, without undertaking detailed design to confirm whether they can accommodate onsite disposal, it is necessary to consider the implications of the timing of the rebuilds. Ideally a cluster system will be planned and designed for a group of existing dwellings or planned dwellings that would be constructed at a similar time.

In the current situation the timing of individual rebuilds is unknown and it may not be possible to have a full understanding of likely occupancy and other characteristics to allow the design of a cluster system. In many situations an interim wastewater management solution would be required. If a property, which may otherwise have entered into a cluster system, installs an interim onsite system it is unlikely that they would then want to join a cluster system when the surrounding properties were ready. There is some potential to consider scalable cluster systems and reusing components of an onsite system (for example the septic tank as onsite storage and preliminary treatment).

As previously indicated, economies of scale suggest that the more homes connected to a cluster system, the less expensive it will be on a per-lot basis, but only to a point. It is also critical to note that generalisations only go so far. To really answer the question of what size cluster is ideal, detailed LCAs for existing properties would need to be conducted with mapping to indicate where high priority lots are located. Using this information, concept-level designs and corresponding cost estimates for cluster systems to serve the high priority lots can be developed and different scales of cluster systems can be compared to find the ideal (i.e., lowest cost) option.

Ideally cluster systems would be designed based on the number of homes and other buildings requiring offsite treatment. However, as for any type of wastewater system, capacity can be built into the design to accommodate uncertainties and/or in anticipation of future development. In this way, the distributed, cluster system approach provides significant advantages over alternatives. Centralised systems are almost always overdesigned (i.e., designed with a significantly greater capacity than needed at the time). This results in large capital costs that can only be economically recovered if growth indeed meets or exceeds design projections.

Distributed systems, by contrast, offer the ability to phase in modular treatment and dispersal capacity (provided that enough land is secured for the systems), as required to match demand. This feature of distributed wastewater management appears to be a good fit for Wye River and Separation Creek for several reasons:

- The high costs associated with a centralised solution may be difficult to ‘sell’ to residents.
- Rebuilding (and thus, capacity demands) may occur in ‘phases’ informally driven by external or property owner-specific issues.
- Individual onsite systems that are currently functional may malfunction in the future and for those properties with limited ability to repair or replace their systems, connection to a cluster may be necessary.

In consideration of the above, planning of cluster systems can proceed from the ‘opposite direction’ to an extent. In other words, instead of only trying to match demand with a nearby property that could host a cluster, cluster sites can be evaluated somewhat independently of demand.

In addition to the capacity-matching advantages to phasing in cluster treatment and dispersal capacity, the ability to phase-in systems allows for system development to match the availability of funding and for management authorities to gain experience operating cluster systems with a small amount of capacity in service before scaling-up to more or larger systems.

7.5.3. Ownership and management

There are a range of options for ownership and management of a cluster system. Onsite components of the system infrastructure (including septic tank and pump or grinder pump depending on the system type) are generally owned by the property owner. Ownership of the communal components of a cluster system (reticulation, treatment system and disposal) can be by a group of property owners or a management entity such as Barwon Water. A range of ownership and management models has been identified in Table 7.9.

Table 7.9 Ownership and management models for cluster systems

Ownership and management model	Description	Discussion
1. **Property owner awareness model**	The cluster treatment and disposal system would be owned, operated and maintained by a property owners group or organisation. Council would prompt the owners to undertake maintenance and periodically review system performance.	This model is unlikely to be suitable, and provides a lower level of governance than currently required for onsite systems, for which the Council is required to enforce owners to have a maintenance contract.
2. **Property owner maintenance contract model**	The cluster treatment and disposal system would be owned, operated and maintained by a property owners group or organisation. Council would require the owners to enter into an operation and maintenance contract with a suitable contractor.	This model is similar to the existing requirements for onsite systems. It would be reliant on the Council enforcing the owners group or organisation to enter into a maintenance contract. There is significant potential for governance of the owners group or organisation to deteriorate and influence the ability to pay for ongoing operation, maintenance and contribute to future capital expenditure. This model may be appropriate for low risk situation involving a small number of properties.
3. **Council or Barwon Water operation and maintenance model**	The cluster treatment and disposal system would be owned by a property owners group or organisation. Council or Barwon Water would operate and maintain the system directly or through an operation and maintenance contract with a suitable contractor	This model may be subject to similar limitations as model 4.
4. **Council or Barwon Water ownership, operation and maintenance model**	The cluster treatment and disposal system would be owned, operated and maintained by Council or Barwon Water directly or through an operation and maintenance contract with a suitable contractor	This model would provide a high level of operational and maintenance security.

The selection of an appropriate management option will be dependent on the number of properties connecting to the cluster system and the potential risks of operational or maintenance failure. In a situation where there are only two or three properties connecting to a cluster system, ownership, operating and maintenance by the property owners may be feasible. In larger cluster systems ownership, operation and maintenance by a management entity such as Barwon Water may be required.

7.5.4. Treatment options for cluster systems

A wide variety of treatment technologies can be used in cluster systems ranging from septic tank primary treatment to advanced secondary treatment with membrane bioreactors. Appropriate treatment systems can only be designed after the number of properties connecting and the disposal method is determined.

Economies of scale for treatment systems can be significant and provide the opportunity for an improved effluent standard when compared to onsite systems.

Disposal options for cluster systems

A summary of potential disposal options for cluster systems or a community sewerage scheme are provided in Table 7.10 including a preliminary assessment of their likely feasibility. Individual disposal options are discussed further in the following sections.

Table 7.10 Options for disposal from a community sewerage scheme

Option	Description	Feasibility	Rational for determining feasibility
Recycling of all effluent	Wastewater would be treated to Class A standard and reticulated back to each property in the cluster (or other users such as caravan parks and other commercial and communal areas).	Unlikely to be feasible	Treatment to Class A standard is technically feasible, but has significant regulatory requirements to meet the provisions of the EPA Guidelines for Environmental Management: Use of Reclaimed Water. Provision of a recycled water reticulation system would be expensive and potentially contribute further to land stability risk. There is not a water shortage in the area that would demand the consideration of a domestic recycling scheme from an integrated water management perspective.
Land disposal to rapid infiltration basin, trenches or other structures	Wastewater would be treated to a high standard and disposed to rapid infiltration basin, trenches or other land disposal structures adjacent to the treatment plant.	Unlikely to be feasible	This would require relatively large areas of gently sloping land. These would include the potential irrigation areas identified in SKM (2011). This would require wastewater to be piped a significant distance from the cluster to the treatment and disposal area. Land stability risks in these areas were recognised and such a point source loading may contribute to unacceptably increasing risk.
Discharge to effluent disposal wells	Wastewater would be treated to a very high standard (possibly background groundwater) and discharged to a series of effluent disposal wells.	Unlikely to be feasible	It is unlikely that effluent disposal wells would be feasible in the relatively low permeability Otway Group sediments. The cost of treating effluent to background groundwater quality standard may be excessive.

Table 7.10 Options for disposal from a community sewerage scheme (cont'd)

Option	Description	Feasibility	Rational for determining feasibility
Irrigation to pasture	Wastewater would be treated to Class C standard and discharged via surface spray or drip irrigation.	Likely to be feasible	These would include the potential irrigation areas identified in SKM (2011). This would require wastewater to be piped a significant distance from the cluster to the treatment and disposal area.
Irrigation to forest	Wastewater would be treated to Class C standard and discharged via surface spray or drip irrigation in forest areas at very low rates.	Unlikely to be feasible	SKM (2011) determined that this option was not feasible. There are significant regulatory constraints; however from a technical perspective the identified constraints could likely be overcome. On balance we consider this option unlikely to be feasible for a sewerage scheme, but that it could warrant further investigation for a cluster system.
Surface water – Wye River or Separation Creek	Wastewater would be treated to Class A standard (and to sufficient quality to meet the relevant SEPP water quality objectives) and discharged to Wye River or Separation Creek	Likely to be feasible	Previous assessments have determined that this option is likely to be feasible.
Foreshore or near shore	Wastewater would be treated to Class A standard (and to sufficient quality to meet the relevant SEPP water quality objectives) and discharged to Wye River or Separation Creek	Likely to be feasible	Previous assessments have determined that this option is likely to be feasible.
Ocean – near shore or off shore	Wastewater would be treated to a high standard and discharged to the subsurface in the foreshore or near shore environment	Likely to be feasible	Previous assessments have determined that this option is likely to be feasible.
Transport to sewage treatment plant	A cluster scheme could potentially direct sewage to a central location for collection and storage before road transport to a nearby sewage treatment plant	Unlikely to be feasible	Cost of transport is prohibitive.
Thermal evaporation	Liquid waste would be separated from solids using thermal evaporation, leaving a small quantity of solid waste for disposal	Unlikely to be feasible	Energy cost is prohibitive.
Atomisation	Wastewater would be treated to Class A standard and atomised to forest areas	Potentially feasible	Atomisation is not commonly used for effluent disposal, although it is likely to be feasible if suitable areas of forest can be found.
Stormwater system	Treated wastewater would be discharged to the stormwater system	Potentially feasible	For situations where offsite discharge is being considered there may be benefit in several properties using a shared wastewater treatment system to provide a very high effluent standard and then using the existing stormwater system for disposal.

Land disposal

Although land disposal options for small and large cluster systems are similar to those associated with individual onsite systems, there are some additional considerations. As the size of the cluster dispersal system will be greater (much greater for larger clusters), pressurised distribution is commonly used. This can include the use of proprietary products like drip or spray irrigation tubing and control systems or traditional low pressure distribution (LPD, which is sometimes called “low pressure pipe” or LPP). Although either drip irrigation or LPD provide even distribution of effluent throughout a drain field, drip systems irrigate at a much lower rate than possible with LPD. This allows the drip emitters to be more tightly placed which avoids localised overloading of effluent and periodic saturation of the field. Additionally, drip lines can be installed shallower than LPD or other ‘trenched-based’ dispersal technologies. This has multiple advantages. For one, it is easier and less damaging to install, particularly in more difficult topographies (e.g., forested or steep areas). Another big advantage is that the effluent will have greater contact with biologically active surficial soils and with plant roots that can assimilate water and nutrients in the effluent.

Land disposal systems show moderate economies of scale. Although the length of line is typically essentially additive (e.g., all else being the same, the length of line required for a two house cluster will be twice that required for a single home), some of the costs for other needed components can be shared between users. These common components can include pumps, valves and other needed appurtenances, and product specific components (e.g., some drip systems include a mechanical filtration unit).

SKM (2011) determined that each of the land disposal areas investigated had significant ecological, geotechnical, competing land use or water balance issues. These are described in Table 7.11.

Table 7.11 Summary of constraints for potential land disposal areas considered in the Wye River and Separation Creek Sewerage Scheme Options Report (SKM, 2011)

Area	Constraint
Area 1 and 2	The sites are not large enough to accommodate the expected effluent load. Within a known landslip. Irrigation of these sites is not recommended due to increased geotechnical risks associated with irrigation.
Area 3	The site is not large enough to accommodate the expected effluent load. This area is proposed for recreation and/or residential development. It is also very close to Wye River and is subject to flooding.
Area 4	The site is not large enough to accommodate the expected effluent load. Irrigation of the forest is not recommended because of the increased risk associated with landslip and impracticalities of establishing and maintaining an irrigation area on steep and inaccessible land.

A review by AS Miner Geotechnical supported the findings of the SKM report (2011) and its conclusions that the risk associated with land disposal on the identified areas were unacceptable. Although a cluster system would have a significantly lower effluent flow than a sewerage scheme, many of these same risks may still be relevant.

The potential land disposal areas identified by SKM (2011) represent all of the cleared areas greater than approximately 500 m2 in the vicinity of Wye River and Separation Creek. All other areas of land are forested.

Irrigation to forested areas

There are only limited areas of forested non-reserve Crown Land in the vicinity of Wye River and Separation Creek; the remaining forested areas are private tenure. There is potential to consider these forested areas for effluent irrigation. However, as discussed in the SKM (2011) report, effluent irrigation in forested areas presents significant risks.

SKM (2011) undertook a preliminary assessment of the suitability of an area of privately owned forested land to the north of Wye River. Part of this area included a proposed firebreak. This area was burnt in the December 2015 bushfire. The constraints identified are summarised in Table 7.12:

Table 7.12 Summary of constraints for irrigating to forest areas

Constraint	Description
Flora and fauna	The forested area generally consists of native shrubby foothill forest with a conservation significance of “least concern”. Removal or disturbance of this vegetation would require approval from DELWP and offsetting.
Fire management	It was assumed that forest areas would require intermittent burning, at a frequency greater than the preferred management interval of 30 years to “reduce nutrient loads”, however the basis for this assumption was not described. An increased fire frequency would change the composition of the vegetation community and change the availability of habitat for fauna.
Geotechnical	No landslips were identified in the area, however it was noted that increased drainage and or removal of vegetation would increase the land stability risk
Irrigation practicalities	Difficulties were identified around the establishment and maintenance of the irrigation in highly vegetated steep terrain, the need to construct access roads, and incompatibility with potential back burning operations.

In addition to the constraints identified by SKM (2011) there are specific issues relating to the irrigation of bushfire affected land that would need to be considered. Increasing the irrigation area to enable a lower application rate can potentially mitigate land stability risks. However, in this case the effluent irrigation area may become untenably large. We have not considered the option of deforesting existing forested land, as this would present a significant erosion and land stability risk and possibly insurmountable approvals process. The forested areas also present challenges for the choice of an appropriate irrigation system as the land generally has a slope of between 20 and 30 degrees and would be unsuitable for surface irrigation.

