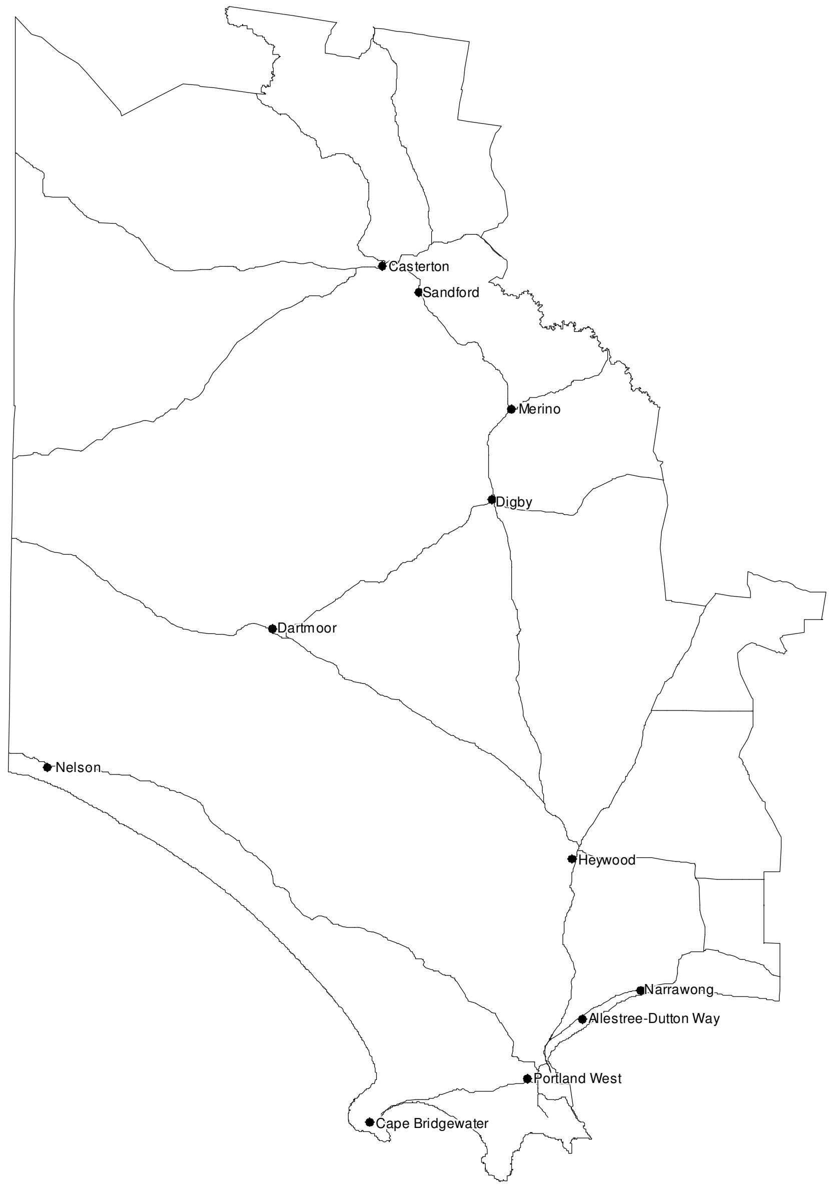

A Review Of
Domestic Wastewater Management
In The
Shire Of Glenelg

March 2009

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Introduction to the text

In the following text we present a series of domestic wastewater management studies for unsewered and partly unsewered towns in the Shire of Glenelg. The document illustrates in simple terms the nature and extent of domestic wastewater related problems in the Shire, and is written in a manner that will be accessible to a variety of audiences. There are three categories of towns.

- *Unsewered-detailed* towns are Allestree / Dutton way, Cape Bridgewater, Nelson and Narrawong
- *Unsewered-overview* towns are Dartmoor, Digby, Merino and Sandford
- *Unsewered-in-part* towns are Casterton, Heywood and Portland West

Each category of town has an accompanying report structure, the information within which is summarized in Table 1. Mapping content is summarised in Table 2. All reports are structured similarly to make comparison easy.

Table 1: Summary of report information content.

Section	Unsewered detailed	Unsewered overview	Unsewered in part
Introduction	Y	Y	N
Development density mapping series	Y	N	N
Constraint mapping series	Y	N	N
Detailed wastewater performance mapping series	Y	N	N
Simplified wastewater performance mapping series	N	Y	N
Preferred management tables	Y	Y	Y
Recommendations section	Y	Y	N