Forest irrigation is relatively common practice in the US, including in areas with steep slopes and lush/dense vegetation. Drip irrigation systems can be installed (and maintained in the future) with small equipment or even by hand, so access infrastructure (e.g., roads) requirements can be greatly minimised.

Land management approaches can be broken down into several primary tools that can be effectively used: fire, rest, grazing, use of technology, money/labour, and human creativity. Although fire is commonly used to remove understories within forestry systems, this practice has its limitations in ecological value compared to other tools, and is not compatible on drip-irrigated lands. Fire generally reduces the effectiveness of the water cycle over time as it exposes soil, destroys the ground litter that slows water flow and helps maintain soil surface structure/aeration, and impairs the soil surface microenvironments that support decomposing organisms. When used repeatedly, fire tends to slow the mineral cycle within forests in the long run (despite the short term release). Fire is not compatible with drip irrigations. With the tubing installed so close to the surface, even moderate warming could compromise the integrity of the plastic considering that operating pressures of drip systems can be relatively high.

Other alternatives for brush management within drip-irrigated forests can include:

- Grazing: Use of intermittent, high-density rotational stocking of cattle, goats and/or sheep. A planned grazing system can not only suppress the growth of woody seedling species, but improve the water holding capacity and biological health of the forest soil while supporting herbaceous species that can't survive in fire-managed lands.
- Mechanical: Use of brush clearing equipment that clear tree alleys but also provide scattered wood chip piles for slower mineral release and water holding capacity.
- Labour: Hand clearing can also be used for areas not easily accessible to equipment.

Additional information about the forest management objectives of the area would be required to determine the most appropriate strategy for vegetation management. Although it is likely that increased water and nutrient loading to the land will stimulate increased vegetative growth in the immediate vicinity of the drip system, appropriate controls (i.e., as suggested above) will be sufficient to manage this growth. As the larger trees in the drip irrigated areas continue to grow, more effective shading is likely to limit understory growth, at least in some areas.

Although it is difficult to comment on specific irrigation rates for drip systems in forested areas in Wye River and Separation Creek, experience in the US suggests that irrigation rates are typical as high or modestly higher for forested areas than for comparable/adjacent un-forested areas. There are several reasons for this. First, surficial soils in forested areas often have better wastewater assimilation properties than in cleared, un-forested areas. Soils in forested settings are often more likely to be held in place by roots and to have loamy organic characteristics owing to repeated coverage by and decomposition of leaf litter. The other main reason for the improved assimilative capacity of forest soils is water balance related. That is, big trees with deep roots will take up more soil (and nutrients) than will shallow-rooted grasses.

Two approaches are often used for sizing drip irrigation systems: soil transmissivity-based and water balance-based. These are of course related, and can be simplified as follows: transmissivity-based loading rates relate to the short-term ability of the soils to accept and transport irrigated effluent, while water balance-based loading rates relate to the longer-term ability of the site to assimilate or move irrigated effluent. Both approaches are required to properly design a cluster-scale irrigation system, regardless of whether forested or non-forested land is being irrigated.

Rapid infiltration basins

Rapid Infiltration Basins (RIBs) can be a successful and cost effective means of land disposal and may utilise application rates of up to 100 metres per year in ideal conditions. A RIB system will typically consist of a series of basins, which are loaded with effluent intermittently and then left for infiltration and drying to occur. They require relatively flat land, high sub-surface permeability and sufficient depth to groundwater and distance to connected surface water to ensure adequate contaminant attenuation. Compared to irrigation, a RIB represents a point source hydraulic load and thus may significantly influence land stability risk if not sited on flat land. The RIB system would also need to be protected from flooding. We have not identified any suitable areas for the location of a RIB system at Wye River or Separation Creek.

Effluent disposal wells

Groundwater wells can be used for the disposal of treated effluent when hydrogeological conditions are favourable. Determining the feasibility of such a system would require a detailed understanding of the site hydrogeology. Our initial assessment suggests that the Otway Group sediments are unlikely to be suitable for effluent disposal wells due to the relatively low aquifer permeability. A more detailed hydrogeological assessment would be needed to determine the feasibility of this option.

Surface water discharge

SKM (2011) considered alternatives to land disposal, include discharge to Wye River and Separation Creek. The SKM assessment only considered a dual land disposal and surface discharge scenario where effluent would be treated to Class A standard for toilet flushing at caravan parks and irrigation of available open space (approximately 15 ML/year). Effluent not used for these purposes would be directed to the surface discharge (approximately 25 ML/year). However the report did conclude that both the Wye River and Separation Creek surface water discharges may be capable of receiving the entire effluent load. On this basis, it can be assumed that, if treated to a sufficient standard Wye River or Separation Creek may be able to accommodate effluent from a cluster system.

For both surface water discharge options significant additional investigations would be required to further assess dilution ratios, cultural heritage, planning approval requirements, terrestrial flora and fauna, and aquatic fauna.

Foreshore or near shore discharge

Discharge of effluent to a subsurface foreshore or near shore discharge may be a suitable alternative to land disposal. This approach is currently used by the Wye River Hotel under an EPA permit. This option would be best suited to a cluster close to the coast.

Transport to nearby sewage treatment plant

A cluster scheme could potentially direct sewage to a central location for collection and storage before road transport to a nearby sewerage treatment plant. The closest existing sewerage treatment plant to Wye River is Lorne at a distance of 22 km. Even a small cluster of several properties is likely to produce effluent volumes that would require many hundreds of truck movements per year. Such a scheme is likely to be cost prohibitive and has not been considered further.

Thermal evaporators

Thermal evaporator systems convert the liquid based portion of the effluent to water vapour, leaving a small quantity of solid or sludge material for offsite disposal (or possibly onsite composting). Systems are available in a wide range of capacities, including those sufficiently small for individual dwellings. In some systems there is potential to recover the water vapour or steam and condense it to collect high purity distilled water. Systems can be powered, by electricity, gas or diesel. Capital costs and energy consumption are relatively high compared to alternative treatment and disposal technologies. In most situations a vent stack will be required to dispose of water vapour to the atmosphere.

Atomisation

Atomisers are commonly used in wastewater treatment systems to reduce effluent volumes and in industrial operations to dispose of water in difficult environments. The atomiser simply produced a high-volume, ultrafine mist that is rapidly dispersed and evaporated in the atmosphere.

Atomisation may be an appropriate disposal method in forested areas if they can be located sufficiently far away from dwellings. The atomisation process will reduce, if not eliminate, the infiltration of excess effluent to the forest area, so as to not exacerbate land stability risks. Storage would be required to accommodate those times when atomisation cannot occur due to inappropriate weather conditions.

Irrigation to cleared land

A range of potential land disposal effluent irrigation areas was considered in SKM (2011). Although the SKM assessment was in relation to a sewerage scheme these options are still relevant for a cluster system.

7.5.5. Reticulation options for cluster systems

Cluster systems can use a number of different types of collection and conveyance approaches to move wastewater from homes and other buildings to the common treatment and dispersal site. The small extent of cluster service areas allows for more efficient and less expensive small-diameter alternatives to be used, including vacuum sewers, pressure sewers and small-diameter gravity sewers. Vacuum sewer systems are generally indicated for relatively flat topographies and accordingly would not be appropriate for Wye River and Separation Creek.

Pressure sewers and small-diameter gravity sewers are commonly used for cluster systems. Pressure sewers in particular, can overcome many common topographical challenges that might affect gravity or vacuum sewers. Pressure sewers generally fall into two categories, depending on the onsite sewer infrastructure at each home: septic tank effluent pump (STEP) and grinder pump systems. Grinder pump systems typically include a small pump basin at each lot which receives raw sewage from the home (it is also possible for adjacent lots to share a tank). A grinder pump in the basin conveys ground sewage through an interconnected network of small diameter pipe to the cluster site. STEP systems include a septic tank and effluent pumping system (which may be installed in the second compartment of the septic tank or within a separate pump tank), typically at each home.

In general, grinder systems are somewhat less expensive than STEP systems because the tankage is smaller. However, the grinder pumps themselves are significantly more expensive than effluent pumps and pump damage and repair or replacement tends to be more common for grinder pumps because they are pumping raw sewage and because the pumps are more complex (they have an integral comminutor to grind the sewage before pumping it). Other maintenance issues have been reported, again as a result of pumping raw, rather than primary treated, sewage. Therefore, even though capital costs may be less than for STEP, the O&M hassles and resulting costs associated with grinder systems often suggest STEP systems which tend to be more robust overall. The pressure sewer conveyance system (e.g., sizing, layout, valves and appurtenances) is similar regardless of whether STEP or grinder systems are used.

STEP systems can sometimes be combined with (or replaced by) septic tank effluent gravity (STEG) systems. These are essentially the same as a STEP system, just without the pump. In a STEG system, effluent flows through small-diameter gravity sewer to the cluster site. The choice of STEP versus STEG is primarily a function of topography.

In most cases, costs for collection are not strongly affected by economies of scale since the most costly infrastructure is located on the individual home sites. Where existing lots already include septic tanks, STEP or STEG can be even more favourable from an economic perspective, since the septic tanks can be reused provided they have been inspected and found to be (or made to be) structurally sound and watertight.

A summary of the suitability of these options for Wye River and Separation Creek is provided in Table 7.13.

Table 7.13 Connection options for cluster systems

	Description	Considered feasible	Reason
Direct connection (gravity)	Wastewater from individual dwellings would be directly piped to the cluster wastewater treatment system.	Possibly feasible	Feasibility is entirely dependent on the spatial arrangement of the properties and whether they can be connected by a gravity system. This scenario would involve the reticulation of untreated wastewater, which may be a significant risk in the event of system failure; however the capital costs for each property would be lower.
Pressure sewer	Wastewater would be pumped into the sewer line directly from each property.	Feasible	This system would require only a small onsite storage tank with minimal installation disturbance. Larger pipe diameters and increased excavation may create a high land stability risk than for a STEP/STEG system.
STEP/STEG	Wastewater from individual dwellings would undergo primary treatment in a septic tank on the property before been piped under gravity or pumped to the cluster wastewater treatment system.	Feasible	Feasibility is dependent on the spatial arrangement of the properties and whether they can be connected by a gravity system. A cluster may involve a combination of STEP and STEG connections. Feasibility of this system is also dependent on having sufficient space on the property for the primary treatment and storage system. The size of required treatment plant will be smaller as primary treatment will already have been completed.

8. Key implications for accelerating planning approvals

The acceleration of planning approvals for bushfire-affected properties will involve several key stakeholders, namely, regulatory authorities including DELWP as the overall custodian of the Victoria Planning Provisions, COS as the responsible planning authority, referral authorities (both determining and recommending) such as Barwon Water or EPA Victoria, and individual property owners.

The implications of the findings of the technical investigations for accelerating planning approvals for bushfire affected sites at Wye River and Separation Creek are discussed below.

8.1. Information required under EMO1

As noted in Section 2.1, a key trigger for planning approval for a dwelling in Wye River and Separation Creek is the requirement for a planning permit under the EMO in the Colac Otway Planning Scheme to construct a building or to carry out works. Under Schedule 1 to the EMO (EMO1), a written geotechnical assessment including site specific cross-sections and a Landslide/Landslip Risk Assessment (if required by the geotechnical assessment) must be prepared in accordance with the methodology presented in EMO1 and with reference to the AGS Guidelines (AGS, 2007a).

The timing of the conduct of the Coffey geotechnical assessment and the condition of the affected sites (pre-clean up in most cases) meant that development plans were not available for individual sites at the time this report was compiled. The geotechnical assessment has provided individual site assessments of Risk to Property and Risk to Life for site hazards identified and classified them from 'Very High' Risk to 'Very Low' Risk, but not prepared site-specific reports or cross sections for each site as required under EMO1.

The geotechnical risk ratings for individual sites (see Appendix A) require owners of most bushfire affected properties to provide more geotechnical information in respect of their planning permit application for a new/replacement dwelling.

The advice in relation to good hillside development practices provides guidance to property owners in the formulation of redevelopment plans. It also means that the COS will have a consistent information base to assist individual applicants in pre-lodgement consultations. It may also assist COS to append standard/uniform conditions to planning permits including the mandatory condition required by Schedule 1 (see Section 2.2.3).

Unless there are changes to the EMO1 requirements under any accelerated planning controls to be introduced for the bushfire affected areas, COS will still require site-specific reports in accordance with EMO1 for proposed new dwellings/development. However, given the range of risk classifications identified, there may be potential for the amount and type of additional information required under EMO1 to be assessed on a site by site basis. To achieve this, an amendment to the Scheme would be required to enable this flexibility. To achieve this, an amendment would be required to the current wording of EMO1 along the lines of wording (as appropriate to the local situation in Wye River and Separation Creek) included in the Schedules to the EMO in other planning schemes.

Another consideration arising from the LCA (see Appendix 2) could be:

- Whether the proposed building or works are a minor extension or alteration of an existing development.