Table 2: Summary of mapping content

<table>
<tr><th>Map</th><th>Unsewered detailed</th><th>Unsewered overview</th><th>Unsewered in part</th><th>Description</th></tr>
<tr><td colspan="5">Town overview</td></tr>
<tr><td>Map 1</td><td>Y</td><td>Y</td><td>Y</td><td>Air photo overlaid with soils and contours.</td></tr>
<tr><td>Map 2</td><td>Y</td><td>Y</td><td>Y</td><td>Planning zones overlaid with properties (black) and parcels (grey). For the detailed studies, dwellings are shown as dots.</td></tr>
<tr><td colspan="5">Development density series</td></tr>
<tr><td>Map 3</td><td>Y</td><td>N</td><td>N</td><td>Assuming all present dwellings use trench systems, how sustainable are areas within the town?</td></tr>
<tr><td>Map 4</td><td>Y</td><td>N</td><td>N</td><td>Assuming all parcels in the town were to be developed and trench systems used, how sustainable are areas within the town likely to be?</td></tr>
<tr><td>Map 5</td><td>Y</td><td>N</td><td>N</td><td>Assuming all parcels in the town were to be developed and irrigation systems used, how sustainable are areas within the town likely to be?</td></tr>
<tr><td colspan="5">Constraint map</td></tr>
<tr><td>Map 6</td><td>Y</td><td>N</td><td>N</td><td>Constraints relate to slope, proximity to water and adjoining allotments, and sometimes soils. The detailed mapping is concerned with evaluating contiguous unconstrained areas.</td></tr>
<tr><td colspan="5">Detailed onsite wastewater performance series
This series of maps results from a sophisticated modelling exercise that incorporates all information in the constraints map, an allowance for impervious surfaces, the wastewater flow allowance shown in table 4, and a reserve field for trench systems. Sustainability of each block is expressed in terms of the maximum allowable bedrooms for a development. The maps are shaded according to a traffic light principle of red for development being unsustainable, amber for development sustainable for two bedroom home and green being sustainable for a three bedroom home (and possibly larger).</td></tr>
<tr><td>Map 7</td><td>Y</td><td>N</td><td>N</td><td>Sustainability of properties using trench systems. The detailed mapping is overlaid with dwelling locations to highlight developments that may not be performing.</td></tr>
<tr><td>Map 8</td><td>Y</td><td>N</td><td>N</td><td>Sustainability of parcels using trench systems.</td></tr>
<tr><td>Map 9</td><td>Y</td><td>N</td><td>N</td><td>Sustainability of properties using irrigation systems. The detailed mapping is overlaid with dwelling locations to highlight developments that may not be performing if they were upgraded to irrigation systems.</td></tr>
<tr><td>Map 10</td><td>Y</td><td>N</td><td>N</td><td>Sustainability of parcels if irrigation systems are used.</td></tr>
<tr><td colspan="5">Simplified onsite wastewater performance series
This series of maps results from a simple exercise that involves shading each block according to its size in square metres. Where possible, the classes are sensitive to the minimum block size requirement in table 1 of the relevant town report. This map series does not incorporate the constraints map. Shading is undertaken according to a traffic light principle, but uses slightly different coloration to signal difference to the detailed wastewater performance series.</td></tr>
<tr><td>Map 11</td><td>N</td><td>Y</td><td>N</td><td>Sustainability of properties.</td></tr>
<tr><td>Map 12</td><td>N</td><td>Y</td><td>N</td><td>Sustainability of parcels</td></tr>
</table>

Introduction section of reports

The introduction describes the town, its services, population and dwelling vacancy rates relative to regional and State measures. We believe that regardless of a town's present demographic state, it is important to plan now for full future occupation. Drivers such as faster rural internet speeds in combination with populations seeking affordable housing, or populations mobilized as a consequence of climate change might make rural towns attractive in the future.

This section also includes a description of the landscape, the types of septic systems that are likely to be found there, and refers to town overview maps.

Wastewater section of reports

Our town reports use map modelling to present an overview of each town's domestic onsite wastewater sustainability. The map modelling incorporates the following understanding of domestic wastewater management issues.

A conventional septic tank provides only the first stage of treatment to domestic wastewater. Septic tank effluent should be free of large floating or suspended particles, but still retains a very high biological oxygen demand (BOD) and fine suspended solids (SS), and also a very high bacterial and microbiological content, as well as nutrients, such as nitrogen and phosphorus compounds, and dissolved salts, mainly sodium salts. BOD refers to the dissolved and fine suspended organic material in the effluent that can be fully broken down by biological organisms to form water, carbon dioxide gas, and mineral matter. These organisms require oxygen to do this; hence the amount of such organic matter is measured as the amount of oxygen needed to complete the process. High BOD liquid usually smells badly.

As septic effluent is discharged into the soil by means of absorption trenches, there is further treatment in the soil, where other micro-organisms native to the soil will break down the organic matter arriving with the effluent, as well as predate on the non-native micro-organisms. Nitrogen compounds tend to be converted to nitrate if sufficient oxygen is around, and nitrate to nitrogen gas, where the soil is locally anaerobic, whereas phosphates tend to be bound to soil particles. The final treatment of septic tank effluent in a soil is normally extremely efficient, with the effluent becoming indistinguishable from other soil moisture within a few metres from the absorption trench. Septic tank effluent bacteria have often disappeared within half a metre of travel from the trench. This level of clean-up depends on the effluent passing very slowly through well-aerated soil and hence unsaturated soil.

Exceptions to this high degree of purification mainly occur in highly permeable sandy and gravelly soils (coastal dunes, some river flats) or if the effluent passes through shallow soil over broken up bedrock. There, septic tank effluent contamination can travel great distances in little time. Hence, where such soils are occurring, only those methods which guarantee uniform effluent distribution and low loading rates must be considered acceptable.

While soil micro-organisms can decompose the organic wastes, and vegetation on an effluent disposal area can take up nutrients, there is no biological means of neutralising the sodium salts. These must not be allowed to build up in the soil as they cause poor soil structure and reduce the soil's permeability, which in turn reduces the ability of air and water to move through it. In many cases it is beneficial to apply gypsum (calcium sulphate) to the effluent application area, or to a newly excavated trench bottom, to facilitate the removal of sodium by replacing it with calcium.

Older absorption trench systems often relied on the effluent being run through their full length by gravity, meaning the first section(s) of the trench got most or all of the effluent, so that further sections got none or little. This limits the potential of the soil to provide maximum treatment. Where this is the case, older trench systems can be made to work better by using a pump and a pressurised dosing system, consisting of perforated pipes along the length of the trench so that effluent can be squirted throughout the trench system at fixed times during the day or night. It can be operated automatically using a time clock or a switch activated by a float valve in a sump pit that receives the septic tank effluent.

Many older systems also treated only the toilet wastes, the so-called black water systems. In those cases the remaining effluent, grey water, is discharged to street drains. Upgrading these may be achieved by combining all wastewater and treating it to a higher standard prior to land application, or by also treating the grey water separately.

Irrigation of treated effluent has become much more common in recent times. Irrigation by sprinklers of surface drippers requires a higher level of treatment and disinfection. Such effluent must comply with BOD level smaller than 20 mg/L and SS level smaller than 30 mg/L, as well as an E. coli (bacteria) count of less than 10 organisms per 100 mL and a residual chlorine level of at least 0.5 mg/L. The low level of SS is required to minimise clogging of the dripper or sprinkler system and rendering the effluent clear. Subsurface irrigation does not require disinfection of the effluent.

All irrigation systems are driven by pumps and hence are automatically evenly dosed throughout the effluent application area.

Irrigation is generally a superior means of distributing treated effluent uniformly over an area of land, and hence tends to be economical of space. Trench systems, depending on required spacings, take up more space, but can be fed by gravity, obviating pumps.

EPA guidelines for effluent disposal or re-use date from various times in the past and hence do not all have the same guiding principles. They differ also from the guidelines presented in AS/NZS 1547:2000 (and its successor document) in that in some cases the sizing of the disposal area is based on the soil's hydraulic capacity to transmit water and in some other cases simultaneously on the soil's ability to remove nutrients. The EPA guidelines for soil absorption-transpiration systems take into account the mean annual rainfall of the locality in question, but AS/NZS 1547:2000 does not consider climate. The MAV guideline for irrigation, listed also in the Tables in the Glenelg Strategy, is considerably more conservative than the EPA or the Australian Standard's loading rates because it also requires the full uptake of nutrients by the soil and irrigated vegetation, and not merely a water balance based on hydraulic capacity.

The Tables in the Glenelg township descriptions cannot cope with the plethora of guidelines and sizing methods and are based therefore on AS/NZS 1547:2000 for absorption trenches of raw septic tank effluent and for irrigation of secondary treated effluent only. It is possible to use trenches for secondary treated effluent, in which case lesser lengths of trench are needed as recommended in the Australian Standard. In Victoria it has been the EPA's practice to require EPA guidelines to be used where they exist and AS/NZS 1547:2000 guidelines where the EPA is silent. For trench systems, the Australian Standard tends to be more conservative than the EPA guideline.

Where existing effluent management systems require upgrading as they may be utilising effluent disposal sites that are too small, or a disposal method that would now be regarded as unsuited to the soil, and where new systems are contemplated on limiting sites, water-saving devices ought to be considered. AAA-Rated fixtures and appliances can be installed or re-fitted to reduce the volume of wastewater in such cases. Likewise, improved treatment systems may provide a means of upgrading in a way that reduces environmental impacts. Sand filters can be a means of such improved treatment.

Where existing developed lots are too small in terms of modern acceptable effluent loading rates, or where undeveloped lots are too small for the proposed developments, potential solutions lie in some or all of the following four measures.

1) Improve the treatment and distribution of effluent.

2) Reduce the number of bedrooms.

3) Reduce the area of impervious surfaces.