8.2. Approvals for wastewater solutions

For statutory planning approval purposes, a ‘cluster wastewater treatment system’ is considered to fall within the definition of a ‘minor utility installation’. Under the Township Zone in the Colac Otway Planning Scheme, a ‘minor utility installation’ – which is defined to include both ‘a sewage treatment plant, and any associated disposal works, required to serve a neighbourhood;’ and ‘a pumping station required to serve a neighbourhood’ – does not require a planning permit. As a result, any proposed cluster/innovative wastewater treatment systems could be progressed in a timely manner subject to having either a current CA or it being certified by a Conformity Assessment Body (CAB) as conforming to the relevant Australian Standard.

Individual site-specific waste water treatment systems do not require planning approval as they are usually required as a condition on a planning permit, and are subject to ‘permit to install’ and a ‘certificate to use’ (see Section 2.3).

9. Key implications of geotechnical assessment

The geotechnical assessments considered each site as it existed at the time of the field program, with consideration of Risk to Property and Risk to Life hazards based on a similar structure being reconstructed. The assessments rated the risk of a number of hazards across the site. It is understood that the COS will require risks rated as ‘Moderate’ or greater to be resolved during reconstruction. The geotechnical report (Appendix A) provides engineering advice to assist with addressing risks during reconstruction. Mitigation works are also likely to require action from COS, either in the form of project wide site works and maintenance (on aspects such as drainage) or mitigation of hazards that occur within the road reserve.

If COS require reports in accordance with EMO1, then additional individual reports for each property will be required, once the proposed redevelopment plans become available. The information included in the geotechnical report (Appendix A) provides a basis to expedite the preparation of such development-specific reports.

10. Key implications of land capability assessment

The LCA found that the majority of sites assessed were highly constrained in terms of their suitability to support onsite treatment and dispersal of wastewater. In particular, it was identified that 14 properties are very highly constrained, 124 properties are highly constrained and 12 properties are moderately constrained (classified as being partially able to contain treated wastewater on site). The results of the assessment are found to be consistent with previous investigations across Wye River and Separation Creek.

A key implication of these findings is that individual site assessments will be required to determine the suitability of onsite wastewater management systems on particular sites, based on new building structures, site constraints and potential mitigation measures that can be adopted.

The assessment also found that steep slope is a constraining factor for the majority of sites. In such cases, a range of approaches may be feasible to mitigate the constraint (providing other factors such as lot size are not limiting) but would require individual assessment.

11. Key implications for wastewater management solutions

11.1. Effects of bushfire on soils

Soil type has a significant influence on the suitability of land for wastewater land disposal. Bushfires can potentially reduce soil organic matter and increase the hydrophobic properties of the soil.

Organic material falling on the soil surface helps protect soil from sealing and crusting due to raindrop impact. When this material is removed due to burning in a bushfire there is potential for decreased infiltration capacity and increased runoff and erosion. Depending on the severity of the bushfire, soil organic matter may also be removed and soil faunal activity reduced. This may reduce soil porosity, infiltration capacity and soil water retention.

These effects will be most relevant to the surface irrigation of effluent; however, depending on the severity of the fire and the depth of soil affected these effects may also influence the operation of deeper subsurface irrigation and absorption trenches.

After a bushfire a thin layer of soil can become hydrophobic (water repellent) due to the generation of waxy substances derived from organic material on the surface of and within the soil. The waxy substance penetrates the soil as a vapour and solidifies upon cooling. This can have the effect of reducing infiltration capacity and increasing runoff and erosion.

Recovery of original soil properties may take years or decades after bushfire, and these effects should be considered in the design of land disposal systems. The hydrophobic effect may persist for weeks or months until sufficient rainfall infiltration has removed the substance. These effects should be considered if surface or shallow subsurface irrigation is proposed for a property.

11.2. Human health and environmental risk and wastewater management

Ineffective domestic wastewater management can lead to a range of human health, environmental and aesthetic or social risks. These are briefly discussed below.

11.2.1. Human health risks

Human health risks are primarily related to the presence of pathogens, including bacteria, viruses, protozoa and helminths in domestic wastewater. Ingestion of these pathogens can result in gastrointestinal illness, including nausea, vomiting and diarrhoea. Some pathogens may also be responsible for more serious illnesses and life threatening complications.

Humans may come into contact with pathogens present in wastewater in a number of ways, including:

- Indirect contact with effluent from leaking pipes, failed wastewater management treatment or disposal systems on a property.
- Whole body contact. Indirect contact or ingestion (surface water in Wye River and Separation Creek is used as a drinking water supply source) of diluted effluent after it has passed through the subsurface or groundwater and discharged to drains, Wye River, Separation Creek or the ocean.
- Whole body contact. Indirect contact or ingestion of diluted effluent after it has mixed with stormwater and enters drains Wye River, Separation Creek or the ocean.

In addition to domestic wastewater management systems pathogens may also be sourced from:

- Commercial wastewater management systems.
- Direct impacts from recreational users (swimming, shedding).
- Birds and other animals.

11.2.2. Environmental risks

Domestic wastewater contains a range of nutrients, salts, metals, organic material and other contaminants that can potentially have a negative effect on the environment. The most abundant nutrients in domestic wastewater are nitrogen and phosphorous with are derived from human waste, food waste and household products. In natural surface waters elevated concentrations of nitrogen and phosphorous can lead to eutrophication and encourage algae and plant growth.

High organic material concentrations (high BOD5) can reduce the oxygen concentration of surface water and have a negative influence on aquatic biota. When treated wastewater with high salt concentrations is used for irrigation or land disposal there are potentially negative effects to soil salinity.

11.3. Land stability risk and wastewater management

The Otway Ranges are prone to landslides due to the high rainfall, steep slopes, unfavourable geology and manmade alteration. Tunnel erosion and landslides are ongoing and parts of Wye River are susceptible to larger landslides. Increasing the amount of water applied to the land through a wastewater management land disposal system has the potential to increase land stability risks.

Offsite systems may offer significant advantages in reducing land stability risks associated with wastewater management. However, they may also create their own unique land stability risks associated with the construction of the reticulation network.

Onsite wastewater land disposal represents a significant change in the natural water balance, or the effective rainfall, over the land disposal area. An indicative analysis undertaken by Coffey (2011) suggests that an onsite land disposal area may increase the effective rainfall over the property by up to 70%.

Coffey (2011) reported that a sewerage scheme would reduce the amount of water entering the ground on the residential properties, most notably in the locations of the disposal fields, and as such will significantly reduce the likelihood of small landslides in cut slopes downslope of the disposal fields.

Reductions in deep drainage from effluent disposal can also be achieved by using sub-surface or surface irrigation in preference to high rate disposal structures such as absorption trenches or beds. Irrigation uses a lower loading rate and promotes evapotranspiration to minimise the potential for drainage to occur.

11.4. Wastewater reduction and quality improvement

As identified in the wastewater management hierarchy, reducing the volume of wastewater produced is an important first step in the development of a sustainable wastewater management solution. Many of the dwellings that were destroyed in Wye River and Separation Creek are unlikely to have had water efficient fixtures and appliances. The rebuild presents a significant opportunity to reduce future water consumption and wastewater production.

11.5. Maintenance and monitoring

The redevelopment of bush fire damaged properties in Wye River and Separation Creek provides an opportunity to address wastewater management deficiencies that have been the subject of studies, meetings, and discussions for nearly 30 years. Previous assessments list the primary findings related to poor wastewater management, such as offsite discharges of treatment system effluent, sewage ponding on residential properties, effluent flows in stormwater ditches, odours, and so on.

The range of wastewater treatment systems currently approved for installation in Wye River and Separation Creek are capable of producing effluents amenable for land disposal and further attenuation of pollutant. However, the approved systems cannot meet health and environmental protection goals if they are incorrectly or inappropriately selected, designed, sized, operated, or maintained. In particular, for new and existing systems that are installed and operating, effective maintenance and monitoring can help ensure wastewater treatment systems are working efficiently and meeting relevant performance standards.

The importance of proper system maintenance and monitoring is well-known, but has apparently not been a high priority focus of wastewater management in Wye River and Separation Creek in the past. Previous audits of onsite wastewater systems have revealed a large number of poorly performing treatment units, including the full range of system types designed to provide primary, secondary, and/or advanced secondary treatment.

EPA Victoria permit rules and COS provisions contain most of the regulatory stipulations and procedures needed for a broad-based community framework for maintaining and monitoring wastewater treatment systems in Wye River and Separation Creek. The COS Domestic Wastewater Management Plan (Whitehead and Associates, 2015a) lays out nearly all of the key features of such a framework, including:

- Expanding the database of wastewater treatment systems through inspections of currently undocumented properties.
- Focusing compliance and monitoring activities in areas where risk of adverse outcomes are concentrated.
- Developing a greater understanding of the risks associated with unsewered areas of development.
- Guiding strategic planning initiatives to enhance environmental objectives or examine alternative wastewater solutions for unsewered areas.

11.6. Wastewater management option selection

It is unlikely that a single wastewater management system design will suit all properties. Depending on the characteristics of the property and location within the landscape different systems may provide the best balance of environmental and human health protection, cost and other factors.

Recommending the highest standard of wastewater management for all properties may be unnecessary to achieve the desired performance objectives. Instead we recommend that the best practicable option that best balances human and environmental health and economic objectives be identified.

Previous assessments have considered a wide range of options that encompass most of the possible options for wastewater management at Wye River and Separation Creek. The human health and environmental risk modelling undertaken by SKM and Ecos Environmental (2014) and the DWMP suggest that onsite systems are likely to be a sustainable wastewater management solution for properties that are able to contain wastewater on site. There has been very little previous assessment of cluster systems. Previous assessments of sewerage schemes suggest that they may be feasible, however they would be costly and potentially contribute to land stability risk. The human health and environmental risk modelling suggests that a sewerage scheme may provide no additional human health or environmental benefit over improvements to onsite systems.

11.7. Onsite systems

We have identified a range of onsite wastewater management scenarios for properties that can and cannot contain wastewater on site sustainably (Table 11.1 and 11.2). When determining whether wastewater can be contained on a property sustainably, consideration will need to be given to the dwelling characteristics, LCA and geotechnical aspects.

We have assumed that the effluent standards described in the table can be achieved with the following treatment processes:

- **Primary treatment** – standard septic tank.
- **All waste secondary treatment (20/30, 20/30/10 standard)** – AWTS or primary treatment septic tank and trickling filter.
- **All waste secondary treatment (10/10, 10/10/10 standard)** – MBR or primary treatment septic tank and trickling filter.
- **Greywater advanced secondary treatment (10/10, 10/10/10 standard)** – AWTS, MBR or trickling filter.

The options are broadly divided into the following three categories:

- Treatment and disposal of all wastewater in an all-waste system.
- Treatment and disposal in a split greywater and blackwater system (as a subset of these options, greywater diversion could be considered, but we have not included specifically).
- Treatment and disposal in a split greywater and waterless toilet system.

For each of the three categories we have identified preferred options for properties that can and cannot contain wastewater on site. In selecting these options we have made the following considerations:

- Preference given to options that are supported by EPA Publication 891.3.
- Preference given to sustainable offsite discharge over pump-out systems.
- We have assumed that a 100% reserve area is required for blackwater or all-waste 20/30 or 20/30/10 standard effluent disposed to non-irrigation. No reserve area will be required for 10/10 or 10/10/10 standard effluent.

Table 11.1 Onsite solutions for properties than can contain all wastewater on site

Category	Description of treatment	Status of option	Constraints
Category 1 Onsite treatment and disposal of all wastewater in an all-waste system			
1a on	Primary treatment (septic tank) and disposal to appropriate land disposal system.	Not preferred	Primary treatment is not considered best practice. Irrigation is preferred due to lower potential for land stability risks.
1b on	Secondary treatment to 20/30 standard and discharge to sub-surface irrigation or land disposal system.	Not preferred	Does not provide for disinfection which is preferred to reduce potential human health risks.
1c on	Secondary treatment to 20/30/10 standard and discharge to surface or sub-surface irrigation or land disposal system.	Preferred option	This option is likely to provide sufficient effluent quality to protect human and environmental health. Disinfection provides additional security in the event of a disposal area failure.
1d on	Advanced secondary treatment to 10/10/10 standard and discharge to surface or sub-surface irrigation or land disposal system.	Preferred option	There are currently no all waste wastewater management systems with an EPA Certificate of Approval that meets the 10/10/10 standard, however it is implied that such a system would be acceptable as it would produce higher quality effluent than systems certified for the 20/30/10 standard which would be permitted for these disposal options. For non-irrigation disposal this option is likely to fulfil the requirements to remove the requirement for a reserve area due to the higher quality effluent.
1e on	Advanced secondary treatment to 10/10/10 standard and recycling for toilet flushing, washing machine and garden water ‘purple’ hose, then remainder discharged to surface or sub-surface irrigation or land disposal system.	Not preferred	This option is not permitted by the Code of Practice. There are currently no all waste wastewater management systems with an EPA Certificate of Approval that meets the 10/10/10 standard. Due to the higher human health risk associated with indoor recycling this option is unlikely to be acceptable.