4) Use of full water reduction fixtures. These include “the combined use of reduced-flush 6/3-litre water closets, shower flow restrictors, aerator faucets, front-load washing machines and flow/pressure control valves on all water-use outlets. Additionally, water reduction may be achieved by treatment of greywater and recycling for water closet flushing (reclaimed water cycling)” (EPA, 2008, p.15). Where reclaimed water cycling is undertaken, this should be to a 10/10/10 standard as required in table 5.1 of the same document (EPA, 2008). A waste water management program will need to be developed and implemented to satisfy Council that the effluent quality standard of 10/10/10 can be maintained over the life of the development.

Shops and any other establishments, including schools, that produce an effluent similar to domestic effluent in its chemical properties will have different daily flow volumes. These daily flows, if less than 5,000 L/day, can be used to design treatment and disposal systems by proportioning them in terms of the Tables provided in the Strategy. For example a design flow of 1200 L/day can be applied to an irrigation area that is (1200/230) times the appropriate loading rate for a 1-bedroom house on the appropriate soil category.

Factories and other establishments that generate industrial wastewater are not covered by this Strategy.

Small townships that cannot be economically sewered and provided with a full, conventional sewerage treatment plant may possibly benefit from a Common Effluent Drainage system (CED), when there is surrounding land that can be made available for effluent disposal. In these cases, the existing homes and establishments, and any new ones, will retain their septic tank and continue to carry out regular desludging and septic tank maintenance, but the primary septic effluent will be managed in a common treatment and disposal area. This could be a constructed wetland designed to attenuate the effluent’s BOD, nutrients and suspended solids, prior to off-site disposal. Effluent treated in a common system may be suitable for pasture irrigation. The planning of CED schemes can benefit from the information presented in the Strategy but will require a full independent investigation.

Land Capability Assessments that are being conducted for new proposed developments must take note of the specific concerns that have been identified for each of the townships in this Strategy. For example, in some places the nature of the soil can vary dramatically over short distances. Elsewhere, due to topography and terrain slopes, a level area may be very poorly drained and waterlogged for long times or be sloping and able to shed surface water easily and have moderately good drainage with little visible difference in soil appearance. A Land Capability Assessment (LCA) for a single allotment, or for a multiple lot development, must carry out a detailed soil survey and/or soil wetness assessment and ensure that effluent management planning is in accord with soil conditions at that lot or area.

WASTEWATER MAPPING SECTION OF REPORTS

For those towns where *detailed* onsite wastewater sustainability mapping was undertaken, the maps are expressed in terms of a traffic light principle. A block shaded red should be capable of dealing with wastewater for a house of up to 1 bedroom, amber up to 2 bedrooms, and green three or possibly more bedrooms (depending on the site). The “3 or more” legend category does not necessarily mean that wastewater from a home with four or more bedrooms could be accommodated by the site.

The maps identify individual blocks and clusters of blocks that are currently or have the potential to cause wastewater problems. According to the soils ability to deal with septic effluent, block size, a constant 450 m^2 of impervious surfaces and constraints, a block shaded red should be capable of dealing with wastewater for a house of up to 1 bedroom, amber up to 2 bedrooms, and green three or possibly more bedrooms (depending on the site). It is important to note that block shape and actual site coverage are impossible to incorporate into a study such as this so some site level decision making will still be required by the Shire. The assumptions used for the map modelling are described more fully in the greyed notes box later in this introductory text. At the time of permit application, a block might change sustainability status for any one or combination of the following.

- More sustainable (more developable)
    - Proposed onsite system produces wastewater of a quality exceeding that specified in this report. For example, although a trench might be suitable for some blocks, an irrigation system would increase the opportunity for development.
    - Coverage of block with impervious surfaces is less than the 450m^2 used in this study.
    - Water reduction fixtures being used lead to a wastewater flow that is less than 115 litres per person per day.
- Less sustainable (less developable)
    - Proposed onsite system produces wastewater of a lesser quality than that specified in this report. For example, where a trench was proposed rather than an irrigation system, there would be a reduced opportunity for development.
    - Coverage of block with impervious surfaces is more than the 450m^2 used in this study.
    - Water reduction fixtures being used lead to a wastewater flow that is greater than 115 litres per person per day.
    - The proposed dwelling is positioned on the block in a way that a wastewater envelope of a sufficient size cannot be found.
    - Block is affected by additional constraints that were not mapped. For example, a high seasonal water table.

For those towns where *simplified* onsite wastewater sustainability mapping was undertaken, the maps are shaded using categories that are sensitive to minimum block size requirements for a 3 bedroom home that are shown in table 1 of the relevant town report. These maps do not incorporate constraint mapping.

These maps are intended to be used as a performance guide for onsite domestic wastewater systems, and their application to non domestic circumstances such as caravan or cabin parks would be inappropriate due to the fluctuating and seasonal nature of usage in them. For site capability decision making the maps should always be supported by close analysis, including site inspections where appropriate. Site specific considerations such as block shape, building and wastewater envelope shape, size and position, setbacks, and wastewater technology could all affect the ability of a development to deal with its wastewaters onsite.

In maps 3 thru 10 we map the trench scenario first for the purpose of showing areas where concentrations of existing developments, which tend to use trench systems, might be causing problems that require a priority response by Council, and second to illustrate the extent of problems that might arise should Council continue to approve trench systems.

Development density map series (Map 3, Map 4 and Map 5)
Towns - Allestree / Dutton way, Cape Bridgewater, Nelson and Narrawong

Adjoining titles (in the most part in the same soil type and unseparated by road reserves) were combined. Accounting for a constant allowance of 450 m^2 of impervious surfaces (roofs, footpaths, etc) and not considering the constraints in Map 6, the new area was related to the AS/NZS and requirements within the Code of Practice. According to one of three criteria the average sustainable bedrooms for that area was calculated and traffic-light-mapped.

- Criteria 1 (Map 3): Assuming all present dwellings use trench systems with a dosing pump, how sustainable are areas within the town?
- Criteria 2 (Map 4) Assuming all parcels in the town were to be developed and trench systems with a dosing pump used, how sustainable would areas within the town be?
- Criteria 3 (Map 5) Assuming all parcels in the town were to be developed and irrigation systems used, how sustainable would areas within the town be?

Constraints (Map 6)
Towns - Allestree / Dutton way, Cape Bridgewater, Nelson and Narrawong

Constraints relate to slope, proximity to water and adjoining allotments, and sometimes soils. They vary from town to town.

Onsite wastewater performance series (Map 7, Map 8, Map 9 and Map 10)
Towns - Allestree / Dutton way, Cape Bridgewater, Nelson and Narrawong

Note 1

Maps 7 thru map 10 represent the developability of properties and parcels using trench and irrigation technologies, and are expressed in terms of maximum allowable bedrooms. The maps have been calculated on the basis of block area less a 450m^2 allowance for impervious surfaces that would normally be associated with footpaths, driveways, the dwelling and outsheds, wastewater technology, and the constraints shown in map 6. For trench systems the EPA Code Of Practice (2008) requires the provision of a reserve field to ensure additional space is available should there be a failure of the primary disposal field.

(Unconstrained block area m^2 less impervious 450m^2) < wastewater disposal field requirement *

*** Disposal field requirements for trench systems are shown in table 6, table 7 and table 9 of this introduction, and for irrigation systems in table 8 of this introduction and table 3 of the accompanying report.**

This map series (map 7 thru map 10) applies the same philosophy as was applied to the development density map series, but this time to individual blocks. The maps evaluate the proposition that after an impervious surface allowance of 450m^2 is deducted from the size of the block, there should be an unconstrained area large enough for both a disposal area and a reserve area for trench systems, and a disposal area only for irrigation systems. The methodology for doing this is explained in note 1. The maps illustrate that the development potential of a block is sensitive to its size, constraints, soil and the wastewater technology used. Many blocks will have increased development potential with the use of irrigation systems.

In general, for each technology (trench and irrigation), the maps showing properties (Map 7 and Map 9) represent the ability of the local soils to deal with wastewater onsite if only properties were ever to be developed. In contrast, the maps showing parcels (Map 8 and Map 10) represent the ability of the local soils to deal with wastewater onsite if all parcels in the town were to be developed at some point in the future.

Onsite wastewater performance series - Trench performance (Map 7 and Map 8)
Towns - Allestree / Dutton way, Cape Bridgewater, Nelson and Narrawong

The trench system series gives some indication how existing systems might be performing in terms of surface runoff potential and does not account for impacts on groundwater. The maps often identify clusters of properties that seem to have minimal ability to adequately deal with their wastewater onsite. Although the presence of blackwater-only systems may mean that a block is adequately dealing with septic-waste (blackwater generally accounts for < 40% of domestic wastewater), the disposal of untreated greywater off-site is in breach of the Septic Tank Code Of Practice (EPA, 2008) and the State Environment Protection Policy (Waters of Victoria) (Victorian Government, 2003).

Map 7 illustrates a town's sustainability / development potential using trench systems based on properties.

Map 8 illustrates a town's sustainability / development potential using trench systems if all parcels were to be developed.

This map series tends to illustrate that the continued use of trench based onsite technologies is not a sustainable option for town growth.

Onsite wastewater performance series - Irrigation performance (Map 9 and Map 10) Towns - Allestree / Dutton way, Cape Bridgewater, Nelson and Narrawong

The irrigation system series (Map 9 and Map 10) often shows that many blocks constrained when trench systems are used, are not constrained when irrigation technologies are used.

Map 9 represents the present ability of the local soils to deal with wastewater onsite if all existing developments were to be upgraded to irrigation technology.

Map 10 shows the present ability of the local soils to deal with wastewater onsite if all parcels in the town were to be developed and irrigation technology was to be used.