Table 11.1 Onsite solutions for properties than can contain all wastewater on site (cont'd)

Category	Description of treatment	Status of option	Constraints
Category 2 Onsite treatment and disposal in a split greywater and blackwater system			
2a split	Blackwater: Primary treatment and disposal to appropriate land disposal absorption system. Greywater: Secondary treatment to 20/30 standard and discharge to sub-surface or surface irrigation or land disposal absorption system.	Not preferred	Primary treatment is not considered best practice. Irrigation is preferred due to lower potential for land stability risks.
2b split	Blackwater: Secondary treatment to 20/30 standard and discharge to appropriate sub-surface irrigation or land disposal absorption system. Greywater: Advanced secondary treatment to 10/10/10 standard and recycling for toilet flushing, washing machine and garden water 'purple' hose, then remainder discharged to irrigation or land disposal absorption system.	Not preferred	Does not provide for disinfection which is preferred to reduce potential human health risks in the event of a disposal area failure.
2c split	Blackwater: Secondary treatment to 20/30/10 standard and discharge to sub-surface or surface irrigation or land disposal absorption system. Greywater: Advanced secondary treatment to 10/10/10 standard and recycling for toilet flushing, washing machine and garden water 'purple' hose, then remainder discharged to irrigation or land disposal absorption system.	Preferred option	This option is likely to provide sufficient effluent quality to protect human and environmental health and would be suitable where the property owner desires to recycle water and or does not have sufficient space for containment of all effluent.
Category 3 Onsite treatment and disposal in a split greywater and waterless toilet system			
3a split	Blackwater: Dry composting, urine diversion or incinerating toilet. Greywater: Advanced secondary treatment to 20/30/10 standard and discharge to sub-surface or surface irrigation or land disposal absorption system.	Not preferred	Has been considered "not preferred due to a general reluctance by property owners to adopt waterless toilet systems. However, it may be suitable if a property owner does desire to use a waterless toilet system.
3b split	Blackwater: Dry composting, urine diversion or incinerating toilet. Greywater: Advanced secondary treatment to 10/10/10 standard and recycling for toilet flushing, washing machine and garden water 'purple' hose, then remainder discharged to surface or sub-surface irrigation or land disposal absorption system.	Not preferred	Has been considered "not preferred due to a general reluctance by property owners to adopt waterless toilet systems. However, it may be suitable if a property owner does desire to use a waterless toilet system.

Table 11.2 Alternative solutions for properties that cannot contain all wastewater on site

Category	Description of treatment	Status of option	Constraints
Category 1 Onsite treatment and disposal of all wastewater in an all-waste system			
1a off	Primary treatment (septic tank) and discharge to storage then pump out.	Not preferred	Pump out is only considered as an option of last resort and should not be adopted where onsite containment is possible.
1b off	Secondary treatment to 20/30 standard and discharge to storage then pump out	Not preferred	Pump out is only considered as an option of last resort and should not be adopted where onsite containment is possible.
1c off	Advanced secondary treatment to 10/10/10 standard and discharge to surface or sub-surface irrigation or land disposal absorption system, excess water discharged to offsite stormwater drain, surface water or irrigation.	Not preferred	There are currently no all waste wastewater management systems with an EPA Certificate of Approval that meets the 10/10/10 standard. Off site discharge is likely to only be permitted in situations where it has occurred previously and where measures have been taken to reduce wastewater volumes and improve quality.
1d off	Advanced secondary treatment to 10/10/10 standard and recycling for toilet flushing, washing machine and garden water ‘purple’ hose, then remainder discharged to offsite stormwater drain, surface water or irrigation.	Not preferred	There are currently no all waste wastewater management systems with an EPA Certificate of Approval that meets the 10/10/10 standard. Off site discharge is likely to only be permitted in situations where it has occurred previously and where measures have been taken to reduce wastewater volumes and improve quality.
Category 2 Onsite treatment and disposal in a split greywater and blackwater system			
2a split	Blackwater: Primary treatment (septic tank) and disposal to appropriate land disposal absorption system. Greywater: Secondary treatment to 20/30 standard and discharged to offsite stormwater drain, surface water or irrigation.	Not preferred	Off site discharge is likely to only be permitted in situations where it has occurred previously and where measures have been taken to reduce wastewater volumes and improve quality.

Table 11.2 Alternative solutions for properties that cannot contain all wastewater on site (cont'd)

Category	Description of treatment	Status of option	Constraints
2b split	Blackwater: Secondary treatment to 20/30 standard and discharge to appropriate sub-surface irrigation or land disposal absorption system. Greywater: Advanced secondary treatment to 10/10/10 standard and recycling for toilet flushing, washing machine and garden water 'purple' hose, then remainder discharged to offsite stormwater drain, surface water or irrigation. (As greywater volumes would be reduced under this scenario it may be possible to contain blackwater on site. If this is not possible it would be necessary to consider other options for disposal, including offsite discharge, pump-out, cluster systems or community sewerage scheme).	Not preferred	Does not provide for disinfection which is preferred to reduce potential human health risks in the event of a disposal area failure.
2c split	Blackwater: Secondary treatment to 20/30/10 standard and discharge to sub-surface or surface irrigation or land disposal absorption system. Greywater: Advanced secondary treatment to 10/10/10 standard and recycling for toilet flushing, washing machine and garden water 'purple' hose, then remainder discharged to offsite stormwater drain, surface water or irrigation. (As greywater volumes would be reduced under this scenario it may be possible to contain blackwater on site. If this is not possible it would be necessary to consider other options for disposal, including offsite discharge, pump-out, cluster systems or community sewerage scheme).	Preferred option	Off site discharge is likely to only be permitted in situations where it has occurred previously and where measures have been taken to reduce wastewater volumes and improve quality. This option is likely to provide a sufficient effluent standard for offsite discharge of greywater in situation where blackwater can be contained on site.
Category 3 Onsite treatment and disposal in a split greywater and waterless toilet system			
3a split	Blackwater: Dry composting, urine diversion or incinerating toilet. Greywater: Secondary treatment to 20/30 standard and discharged to offsite stormwater drain, surface water or irrigation. (As there would be no blackwater in this scenario it may be possible to contain the greywater on site via surface or sub-surface irrigation or land disposal without the need for the offsite discharge. If this is not possible it would be necessary to consider other options for disposal, including offsite discharge, pump-out, cluster systems or community sewerage scheme).	Not preferred	Off site discharge is likely to only be permitted in situations where it has occurred previously and where measures have been taken to reduce wastewater volumes and improve quality.

Table 11.2 Alternative solutions for properties that cannot contain all wastewater on site (cont'd)

Category	Description of treatment	Status of option	Constraints
3b split	Blackwater: Dry composting, urine diversion or incinerating toilet. Greywater: Advanced secondary treatment to 10/10/10 standard and recycling for toilet flushing, washing machine and garden water 'purple' hose, then remainder discharged to offsite stormwater drain, surface water or irrigation. (As there would be no blackwater in this scenario it may be possible to contain the greywater on site via surface or sub-surface irrigation or land disposal without the need for the offsite discharge. If this is not possible it would be necessary to consider other options for disposal, including offsite discharge, pump-out, cluster systems or community sewerage scheme).	Preferred	Off site discharge is likely to only be permitted in situations where it has occurred previously and where measures have been taken to reduce wastewater volumes and improve quality.
3c **split**	Blackwater: Dry composting, urine diversion or incinerating toilet. Greywater: Primary treatment and discharge to storage then pump out.	Potentially suitable for properties that cannot contain waste water onsite and cannot sustainable dispose offsite through an individual or cluster system.	Pump out is only considered as an option of last resort. Consideration should be given to all alternatives including water efficiency and reducing the dwelling size.

11.8. Cluster systems

There are a range of options for the development of cluster systems at Wye River and Separation Creek. The selection of an appropriate option is dependent on the results of a detailed LCA and the presence of adjoining or closely spaced properties that could consider joining a cluster scheme. As discussed previously there are several significant barriers to the implementation of cluster schemes, including:

- Properties best suited to a cluster scheme may not be adjoining or close by, increasing reticulation costs.
- Timing of rebuilds may not be compatible with cluster scheme development.
- Limited areas suitable for disposal from a cluster scheme.
- Limited options for recycling of treated effluent unless the provisions of the Guideline for Environmental Management (GEM): Use of Reclaimed Water (EPA Publication 464.2) are met, including the need for treatment to Class A standard for household reuse.
- Domestic water recycling from a cluster system would require reticulation back to each property in the cluster, increasing the cost of system installation.

The land capability assessment has categorised properties into three risk classes. 14 properties (9.5%) are classified as ‘Very Highly Constrained’, 122 properties (82.4%) are classified as ‘Highly Constrained’ and 12 properties (8.1%) were classified as ‘Moderately Constrained’. These risk classes are mapped on Figure 6.

LCA risk classification approaches can be useful to identify properties or groups of properties that may be appropriate for specific wastewater management solutions, including the incorporation into cluster systems. In general, properties at Wye River and Separation Creek are highly constrained in terms of the selection of appropriate wastewater management solutions. However a higher concentration of properties that are unlikely to be able to contain wastewater are found in a cluster at Wye River and another cluster at Separation Creek. These properties may potentially be suitable for inclusion in cluster systems and are discussed further in Section 12.17 that presents a conceptual system and costing.

There may be situations where a group of property owners identify that they would prefer to enter into a cluster scheme on their own accord, whether they are able to contain wastewater on site or not, however this is probably unlikely as conventional on site systems are likely to be more cost effective and less complicated in their planning and development given the constraints outlined above. On properties that are able to contain wastewater on site a cluster system is unlikely to result in a significant human health or environmental benefit compared to an onsite system.

11.9. Sewerage scheme

Previous assessments have determined that a sewerage scheme would be unfeasible due to its excessive cost and potential to increase land stability risks. However, that assessment considered a scenario in which water would be treated to a Class A standard for recycling and discharged to Wye River, Separation Creek or the ocean. There is potential to re-examine these costs for a scenario where the total treated effluent flow was discharged to surface water or the ocean. We have not considered these options further, other than identifying that this type of community sewerage scheme is at least potentially feasible, and possibly significantly cheaper than previously estimated.

Source:
Land capability constraint rating from Coffey.
Roads, watercourses and parcel boundaries from VICMAP.
Imagery from DEWLP (captured 9 January 2016).

MXD Reference: 11630AA_01_GIS020_v0_1

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Date: 05.04.2016
Project: ENAUABTF0DELWPAA
File Name: 11630AA_01_F006_GIS

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Geotechnical, Land Capability and Wastewater Solutions Project

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Land capability constraint rating

Figure No: 6

12. Preferred options for wastewater management

In terms of human health and environmental risk, previous modelling undertaken (SKM, 2014) suggests that a community sewerage scheme may offer no significant benefit when compared to undertaking improvements to existing onsite wastewater management systems. On this basis it may be difficult to justify the increased cost of a community sewerage scheme. On an intermediate scale, cluster systems may provide a cost benefit for properties that cannot contain wastewater on site, however are unlikely to provide any benefit for those that can. The economics of a cluster system will be largely dependent on the number of properties involved and their spatial relationship to one another.

The findings of this and previous reports suggest that effective and sustainable wastewater management can likely be achieved with onsite systems if surface ponding and overland flow of effluent can be prevented, however on some properties it may not be possible to contain all wastewater on site. For these situations we recommend a range of solutions including: the consideration of cluster systems, partial onsite containment, greywater split systems, waterless toilets and pump out systems. Trench systems are not a preferred option.

When determining whether wastewater can be sustainably contained on site it is necessary to consider both the LCA and geotechnical aspects of the property. In some situations onsite disposal may create an increased land stability risk, and this would need to be assessed on an individual property basis.

Existing onsite wastewater management systems with EPA Certificate of Approval are likely to be able to provide effluent of a sufficient standard to meet the required performance standards and ultimately the performance objective of the protection of environmental and human health so that the beneficial uses of the environment are not compromised. More advanced systems could be adopted, but these may not provide any significant benefit in fulfilling the primary objectives of wastewater management.

A summary of the preferred options and a flow chart for the selection of a suitable option are provided in Table 12.1 and Figure 7.