Simplified onsite wastewater mapping (Map 11 and Map 12)
Towns - Dartmoor, Digby, Merino and Sandford

Map 11 and map 12 are shaded using categories that are sensitive to minimum block size requirements for a 3 bedroom home that are shown in table 1 of the relevant town report. Although the map shades used for each of the four towns in the series are the same, what they represent is different for each town. These maps do not incorporate constraint mapping.

Flow rates / wastewater production rates

For the purpose of our map modelling, we used the dwelling occupancy formula of "Number Of Bedrooms Plus One" Specified in the Code of Practice (EPA, 2008; p.13). We then adopted the flow rates shown in Table 3 and applied them to towns in the manner shown in 4. Our research suggests that daily water usage rates lower than these are unlikely (see **Error! Reference source not found.**). Flow rates / water usage rates are important because as they change, so to do wastewater disposal area requirements. In every soil category Aerated Wastewater Treatment Systems (irrigation systems) that produce higher quality wastewater require less area to dispose of wastewater than trench systems. Figures used in our modelling are shown in table 6, table 7, table 8 and table 9. The mapping is described in the sections following the tables that accompany this paragraph.

Table 3: Flow rates recommended in table 4.1 of the Code of Practice (EPA, 2008; table 4.1) and AS/NZS 1547:2000 (Appendix 4.2D, p.141)

Technology	Flow rate per person / day	Water supply	Comments
Septic system with trench disposal	115 litres	Tank and town	Standard water reduction fixtures: Council should specify water reducing fixtures in new permit conditions.
	180 litres	Town water	Standard fixtures: These flow rates were used to highlight the impact of existing trench systems.
	140 litres	Water tank	
Septic system with treatment plant and irrigation disposal	115 litres	Water tank	Standard water reduction fixtures: Council should specify water reducing fixtures in new permit conditions.

Table 4: Towns and flow rates specified by the Code as applied in our town reports. We adopted a 115 litre / person / day flow rate for all new systems on the basis of our recommendation that Council specify Standard Water Reduction Fixtures in permit conditions.

Town	Water source	System flow rate for existing trench systems (Litres / person / day)	System flow rate for new irrigation and trench (Litres / person / day)
Allestree / Dutton Way	Tank	140	115
Cape Bridgewater	Tank	140	115
Nelson	Tank	140	115
Narrawong	Town	180	115
Sandford	Town	180	115
Dartmoor	Town	180	115
Digby	Tank	140	115
Merino	Town	180	115
Casterton	Town	180	115
Heywood	Town	180	115
Portland West	Town	180	115

Table 5: Daily water usage figures for Victoria and a selection of places within it.

Place / Authority	Period	Litres / person / day	Source
Victoria	2004-2005	222	ABS 2006, Analysis of fig.7.7, p.103.
Central Highlands Water	2005-2006	212	Wannon Water 2007, p.33.
Barwon Water	2005-2006	217	As above
Western Water	2005-2006	206	As above
Melbourne's water retailers	2005-2006	208	As above
Gippsland Water	2005-2006	233	As above
Wannon Water	2005-2006	258	As above
Portland	2005-2006	264	As above
Casterton	2005-2006	237	As above
Heywood	2005-2006	273	As above
Heywood	Winter 2006	231	* Analysis of data provided by Wannon Water

* During winter little if any garden watering takes place so water usage figures from this period are more likely to be representative of actual household usage. Meter readings were excluded from the analysis if they were less than 100 litres per day (probably vacant), or more than 5000 litres per day (not covered by the Code). The 553 meter readings that were selected approximate the DSE (2008) count of 527 occupied dwellings in the town. It is likely that some of the discrepancy would be accounted for by shops. The daily water consumption of 284,337 litres for these 553 premises was divided by the DSE's 2008 census derived population of 1229 to arrive at an average water consumption figure of 231 litres per person per day.

Table 6: The flow rate used for modelling the sustainability of existing trench systems where the water source is a water tank was 140 litres / person / day. This rate assumes standard water fixtures. Soils 5b,5c,6a,6b,6c were judged to have identical characteristics to soil category 4c.

AS/NZS Soil code	Maximum Bedrooms	Field size m^2
1	1	189
1	2	238
1	3	336
1	4	385
1	5	483
2a	1	189
2a	2	238
2a	3	336
2a	4	385
2a	5	483
2b	1	238
2b	2	336
2b	3	434
2b	4	483
2b	5	581

AS/NZS Soil code	Maximum Bedrooms	Field size m^2
3a	1	238
3a	2	336
3a	3	434
3a	4	483
3a	5	581
3b	1	336
3b	2	483
3b	3	581
3b	4	728
3b	5	875
4a	1	336
4a	2	483
4a	3	581
4a	4	728
4a	5	875

AS/NZS Soil code	Maximum Bedrooms	Field size m^2
4b	1	483
4b	2	728
4b	3	973
4b	4	1169
4b	5	1414
4c	1	728
4c	2	1071
4c	3	1414
4c	4	1757
4c	5	2100
5a	1	581
5a	2	875
5a	3	1169
5a	4	1414
5a	5	1708

Table 7: The flow rate used for modelling the sustainability of existing trench systems where the water source is town water was 180 litres / person / day. This rate assumes standard water fixtures. Soils 5b,5c,6a,6b,6c were judged to have identical characteristics to soil category 4c.

AS/NZS Soil code	Maximum Bedrooms	Field size m^2
1	1	238
1	2	336
1	3	385
1	4	483
1	5	581
2a	1	238
2a	2	336
2a	3	385
2a	4	483
2a	5	581
2b	1	287
2b	2	385
2b	3	532
2b	4	630
2b	5	777

AS/NZS Soil code	Maximum Bedrooms	Field size m^2
3a	1	287
3a	2	385
3a	3	532
3a	4	630
3a	5	777
3b	1	385
3b	2	581
3b	3	777
3b	4	924
3b	5	1120
4a	1	385
4a	2	581
4a	3	777
4a	4	924
4a	5	1120

AS/NZS Soil code	Maximum Bedrooms	Field size m^2
4b	1	630
4b	2	924
4b	3	1218
4b	4	1512
4b	5	1806
4c	1	924
4c	2	1365
4c	3	1806
4c	4	2247
4c	5	2688
5a	1	777
5a	2	1120
5a	3	1463
5a	4	1806
5a	5	2149

Table 8: The flow rate used for modelling the sustainability of new irrigation systems was 115 litres / person / day. This rate assumes standard water reduction fixtures.

AS/NZS Soil code	Maximum Bedrooms	Field size m^2
1	1	120
1	2	153
1	3	185
1	4	217
1	5	249
2a	1	120
2a	2	153
2a	3	185
2a	4	217
2a	5	249
2b	1	120
2b	2	153
2b	3	185
2b	4	217
2b	5	249
3a	1	137
3a	2	177
3a	3	217
3a	4	257
3a	5	298
3b	1	137
3b	2	177
3b	3	217
3b	4	257
3b	5	298

AS/NZS Soil code	Maximum Bedrooms	Field size m^2
4a	1	146
4a	2	191
4a	3	236
4a	4	281
4a	5	327
4b	1	146
4b	2	191
4b	3	236
4b	4	281
4b	5	327
4c	1	146
4c	2	191
4c	3	236
4c	4	281
4c	5	327
5a	1	169
5a	2	225
5a	3	281
5a	4	337
5a	5	394
5b	1	169
5b	2	225
5b	3	281
5b	4	337
5b	5	394

AS/NZS Soil code	Maximum Bedrooms	Field size m^2
5c	1	169
5c	2	225
5c	3	281
5c	4	337
5c	5	394
6a	1	206
6a	2	282
6a	3	357
6a	4	432
6a	5	507
6b	1	206
6b	2	282
6b	3	357
6b	4	432
6b	5	507
6c	1	206
6c	2	282
6c	3	357
6c	4	432
6c	5	507

Table 9: The flow rate used for modelling the sustainability of new trench systems was 115 litres / person / day. This rate assumes standard water reduction fixtures. Soils 5b,5c,6a,6b,6c were judged to have identical characteristics to soil category 4c.

AS/NZS Soil code	Maximum Bedrooms	Field size m^2	AS/NZS Soil code	Maximum Bedrooms	Field size m^2	AS/NZS Soil code	Maximum Bedrooms	Field size m^2
1	1	140	3a	1	189	4b	1	434
1	2	238	3a	2	287	4b	2	630
1	3	287	3a	3	336	4b	3	777
1	4	336	3a	4	434	4b	4	973
1	5	385	3a	5	483	4b	5	1169
2a	1	140	3b	1	287	4c	1	630
2a	2	238	3b	2	385	4c	2	875
2a	3	287	3b	3	483	4c	3	1169
2a	4	336	3b	4	630	4c	4	1463
2a	5	385	3b	5	728	4c	5	1757
2b	1	189	4a	1	287	5a	1	483
2b	2	287	4a	2	385	5a	2	728
2b	3	336	4a	3	483	5a	3	973
2b	4	434	4a	4	630	5a	4	1169
2b	5	483	4a	5	728	5a	5	1414

Sustainability

> *"Sustainable: able to continue indefinitely without any significant negative impact on the environment or its inhabitants" (EPA, 2008, p.35).*

For the following two reasons, our map models are likely to represent a block as more sustainable than it might actually be.

- The Code of Practice regards a block size of 10,000 m^2 as being a risk threshold for onsite wastewater planning (EPA 2008, p6). In the towns in this study, blocks are commonly less than 1000 m^2.
- Design flow rates are an important input to Land Capability Assessments because they prescribe how much wastewater a household must dispose of. The design flow rates used in our modelling were taken from the Code of Practice. The daily water usage figures in the Code are well below actual figures for various places within Victoria (see table 5).