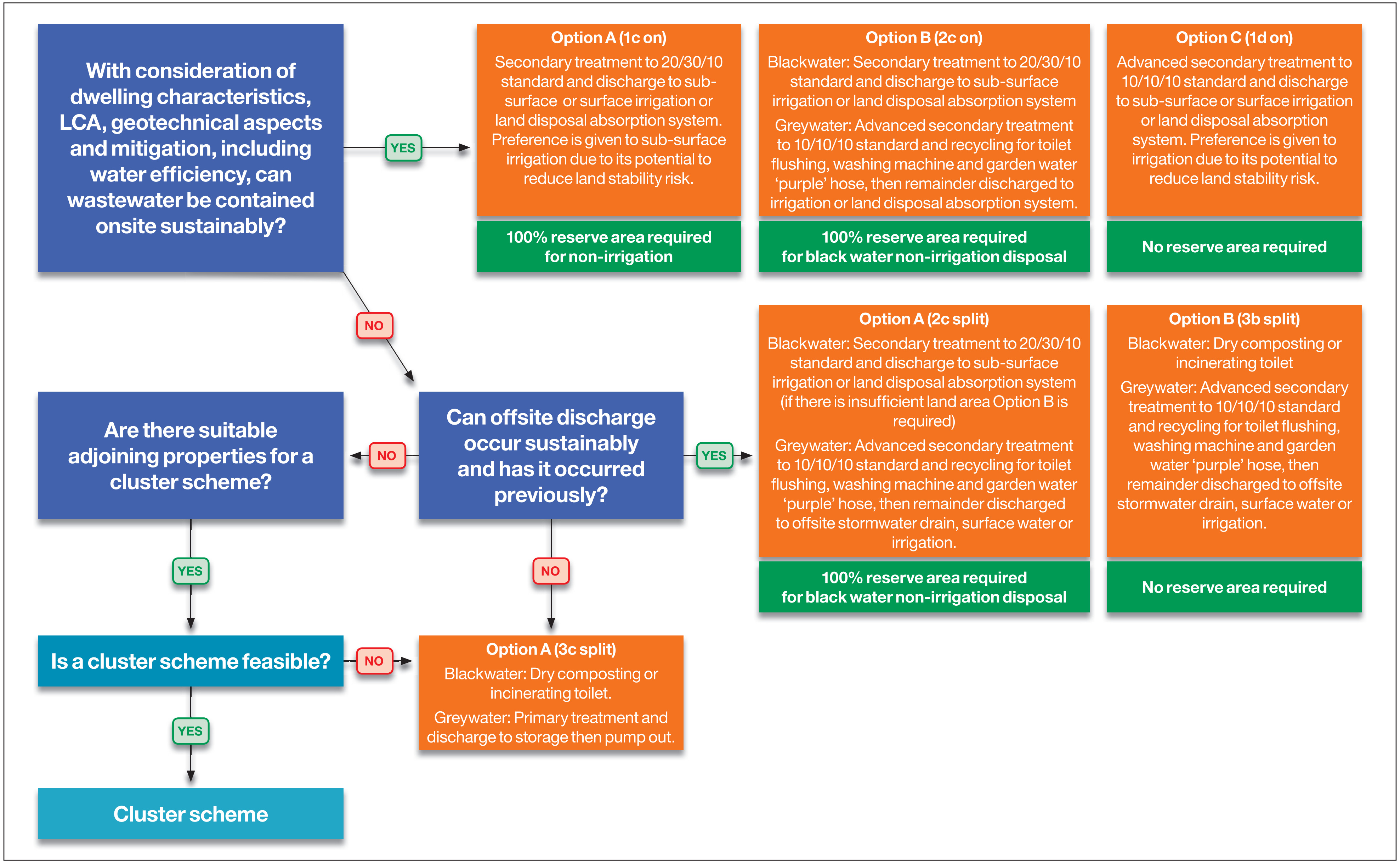
Table 12.1 Summary of onsite system selection

Description	Criteria	Approach
Wastewater can be contained on site	LCA and geotechnical assessments determine that it is feasible to contain wastewater on site and that there is sufficient space for the irrigation or disposal area and reserve area if required.	Three options have been provided with varying requirements for reserve areas. Selection of the appropriate option will dependent on the LCA results for the property and or the willingness of the owner to enter into a split blackwater and greywater system. Preference should be given to sub-surface or surface irrigation due to its potential to reduce land stability risk. The choice between the three options will be dependent on the property owners desire for a split system with water recycling and the useable lot area in relation to the requirement for reserve areas. Option A (1c on) involves secondary to 20/30/10 standard and discharge to sub-surface or surface irrigation or land disposal system. A reserve area would not be required if irrigation was used.

Table 12.1 Summary of onsite system selection (cont'd)

Description	Criteria	Approach
Wastewater can be contained on site (cont'd)		Option B (2c on) involves a split system with black water secondary treatment to 20/30/10 standard and discharge to sub-surface irrigation or land disposal. Greywater would receive advanced secondary treatment to 10/10/10 standard and be used for toilet flushing, washing machine and garden water, then the remainder would be discharged to irrigation or a land disposal system. Option C (1d on) involves advanced secondary treatment to 10/10/10 standard and discharge to surface or sub-surface irrigation or land disposal system. No reserve area would be required for this scenario.
Wastewater cannot be contained on site, the property is not suitable for inclusion in a cluster system, but sustainable offsite discharge can occur	LCA and or geotechnical assessments determine that it is not feasible to contain all wastewater on site. There is potential for a sustainable offsite discharge to occur and it has occurred previously.	Two options have been provided. If possible it is recommended to dispose of as much effluent as possible on site, with the remainder disposed offsite. Preference should be given to sub-surface irrigation due to its potential to reduce land stability risk. Option A (2c split) involves a split system, disposing all treated blackwater onsite (if there is sufficient space). Treated greywater would be recycled for toilet flushing, washing machine and garden 'purple hose' use with the remainder discharged off site to the stormwater system at the legal point of discharge or a land disposal system if possible. Option B (3b split) uses a dry composting or incinerating toilet. Treated greywater would be recycled for toilet flushing, washing machine and garden 'purple hose' use with the remainder discharged off site to the stormwater system at the legal point of discharge or a land disposal system if possible.
Wastewater cannot be contained on site, the property is not suitable for inclusion in a cluster system and sustainable offsite discharge cannot occur	LCA and or geotechnical assessments determine that it is not feasible to contain all wastewater on site. Sustainable offsite discharge cannot occur, or the property has previously not had an offsite discharge	If it is possible to dispose of a proportion of the wastewater on site it may be possible to partially use Option B (3b split) where as much greywater as possible is disposed on site and any remainder directed to primary treatment and pumped out. If not possible to partially dispose on site a dry composing or incinerating toilet (3c split) could be used for blackwater and greywater pumped out.

Our preferred approach recommends the consideration of cluster systems in situations where it is determined that on site containment is not possible. Two potential clusters have been identified in Section 11.8 however more detailed, site specific LCA and geotechnical assessment, including consideration of the proposed dwelling and sitting, will be required to accurately determine whether onsite containment is feasible.



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Flow chart for selection of onsite systems

Figure No: 7

12.1. On site containment potential

The LCA has included an assessment of the useable area of each property and compared this with the calculated design area for absorption trenches and irrigation. Results of this assessment are included in Appendix D of the LCA Report. This data was used to assess the potential suitability of each property for the preferred wastewater management options. The assessment results are presented in Table 12.2. The assessment is based only on useable lot area and does not include consideration of slope or other parameters which may influence the ability to achieve onsite containment. The assessment results in Table 12.2 provide only an initial guide to property owners on the possible wastewater management solutions that may be suitable.

The results show that for each property there may be a range of suitable wastewater management solutions and that this will be largely dependent on the dwelling size. The assessment provides an indication of whether there is sufficient useable area for irrigation or only absorption. Although there may only be sufficient useable area for absorption, in many situations geotechnical concerns may require irrigation rather than absorption to minimise land stability risk. In this situation effluent is unlikely to be fully contained on site. This suitability of a site for absorption trenches can only be made after a further, detailed LCA, which incorporates the proposed dwelling characteristics, has been undertaken.

12.2. Intermittent and surge flows

We recommend that in situations where the dwelling is used for holiday or rental accommodation careful consideration is given to selecting an appropriate wastewater treatment system that can deal with these conditions. This will include the provision of a suitably sized storage or balancing tank to moderate flow into the wastewater treatment system or a treatment system that uses integral multiple chambers. Generally, fixed growth bioreactors are more suitable to these conditions and thus consideration should be given to these systems or at least selecting an AWTS that includes a recirculation function or other technology to accommodate intermittent flows.

12.3. Appropriate treatment systems

Specific brands or models of onsite wastewater management systems have not been recommended as systems within a particular class (e.g. AWTS or MBR) generally provide a similar effluent standard. In accordance with the proposed changes to the EPA Certificate of Approval program we have made recommendations on the general class of system that may be required to meet the identified performance standards. It is understood that the most commonly installed secondary treatment systems previously installed at Wye River and Separation Creek are Econocycle models produced by Eco Septic. These systems have proven to be reliable in the Wye River and Separation Creek environment and there may be benefit in the continued use of these and similar systems, where an AWTS will provide the required level of treatment.

Although the existing EPA Certificates of Approval or EPA Publication 893.1 don’t specifically include consideration of a blackwater or all-waste 10/10/10 standard, this is likely to be achievable with a range of the currently available MBR and trickling filter systems.

Table 12.2 Potential wastewater management options

LEGEND

IA	Irrigation or absorption
A	Absorption only
NS	Not suitable
bdr	Bedroom

			Onsite containment possible						Offsite discharge required					
			Option A or B			Option C			Option A			Option B		
			Option A (1c on) Secondary treatment to 20/30/10 standard and discharge to sub-surface or surface irrigation or absorption trenches. Preference is given to irrigation due to its potential to reduce land stability risk. Option B (2c on) Blackwater: Secondary treatment to 20/30 standard and discharge to sub-surface irrigation or absorption trenches Greywater: Advanced secondary treatment to 10/10/10 standard and recycling for toilet flushing, washing machine and garden water 'purple' hose, then remainder discharged to irrigation or absorption trenches.			Option C (1d on) Advanced secondary treatment to 10/10/10 standard and discharge to sub-surface or surface irrigation or absorption trenches. Preference is given to irrigation due to its potential to reduce land stability risk.			Option A (2c split) Blackwater: Secondary treatment to 20/30 standard and discharge to sub-surface irrigation or absorption trenches (if there is insufficient land area Option B is required). Greywater: Advanced secondary treatment to 10/10/10 standard and recycling for toilet flushing, washing machine and garden water 'purple' hose, then remainder discharged to offsite stormwater drain, surface water or irrigation.			Option B (3b split) Blackwater: Dry composting or incinerating toilet Greywater: Advanced secondary treatment to 10/10/10 standard and recycling for toilet flushing, washing machine and garden water 'purple' hose, then remainder discharged to offsite stormwater drain, surface water or irrigation.		
		Site Area (m^2)	1-3 bdr	4 bdr	5 bdr	1-3 bdr	4 bdr	5 bdr	1-3 bdr	4 bdr	5 bdr	1-3 bdr	4 bdr	5 bdr
Separation Creek	2 Bass Avenue	852	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	7 Bass Avenue	837	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	8 Bass Avenue	837	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	9 Bass Avenue	837	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	10 Bass Avenue	837	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	11 Bass Avenue	939	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	12 Bass Avenue	837	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	14 Bass Avenue	837	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	16 Bass Avenue	836	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	18 Bass Avenue	1507	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	1-5 Bass Avenue	973	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	9 Harrington Street	1071	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	25 Harrington Street	728	IA	NS	NS	IA	A	A	IA	IA	IA	IA	IA	IA
	30 Harrington Street	500	NS	NS	NS	NS	NS	NS	NS	NS	NS	IA	IA	IA
	3 Mitchell Grove	515	NS	NS	NS	NS	NS	NS	A	A	NS	IA	IA	IA
	5 Mitchell Grove	656	NS	NS	A	NS	NS	NS	IA	IA	IA	IA	IA	IA
	9 Mitchell Grove	786	IA	IA	NS	IA	IA	A	IA	IA	IA	IA	IA	IA
	10 Mitchell Grove	680	NS	NS	NS	NS	NS	NS	IA	IA	IA	IA	IA	IA
	11 Mitchell Grove	963	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	12 Mitchell Grove	593	NS	NS	NS	NS	NS	NS	IA	IA	IA	IA	IA	IA
	13 Mitchell Grove	631	NS	NS	NS	NS	NS	NS	IA	IA	IA	IA	IA	IA
	14 Mitchell Grove	829	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	15 Mitchell Grove	755	IA	NS	NS	IA	A	A	IA	IA	IA	IA	IA	IA
	16 Mitchell Grove	945	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	17 Mitchell Grove	567	NS	NS	NS	NS	NS	NS	IA	NS	NS	IA	IA	IA
	19 Mitchell Grove	567	NS	NS	NS	NS	NS	NS	IA	NS	NS	IA	IA	IA
	21 Mitchell Grove	725	IA	IA	A	IA	IA	A	IA	IA	IA	IA	IA	IA
	23 Mitchell Grove	4054	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	2 Olive Street	4053	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	8 Olive Street	737	IA	NS	NS	IA	A	A	IA	IA	IA	IA	IA	IA
	10 Olive Street	736	IA	NS	NS	IA	A	A	IA	IA	IA	IA	IA	IA
	12 Olive Street	614	NS	NS	NS	NS	NS	NS	IA	IA	IA	IA	IA	IA
	14 Olive Street	1133	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	16 Olive Street	745	IA	NS	NS	IA	A	A	IA	IA	IA	IA	IA	IA
	2 Sarsfield Street	641	NS	NS	NS	NS	NS	NS	IA	IA	IA	IA	IA	IA

Table 12.2 Potential wastewater management options (cont'd)

			Onsite containment possible						Offsite discharge required					
Wye River	1 Coryule Avenue	658	IA	A	A	IA	A	A	IA	IA	IA	IA	IA	IA
	2 Coryule Avenue	808	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	1 Dunoon Road	729	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	2 Dunoon Road	728	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	5 Dunoon Road	727	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	9 Dunoon Road	1029	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	10 Dunoon Road	1366	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	11 Dunoon Road	885	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	13 Dunoon Road	747	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	14 Dunoon Road	723	IA	IA	A	IA	IA	A	IA	IA	IA	IA	IA	IA
	15 Dunoon Road	1278	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	16 Dunoon Road	1189	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	17 Dunoon Road	971	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	19 Dunoon Road	1261	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	20 Dunoon Road	1066	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	7-8 Dunoon Road	646	A	A	A	A	A	A	IA	IA	IA	IA	IA	IA
	1 Durimbil Avenue	841	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	3 Durimbil Avenue	662	IA	A	A	IA	A	A	IA	IA	IA	IA	IA	IA
	4 Durimbil Avenue	834	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	5 Durimbil Avenue	845	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	6 Durimbil Avenue	570	NS	NS	NS	A	A	A	IA	A	A	IA	IA	IA
	7 Durimbil Avenue	1041	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	9 Durimbil Avenue	734	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	10 Durimbil Avenue	907	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	12 Durimbil Avenue	978	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	14 Durimbil Avenue	1172	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	16 Durimbil Avenue	977	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	18 Durimbil Avenue	1330	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	20 Durimbil Avenue	1155	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	23 Durimbil Avenue	657	IA	A	A	IA	A	A	IA	IA	IA	IA	IA	IA
	24 Durimbil Avenue	717	IA	IA	A	IA	IA	A	IA	IA	IA	IA	IA	IA
	25 Durimbil Avenue	656	IA	A	A	IA	A	A	IA	IA	IA	IA	IA	IA
	26 Durimbil Avenue	648	A	A	A	A	A	A	IA	IA	IA	IA	IA	IA
	27 Durimbil Avenue	806	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	28 Durimbil Avenue	1246	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	2 Illowra Avenue	674	IA	A	A	IA	A	A	IA	IA	IA	IA	IA	IA
	3 Illowra Avenue	777	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	1 Iluka Avenue	1151	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	3 Iluka Avenue	630	A	A	NS	A	A	NS	IA	IA	IA	IA	IA	IA
	4 Iluka Avenue	615	A	A	NS	A	A	A	IA	IA	IA	IA	IA	IA
	5 Iluka Avenue	631	A	A	NS	A	A	NS	IA	IA	IA	IA	IA	IA
	7 Iluka Avenue	631	A	A	NS	A	A	NS	IA	IA	IA	IA	IA	IA
	8 Iluka Avenue	673	IA	A	A	IA	A	A	IA	IA	IA	IA	IA	IA
	9 Iluka Avenue	535	NS	NS	NS	NS	NS	NS	NS	NS	NS	IA	IA	IA
	13 Iluka Avenue	672	IA	A	A	IA	A	A	IA	IA	IA	IA	IA	IA
	14 Iluka Avenue	671	IA	A	A	IA	A	A	IA	IA	IA	IA	IA	IA
	15 Iluka Avenue	671	IA	A	A	IA	A	A	IA	IA	IA	IA	IA	IA
	16 Iluka Avenue	671	IA	A	A	IA	A	A	IA	IA	IA	IA	IA	IA
	17 Iluka Avenue	671	IA	A	A	IA	A	A	IA	IA	IA	IA	IA	IA
	19 Iluka Avenue	621	A	A	NS	A	A	NS	IA	IA	IA	IA	IA	IA
	20 Iluka Avenue	641	A	A	A	A	A	A	IA	IA	IA	IA	IA	IA
	21 Iluka Avenue	641	A	A	A	A	A	A	IA	IA	IA	IA	IA	IA
	23 Iluka Avenue	677	IA	A	A	IA	A	A	IA	IA	IA	IA	IA	IA
	24 Iluka Avenue	677	IA	A	A	IA	A	A	IA	IA	IA	IA	IA	IA
	25 Iluka Avenue	677	IA	A	A	IA	A	A	IA	IA	IA	IA	IA	IA
	10-12 Iluka Avenue	649	A	A	A	A	A	A	IA	IA	IA	IA	IA	IA
	2 Karingal Drive	1313	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	7 Karingal Drive	2034	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	8 Karingal Drive	936	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	9 Karingal Drive	1870	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	12 Karingal Drive	1615	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	13 Karingal Drive	1149	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA

Table 12.2 Potential wastewater management options (cont'd)

			Onsite containment possible						Offsite discharge required					
Wye River	14 Karingal Drive	1742	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	17 Karingal Drive	771	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	18 Karingal Drive	1633	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	19 Karingal Drive	767	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	23 Karingal Drive	892	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	24 Karingal Drive	2239	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	25 Karingal Drive	678	IA	A	A	IA	A	A	IA	IA	IA	IA	IA	IA
	26 Karingal Drive	1688	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	29 Karingal Drive	842	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	30 Karingal Drive	1505	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	31 Karingal Drive	859	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	33 Karingal Drive	810	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	34 Karingal Drive	948	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	35 Karingal Drive	1278	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	36 Karingal Drive	977	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	37 Karingal Drive	1179	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	38 Karingal Drive	792	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	40 Karingal Drive	679	IA	A	A	IA	A	A	IA	IA	IA	IA	IA	IA
	44 Karingal Drive	824	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	45 Karingal Drive	729	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	46 Karingal Drive	900	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	47 Karingal Drive	1705	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	48 Karingal Drive	656	IA	A	A	IA	A	A	IA	IA	IA	IA	IA	IA
	50 Karingal Drive	659	IA	A	A	IA	A	A	IA	IA	IA	IA	IA	IA
	51 Karingal Drive	770	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	52 Karingal Drive	820	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	55 Karingal Drive	713	IA	IA	A	IA	IA	A	IA	IA	IA	IA	IA	IA
	57 Karingal Drive	706	IA	IA	A	IA	IA	A	IA	IA	IA	IA	IA	IA
	59 Karingal Drive	961	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	61 Karingal Drive	729	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	39-41 Karingal Drive	810	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	1 Koonya Avenue	1808	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	2 Koonya Avenue	1013	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	5 Koonya Avenue	1223	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	7 Koonya Avenue	943	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	9 Koonya Avenue	815	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	13 Koonya Avenue	659	IA	A	A	IA	A	A	IA	IA	IA	IA	IA	IA
	15 Koonya Avenue	579	NS	NS	NS	A	A	A	IA	IA	IA	IA	IA	IA
	17 Koonya Avenue	680	IA	A	A	IA	A	A	IA	IA	IA	IA	IA	IA
	24 Riverside Drive	981	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	31 Riverside Drive	784	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	36 Riverside Drive	775	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	37 Riverside Drive	916	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	42 Riverside Drive	756	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	44 Riverside Drive	813	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	6 The Boulevarde	725	IA	IA	A	IA	IA	A	IA	IA	IA	IA	IA	IA
	28 The Boulevarde	1149	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	33 The Boulevarde	890	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	35 The Boulevarde	824	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	36 The Boulevarde	729	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	43 The Boulevarde	1115	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA	IA
	5 Wallace Street	659	IA	A	A	IA	A	A	IA	IA	IA	IA	IA	IA
	33 Wallace Street	682	IA	A	A	IA	A	A	IA	IA	IA	IA	IA	IA

This assessment provides only an initial guide to property owners on the possible wastewater management solutions that may be suitable Additional site specific investigations will be required to determine the potential for onsite containment and the suitability for either irrigation or absorption.

12.4. Appropriate land disposal and irrigation systems

Subsurface drip irrigation is currently the most common land disposal method for secondary treated effluent at Wye River and Separation Creek. Subsurface drip irrigation offers several advantages over high rate land disposal structures such as trenches and beds, including lower land stability risk due to lower hydraulic loading rates and limited or no requirement for excavation. However, irrigation requires significantly larger disposal areas and this provides a constraint on small properties.

The most appropriate land disposal technology and system design for each property will be dependent on detailed assessment, the proposed dwelling design and a range of other factors. The following broad recommendations are made:

- That surface or subsurface drip irrigation is the preferred land disposal method for Wye River and Separation Creek communities' wastewater due to its lower potential to contribute to land stability risk and greater potential for nutrient and pathogen attenuation.
- Where subsurface drip irrigation is used, the use of secondary membrane filtration or a sand filter it is recommended to ensure that TSS and BOD loads are low and do not contribute to premature clogging and failure of the system.
- For properties where there is insufficient area for irrigation, absorption trenches, beds, mounds, low pressure effluent distribution or alternative structures can be considered but only with specific consideration of their contribution to land stability risk.

Design and sizing of systems should be as required under EPA Publication 891.3 and or AS/NZS1546:2012 and where appropriate mitigation measures introduced into the design, include consideration of adjustment factors for slope. Appropriate mitigation for site constraints should be included in the design.

Consideration needs to be given to ensuring increased seasonal occupancy related to holiday or rental homes are taken into account in system sizing. This may involve considering restricting occupancy or rental use for properties if they cannot contain the expected wastewater load on site.

12.5. Offsite discharge

The options selection flow chart identifies offsite discharge as a viable solution in some circumstances. Offsite discharge would occur to the stormwater system at the legal point of discharge, to small surface water courses, or if possible an alternative land disposal area. It is assumed that only offsite discharge of treated greywater would be permissible and that treatment would be required to a high standard (10/10/10).

In addition, it is also assumed that this would only be permissible for properties that previously had an offsite discharge, and that the increase in treatment standard, water efficiency measures and other management would satisfy the requirements of EPA Publication 891.3 in relation to the continuation of existing offsite discharges. This approach will require endorsement from COS and EPA and careful consideration of land stability risks.

12.6. Reserve areas

Reserve areas will not be required for appropriately designed sub-surface or surface drip irrigation systems. EPA Publication 891.3 requires that high rate disposal structures have a reserve area equal to the disposal area unless there is a low risk of negative impact on the environment or public health. We suggest that the 10/10/10 effluent standard is sufficient to meet this requirement and that if this effluent standard is achieved reserve areas may not be required for high rate disposal structures.

Additional investigation and liaison with Council will be required to determine if this approach is justified.

12.7. Human health and environmental risk outcomes

Based on the previous modelling undertaken (SKM, 2014) the preferred option should improve microbiological water quality in Wye River and assist in meeting relevant standards. There would also be a minor improvement in nitrogen levels. If systems are appropriately designed, installed and maintained to meet the requirements of AS/NZS 1547 and EPA Publication 891.3, effluent ponding and other system failures will be minimised, therefore removing the main exposure pathway (surface runoff from ponded effluent) identified in SKM (2014). To confirm this initial assessment additional modelling would be required to confirm the likely human health and environmental risk improvements that would result.

12.8. Land stability risk outcomes

A move away from primary treatment and absorption trench disposal to secondary treatment and recycling and irrigation is recommended. This approach will help reduce soil loading and drainage, potentially reducing land stability risks. Consideration of the influence of land disposal on land stability risk will be required on an individual property basis.

12.9. Water efficiency

It is recommended that water efficiency should be promoted to reduce wastewater production and effluent disposal volumes. This is particularly important on properties than cannot or can only marginally contain their wastewater on site.

For these properties we recommend that the Council make water efficient fixtures and appliances to a specific Water Efficiency Labelling Standards (WELS) rating mandatory and a condition of the permit to install.

Bathtubs and spa baths provide a significant contribution to greywater loads. We recommend that consideration be given to restricting these features on properties that are unable to contain wastewater on site. This could significantly reduce the volume of offsite discharge required.

12.10. Certificates of approval

Existing wastewater management systems with certificates of approval provide only a limited range of options suitable for surface irrigation and recycling.

To facilitate the adoption of suitable systems that do not currently have EPA certificates of approval, systems approved in other States and Territories could be used in lieu of the system having Victorian approval.

12.11. System permitting

In addition to the existing wastewater management system permitting process it is recommended that COS adopt installation inspections to ensure that the installation of systems, particularly disposal areas, is appropriate.

12.12. System maintenance and compliance monitoring

Environmental, human health and land stability risks are most likely occur as a result of poorly designed and maintained wastewater management systems. Irregular sludge pumping from septic tanks is a likely failure mechanism for septic tanks at Wye River and Separation Creek.

We recommend that COS considers implementing the following actions on an annual basis to:

- Ensure that the owner has entered into an appropriate service contract.
- Enforce the service agent or owner to provide the required annual reports and effluent testing results.
- Review the annual reports and effluent testing results and identify any instances of failure that may require remedy.
- Take action to ensure that any identified failure or problem is remedied.

12.13. Receiving environment monitoring

We recommend that a surface water monitoring program is established so that trends in water quality in Wye River and Separation Creek can be established and any changes brought about by improvements to wastewater management identified. This data can also be used to validate previous risk models and inform the development of new models if required.

12.14. Potential for irrigation to forested areas

Previous assessments of irrigation to forested areas have shown that this would be unfeasible. Our review suggests that there is potential for forested areas irrigation to be feasible, however additional investigation would be required to better understand the risks involved. Irrigation to forested areas is an attractive disposal option for cluster systems. If these systems are to be considered further we recommend further investigating the potential to irrigate forested areas and the potential concurrent use of firebreaks and effluent irrigation.

12.15. Potential for household wastewater recycling

Newer MBR and other package treatment plants, when fitted with UV disinfection are capable of producing a very high standard of effluent. It is likely this effluent could be used for household recycling without significant human health risks. Due to the potential of these systems to reduce disposal volumes and form part of an integrated water management solution we recommend that additional investigation is undertaken into the suitability of these systems for household effluent recycling and potential offsite discharge. A controlled and monitored trial of these systems could be undertaken at Wye River and Separation Creek.

12.16. Cost estimates of identified options

We have prepared indicative cost estimates for the broad range of options identified (Table 12.3). The cost of wastewater management systems is highly dependent on the site specific installation requirements. In Wye River and Separation Creek steep slopes and land stability risks may have a significant influence on installation of treatment systems and reticulation. Disposal areas may require extensive excavation in the case of absorption trenches and beds, and potentially filling. Access for excavation machinery is difficult at many sites.

Table 12.2 Estimates of capital costs for suitable options for wastewater management

	Description	Approximate capital and installation cost for each property	Approximate operating cost (per/year)[1]
Onsite systems			
Primary treatment system (for comparison only)	Primary treatment and discharge to absorption trench.	**Total: $7,500 - $12,500** Primary treatment: $2,500 Absorption trench: $5,000 - $10,000 depending on length required and access	$200
Wastewater can be contained on site			
Option A (1c on)	Secondary treatment to 20/30/10 standard and discharge to sub-surface or surface irrigation or land disposal system.	**Total: $17,00 - $35,000** Secondary treatment: $12,000 - $15,000 Disposal: $5,000 - $20,000 depending on area required and access	$800
Option B (2c on)	Blackwater: Secondary treatment to 20/30/10 standard and discharge to appropriate sub-surface irrigation or land disposal system. Greywater: Advanced secondary treatment to 10/10/10 standard and recycling for toilet flushing, washing machine and garden water 'purple' hose, then remainder discharged to irrigation or land disposal system.	**Total: $32,000 - $55,000** Blackwater secondary treatment: $12,000 - $15,000 Blackwater disposal: $5,000 - $20,000 depending on area required and access Greywater advanced secondary treatment and reticulation: $15,000 to $20,000	$1,400
Option C (1d on)	Advanced secondary treatment to 10/10/10 standard and discharge to sub-surface irrigation or land disposal system.	**Total: $25,000 - $40,000** Advanced secondary treatment: $20,000+ Disposal: $5,000 - $20,000 depending on area required and access	$1,000
Wastewater cannot be contained on site, but sustainable offsite discharge can occur			
Option A (2c split)	Blackwater: Secondary treatment to 20/30 standard and discharge to sub-surface irrigation or land disposal system (if there is insufficient land area Option B is required) Greywater: Advanced secondary treatment to 10/10/10 standard and recycling for toilet flushing, washing machine and garden water 'purple' hose, then remainder discharged to offsite stormwater drain, surface water or land.	**Total: $32,000 - $55,000** Blackwater secondary treatment: $12,000 - $15,000 Blackwater disposal: $5,000 - $20,000 depending on area required and access Greywater advanced secondary treatment and reticulation: $15,000 to $20,000	$1,400

Table 12.3 Estimates of capital costs for suitable options for wastewater management (cont'd)

	Description	Approximate capital and installation cost for each property	Approximate operating cost (per/year)[1]
Option B (3b split)	Blackwater: Dry composting, urine diversion or incinerating toilet. Greywater: Advanced secondary treatment to 10/10/10 standard and recycling for toilet flushing, washing machine and garden water 'purple' hose, then remainder discharged to offsite stormwater drain, surface water or irrigation.	**Total: $18,000 - $28,000** Blackwater: $3,000 - $8,000 Greywater advanced secondary treatment and reticulation: $15,000 to $20,000	$800
Wastewater cannot be contained on site and sustainable offsite discharge cannot occur			
Option A (3c split)	Blackwater: Dry composting, urine diversion or incinerating toilet. Greywater: Primary treatment and discharge to storage then pump out.	**Total: $13,000 - $18,000** Blackwater: $3,000 - $8,000 Greywater: $10,000	Cost of transport will be highly dependent on the number of other pump out systems and frequency required.
Cluster systems		Cost is highly dependent on the number of properties involved in the cluster, the chosen connection, treatment and disposal system. Indicative cost estimates for a six property cluster system are provided in Section 12.17.	

1 Includes energy, maintenance and monitoring requirements

The installation of a split blackwater and greywater system results in significantly higher costs as there would be effectively two separate wastewater treatment systems and additional reticulation required. It is likely that this scenario would only be feasible in situations where it was necessary to reduce disposal volumes to prevent or reduce offsite discharge and not where wastewater can be contained on site.

The cost of a split system will also be dependent on whether the recycled water is used within the household. Connection to toilet systems and a washing machine may considerably increase the cost as additional internal plumbing will be required to convey water to toilet systems and a washing machine.

The cost of a split system can be greatly reduced if only wastewater from washing machine and showers is included. These wastes can be recycled without treatment via subsurface irrigation.

Installation of waterless toilet systems is a relatively affordable option for reducing wastewater flows (generally by approximately 30%).

12.17. Cost estimate for conceptual cluster system

Clusters of 'Very Highly Constrained' properties that may not be able to readily contain wastewater onsite, are found at Separation Creek and at Wye River (Figure 8 and 9 respectively). The location of these properties provides a potential opportunity for inclusion in cluster systems.

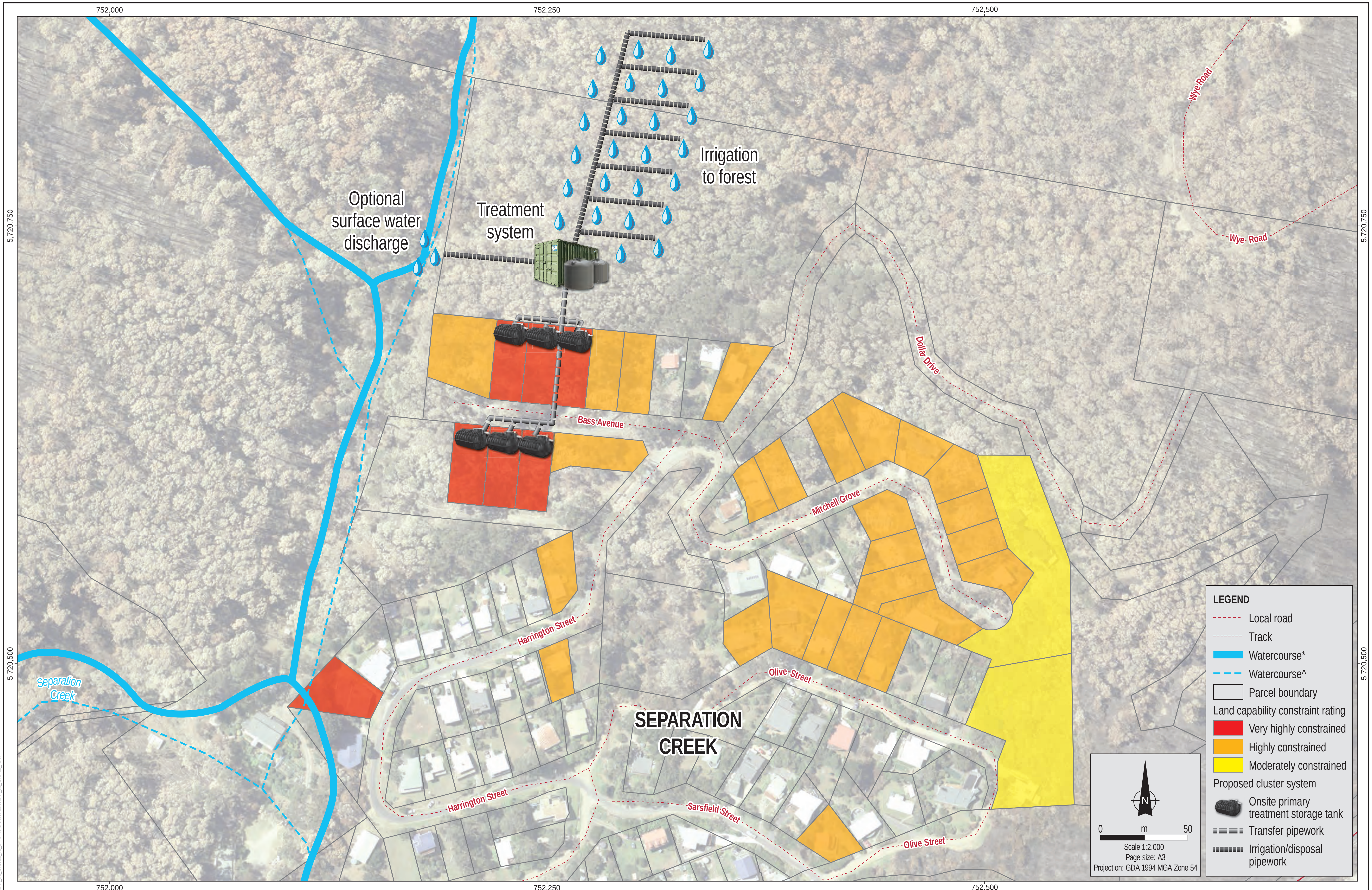
The Wye River cluster is located adjacent to forested areas that may be suitable for irrigation. In addition, within several hundred metres there is a cleared area that may be feasible for limited pasture irrigation. Although previously assessed as unsuitable, that assessment was based on the irrigation of effluent from a community sewerage scheme and there may be potential to accommodate lower effluent flows from a more modest cluster scheme.

The Separation Creek cluster is also surrounded by forest, and Separation Creek itself flows approximately 70 m to the west. Forest irrigation or surface water discharge to Separation Creek are two potential disposal options for a cluster at this location.

An indicative concept design is proposed for a six property cluster system based on a septic tank effluent pumping (STEP) system and disposal to a nearby forest area. The system would involve onsite primary treatment in a septic tank with effluent pumped via a reticulation system to the Aerated Wastewater Treatment System (AWTS). Secondary treated water from the AWTS would be pumped to the forest irrigation discharge system. We have prepared indicative cost estimates for the indicative concept design (Table 12.4).

Table 12.3 Estimates of capital costs for cluster system concept design

Item	Detail	Description	Indicative cost
Properties served	6	Indicative, based on the 'Very Highly Constrained'	-
Expected average daily wastewater flow	5400 L/day	Based on 900 L/day for a 5 bedroom dwelling	-
Expected peak daily wastewater flow	8100 L/day	Peaking factor of 1.5 (applied to accommodate higher holiday period flows)	-
Onsite infrastructure	4,000 L below ground plastic septic/primary treatment tank.	Includes effluent pump and connection to reticulation system	$10,000 - 15,000 per property
Reticulation	DN40 trenchless	Trenchless installation preferred to minimise land disturbance and stability risk	$40,000 – $60,000 (assumes ~200m at $200/m)
Treatment	Aerated Wastewater Treatment System (AWTS) and control equipment	A range of AWTS systems of the required capacity are available. Effluent quality may need to meet Class B standard	$40,000 – $60,000
Disinfection	UV		$3,000
Disposal to Forest	Subsurface pressure compensating drip irrigation. Includes irrigation pump and other components.	Based on a design irrigation loading rates outlined in the LCA report, the estimated irrigation area is approximately 2200m^2.	$20,000 – $40,000



Source:
Land capability constraint rating from Coffey.
Roads, watercourses and parcel boundaries from VICMAP.
Imagery from DEWLP (captured 9 January 2016).

Note:
* Watercourse partially digitised to match local contours.
^ Watercourse from VICMAP.

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Project:	ENAUABTF0DELWPAA
File Name:	11630AA_01_F008_GRA

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Wye River and Separation Creek
Geotechnical, Land Capability and Wastewater Solutions Project

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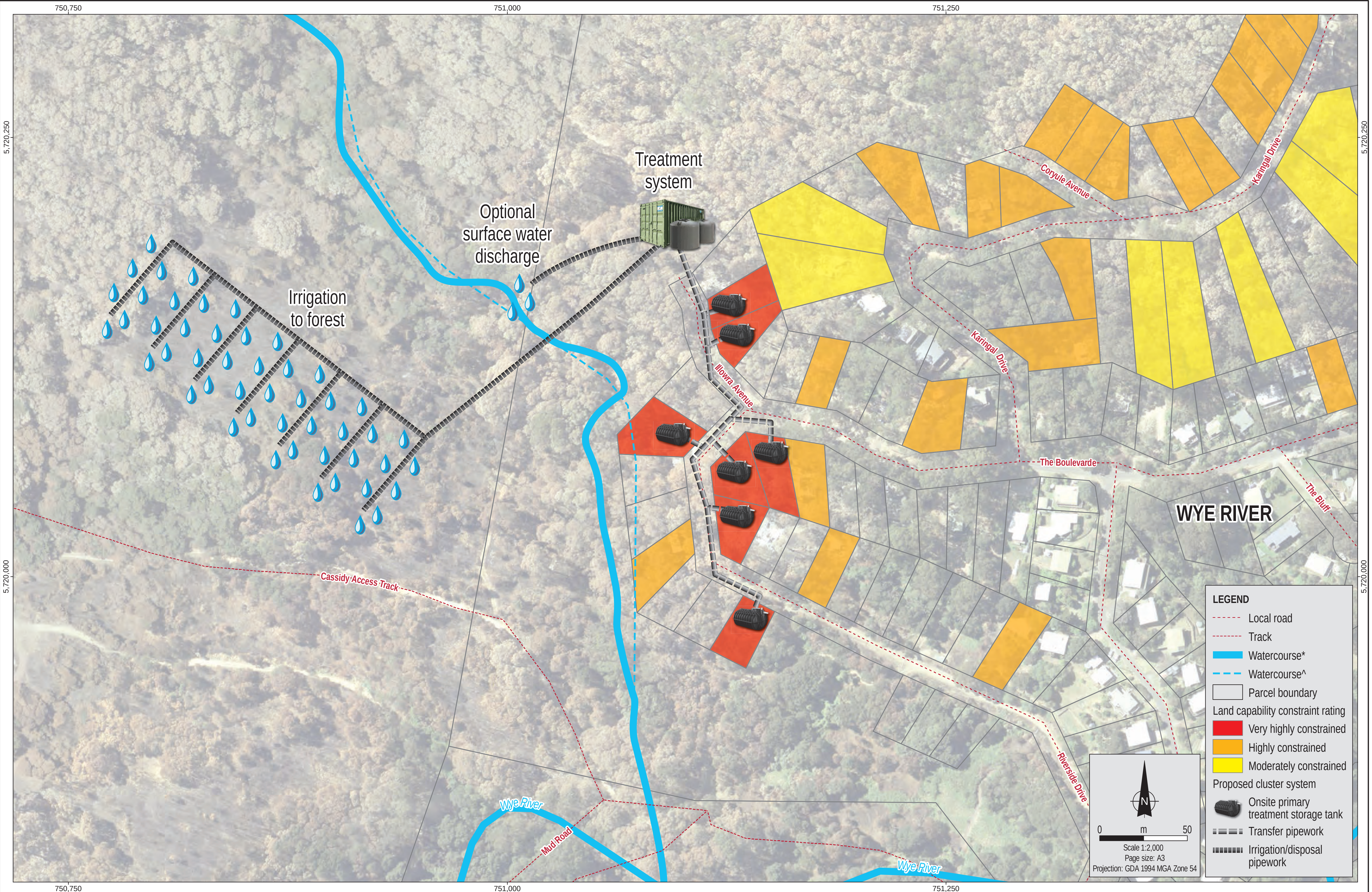
Separation Creek Conceptual Cluster System

Figure No: 8



Source:
Land capability constraint rating from Coffey.
Roads, watercourses and parcel boundaries from VICMAP.
Imagery from DEWLP (captured 9 January 2016).

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Wye River and Separation Creek
Geotechnical, Land Capability and Wastewater Solutions Project

VICTORIA State Government
Environment, Land, Water and Planning

Wye River
Conceptual Cluster System

Figure No: 9

12.17.1. Operation and maintenance

Models for cluster system ownership and management are outlined in Section 7.5.3.

The operation and maintenance requirements for the onsite (landowner) components of the proposed system may require periodic de-sludging of the primary treatment tank, and annual maintenance of the effluent pump. Including electricity, the indicative annual operating and maintenance costs are likely to amount to approximately $500 per property.

The cluster treatment and disposal system will require regular operation and maintenance requirements, and weekly site visits may be required. Including provision for operator visits, proactive and reactive maintenance, sludge removal and electricity the indicative annual operation and maintenance requirements for the AWTS and irrigation system may amount to approximately $10,000.

12.17.2. Assumptions and constraints

- The system would have a daily flow exceeding 5,000 L and therefore may require EPA Works Approval.
- The concept design is reliant on irrigation to forest areas. It is noted that land slope is a factor that would need further investigation to ensure sufficient area available and that irrigation application rates that limit runoff can be achieved. Additional investigations will be required to confirm feasibility and support design decisions.
- The identified forest areas may be under private ownership, and the feasibility of the system would be dependent on the provision of land access or acquisition. Our indicative costing does not include the costs associated with planning, land access or acquisition.
- The concept presented does not include provision for wet weather effluent storage.
- Telemetry would be an optional provision for remote monitoring, but has not been costed.
- Electricity connection to the treatment plant has not been costed.

13. Conclusions and recommendations

This report presents the findings of geotechnical and land capability assessments conducted for the Wye River and Separation Creek communities impacted by the 25 December 2015 bushfires. The report also incorporated an accelerated planning approvals review and an assessment of options and potential solutions for wastewater management in the Wye River and Separation Creek area.

A summary of key issues and risks identified as a part of this study and associated recommendations are as follows:

- There is a history of landslides in the Wye River and Separation Creek area and parts of the area are considered susceptible to further landslides. The bushfire impacted on areas of fossilised landslides that are considered sensitive to redevelopment. Areas of large active landslides were not impacted by the bushfire.
- Key geotechnical risks identified include worsening stability issues on steep fill slopes due to the loss of vegetation during the bushfire and burnt out retaining walls on sites that no longer provide support to retained soil.
- Redevelopment works should prioritise reconstruction of burnt out retaining walls and follow good hillside practice guidelines which recommend a reduction in planned cutting and filling.
- The majority of sites have constraints which limit their ability to individually support onsite treatment and dispersal of wastewater. Key constraints relate to the soil type and steep slopes.
- A range of mitigation measures can be adopted to potentially assist in managing constraints posed by the quality of the soil and steep slopes within the study area and enable the adoption of onsite treatment and disposal of wastewater. However, individual site assessments will be required to determine the suitability of these mitigation measures.
- Several of the previous wastewater studies for Wye River and Separation Creek (Hyder, 2007) recommended a combination of onsite and other cluster/decentralised or semi-centralised wastewater management approaches within the study area.
- A distributed approach often includes wastewater management infrastructure implemented at a combination of scales from individual onsite to small and large clusters to centralised systems. For several reasons (such as cost, public support) it makes sense to continue using onsite systems where the lots are suitable. Therefore, it will be important that detailed wastewater management planning efforts commence with land capacity and geotechnical assessments.
- After detailed LCAs are completed, it will be possible to determine where the higher risk sites are located, which in turn will suggest where and for which properties cluster systems might be appropriate. Cluster systems should be considered in situations where it is determined that onsite containment is highly constrained. Two potential clusters have been identified, however more detailed, site specific LCA and geotechnical assessment, including consideration of the proposed dwelling and siting, will be required to accurately determine whether onsite containment is feasible.
- Environmental, human health and land stability risks can occur as a result of poorly maintained or failed wastewater management systems. These risks can be mitigated by ensuring that COS fully enforces the requirements of EPA Certificates of Approval for wastewater management systems. This includes ensuring that the system owner has entered into an appropriate service contract and provides the required reporting and compliance monitoring results to COS. This will require that COS has sufficient resources to undertake these activities.
- Given the range of risk classifications identified in the geotechnical investigations, there may be potential for the amount and type of additional information required under EMO1 to be assessed on a site by site basis. To achieve this, an amendment to the Scheme would be required to

enable this flexibility. An amendment would be required to the current wording of EMO1 along the lines of wording (as appropriate to the local situation in Wye River and Separation Creek) included in the Schedules to the EMO in other planning schemes.

- There is a reasonably complex set of planning controls applying across the study area in response to the particular physical, environmental and amenity considerations and, depending on location, multiple permit triggers.
- There are specific information requirements under EMO1 in relation to geotechnical and landslide/landslip assessments.
- To accelerate planning approvals consideration should be given to providing additional statutory planning assessment resources to COS to process planning permit applications. It is understood that such a process is already underway. It is also recommended that guidance be provided to affected property owners on developing site-specific design responses that integrate requirements on matters such as onsite water and runoff management, good hillside development practices and landscaping. This guidance could be provided through fact sheets similar to the range of existing fact sheets that address aspects of bushfire recovery, referral to existing State, local and / or Commonwealth Government and private sector resources or running design development workshops to help affected property owners understand key risks and constraints in relation to designing replacement dwellings on bushfire-affected sites.
- To maximise the number of properties that can manage wastewater on site, it is recommended that a full suite of technologies be considered, including conventional systems, advanced onsite systems and combinations of alternative toilets, water conservation and greywater management systems where needed.

Key implications of these findings on Wye River and Separation Creek communities impacted by the bushfire are that site-specific geotechnical information will still be required with planning permit applications for new / replacement dwellings. The type of wastewater solution option adopted will influence whether statutory planning approval is required. Individual site assessments will be required to determine the suitability of the option for the particular site based on its constraints and potential mitigation measures that can be adopted.

14. Glossary

14.1. Abbreviations

AGS	Australian Geomechanics Society
AS/NZS	Australia Standard/New Zealand Standard
AWTS	Aerated Wastewater Treatment System
BOD	Biochemical Oxygen Demand
COS	Colac Otway Shire
DDO	Design and Development Overlay
DELWP	Department of Environment, Land, Water and Planning
DLR	Design Loading Rate
DSE	Department of Sustainability and Environment
DWMP	Domestic Wastewater Management Plan
EAT	Emerson Aggregate Testing
EMO	Environmental Management Overlay
EMO	Environmental Management Overlay Schedule 1
ERA	Environmental Risk Assessment
ESO	Environmental Significance Overlay
ESP	Exchangeable Sodium Percentage
EPA	Environment Protection Authority
GEM	Guideline for Environmental Management
HO	Heritage Overlay
IFAS	Integrated Fixed-Film Activated Sludge
LCA	Land Capability Assessment
LPD	Low Pressure Distribution
LPED	Low Pressure Effluent Distribution
LPP	Low Pressure Pipe
LSIO	Land Subject to Inundation Overlay
MAV	Municipal Association of Victoria

MBR	Membrane Bioreactors
Mg/L	Milligrams per Litre
LPPF	Local Planning Policy Framework
NCO	Neighbourhood Character Overlay
QMRA	Quantitative Microbial Risk Assessment
RCZ	Rural Conservation Zone
SLO	Significant Landscape Overlay
SPPF	State Planning Policy Framework
STEP	Septic Tank Effluent Pump
STEG	Septic Tank Effluent Gravity
TN	Total Nitrogen
TSS	Total Suspended Solids
TZ	Township Zone
UV	Ultraviolet
WELS	Water Efficiency Labelling Standards
WMO	Wildfire Management Overlay

14.2. Terms

Aerobic	organisms and processes that require oxygen (i.e. microbiological digestion and assimilation of organic matter through the use of oxygen).
Australia/ New Zealand Standard	a document produced by Standards Australia and Standards New Zealand. A voluntary national standard, code or specification prepared under the auspices of Standards Australia and Standards New Zealand. Standards are mandatory when referred to in regulations and are enforceable in contracts when called up in contract documents.
Blackwater	toilet waste.
Centralised	(reticulated sewerage, sewerage scheme or community scheme) wastewater management occurring on the scale of a community, town or city.
Cluster	wastewater management that occurs on the scale of a small group of properties.
Decentralised	wastewater management occurring on an onsite or cluster scale.
Disposal	to get rid of a waste product via air (an evaporation pond), land (soil absorption trench), fire (incineration, steam) or water (discharge to surface waters or to groundwater), with no intention of beneficial reuse.

Domestic wastewater	see Sewage
Domestic wastewater management	a wastewater management system for domestic wastewater. This term will generally refer to onsite wastewater management, but may at times also include cluster and centralised wastewater management.
Effluent	liquid flowing out of a container.
Greywater (sullage)	water from a shower, bath, basin, laundry and kitchen.
Groundwater	any sub-surface water, generally present in an aquifer or aquitard.
Hazard	a condition with the potential for causing an undesirable consequence. In relation to landslides this includes the location, size, speed, distance of travel and the likelihood of its occurrence within a given period of time.
Infiltration	the gradual movement of water into the pore spaces between soil particles.
Landslide	the movement, or the potential movement, of a mass of rock, debris, or earth down a slope.
Nutrients	organic and inorganic substances used in an organism's metabolism which must be taken in from the environment (e.g. carbohydrates, fats, such as proteins and vitamins). Nutrients are molecules that include elements such as carbon, nitrogen, phosphorus, potassium, calcium, magnesium and a range of trace elements.
Offsite	wastewater management that occurs off an individual property (in the context of this report this will generally refer to the offsite disposal or discharge of onsite treated effluent).
Onsite	wastewater management that occurs on an individual property. In the Environment Protection Act 1970 an onsite wastewater management system is referred to as a ‘septic tank system’. To avoid confusion we have only used the term ‘septic tank system’ to refer to a primary treatment septic tank and not onsite systems in general.
Permeability	the ability of water to move, through soil which depends upon the soil particle sizes, pore space sizes, soil texture, soil structure and water content.
Recycling	using treated wastewater for an appropriate use (e.g. 10/10/10 greywater used for toilet flushing or 20/30 effluent used for sub-surface irrigation).
Reuse	using a waste product in its present form for another purpose, e.g. diverting (reusing) untreated greywater to water the garden.
Remnant vegetation	land from which the native vegetation has not been cleared.
Retaining structure failure.	anything built by humans which is intended to support the ground and inhibit
Risk	a measure of the probability and severity of an adverse effect to life, health, property or the environment.
Sewage or all-waste	combined blackwater and greywater

Secondary treatment	biological and/or physical treatment following primary treatment of wastewater. Disinfection to kill pathogens may also occur.
Septic tank	a tank that temporarily holds wastewater. In a septic tank, wastewater is primarily treated through filtration, sedimentation, flocculation and flotation to remove organic and inorganic matter from wastewater in combination with anaerobic microbiological digestion.
Sludge	the material that rests on the bottom of a septic tank. It can include inert matter (such as sand, glass and plastics) and biosolids (organic material produced by biological processes).
Sustainable	able to continue indefinitely without any significant negative impact on the environment or its inhabitants.
Treatment	a process or series of processes that remove contaminants from wastewater, whereby the physical, chemical and biological characteristics of wastewater are altered.
Topsoil	the top layer of the soil, typically containing plant roots, organic material and an active microbiological ecosystem, which is usually more fertile than the underlying layers.
Total suspended solids	a measure of the solids in water, expresses in milligrams per litre).
Turbidity	the cloudy appearance of water that is an indication of fine solids suspended in the water, measured by a light penetration test and expressed in nephelometric turbidity units.
Watertable	the upper surface of groundwater or the level below which an unconfined aquifer is permanently saturated with water

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Appendix A - Geotechnical assessment

Appendix B – Land capability assessment