In spite of their slant towards block developability, our maps consistently show that the trench based onsite wastewater treatment systems most likely in use throughout Glenelg Shire are unsustainable in their present form. Poorly performing onsite wastewater systems, particularly when there are clusters of them, have the potential for offsite effects that can impact both human health and the health of the environment.

RECOMMENDATIONS AND CONCLUSIONS FOR IMPROVING SUSTAINABILITY

There are two major problems that relate to onsite wastewater systems.

- Inappropriate technology: Older homes are mostly installed with systems that were considered appropriate at the time they were built. Often these technologies were not ideally suited to the local situation. Time has moved on in terms of government and community expectations for system performance, and the wastewater technologies that are available to address those expectations.
- Lack of maintenance: System performance drops if onsite wastewater systems are not maintained. Estimates of the number of systems failing at any one time vary throughout the literature, but a common theme is that the majority of systems in Australia and overseas fail over time.

The recommendations section aims to address these two important issues. The preferred recommendations for select towns are shown in table 10.

Table 10. Summary of preferred recommendations.

Primary approach	Digby	Merino	Sand-ford	Dart-moor	Cape B-water	Nelson	Allestree & DW	Narra-wong
Sewer using a Common Effluent Disposal (CED) scheme				Medium (part of town)	High (part of town)	High (part of town)	High	
Upgrade trench systems to irrigation systems	Medium	Medium / High		Medium (part of town)		High (part of town)		Medium
Boundary realignment			Low (part of town)					
Community awareness campaign	Low	Low	Low	Low	Low	Low	Low	Low

High priority | Medium priority | Low priority | Part of town

References

ABS, 2006, Water Account Australia 2004–05, Publication number 4610.0

AS/NZS, 2000, On-site Domestic Wastewater Management, Publication 1547

DSE, 2008, Towns In Time dataset for Heywood

EPA, December 2008, Code of Practice – Onsite Wastewater Management document, Publication 891.2

Victorian Government, 2003 (June 4), State Environment Protection Policy, Waters of Victoria - Schedule 107 to the Environment Protection Act 1970, Victoria Government Gazette.

Wannon Water, 2007, Water Supply Demand Strategy

Acknowledgement

This document is a review and update of an earlier series of reports undertaken by Mr Larry White.

Notes regarding the mapping and tables 3.1 and 3.2
Maps 3 thru 12 have by necessity been compiled using a number of assumptions that would in reality vary from site-to-site. • Maps 11 thru 12 (Dartmoor, Digby, Merino and Sandford): All blocks are shaded according to area in a manner that is sensitive to the figures in table 1 of the relevant town report. • All maps have been produced with the assumption that wastewater systems are / would be correctly maintained. • An area of 450m^2 for each existing / potential dwelling has been incorporated to allow for impervious surfaces such as dwelling and out-shed roof areas, and paved surfaces. In reality this will vary from development-to-development. Where a block changes developability status on the basis of less than 450m^2 of impervious surfaces, then Council should make efforts to ensure that new impervious surfaces do not appear at later dates. • In allowing for 450m^2 of impervious surfaces, no allowance has been made for the position of the dwelling on the block. A dwelling located at the centre of a block may leave too-little area for a wastewater disposal field. • Design loading rate – based on the loading tables in AS/NZS:1547:2000[1] employing the soil categorisation system and conservative application rates for primary effluent-loaded absorption trenches; and application rates for secondary quality treated effluent in the case of irrigation. The design trench loading rate provided in this document does not deal with the discharge of secondary treated effluent to trenches. • Where reliable measured soil permeability data for a site are available, it may be justified to use the measured data for design and sizing of a disposal field. • Trench spacing – Trenches are spaced 3 m apart between adjacent trench walls as required by EPA guidelines and are considered to be in units of 10 m length. This length was selected because generally the vacant allotments are small and often narrow as well, and it would be impossible to install trenches to the maximum recommended length of 30 m each. • The size of areas occupied by trench systems will vary depending on how they can be laid out. The Tables in this Strategy have assumed the land surface is plain and trench systems come in multiples of 10 m long parallel trenches.

[1] The Standard's soil categorisation system that uses soil texture and structure to define soil category provides only indicative soil permeability (hydraulic conductivity) values for these soil categories.

GLOSSARY OF TERMS[2]

10/10/10 standard: water quality standard indicating an effluent quality of <10 mg/L BOD5, <10 mg/L suspended solids and *E.coli* <10 cfu/100 mL. Greywater of this quality may be recycled indoors via toilet flushing or cold-water supply to washing machines. It may also be used for surface and subsurface irrigation.

20/30 standard: water quality standard indicating an effluent quality of <20 mg/L BOD5 and <30 mg/L suspended solids. Wastewater including greywater of this quality may be recycled outdoors via subsurface irrigation.

20/30/10 standard: water quality standard indicating an effluent quality of <20 mg/L BOD5, <30 mg/L suspended solids and *E.coli* <10 cfu/100 mL. Wastewater including greywater of this quality may be recycled outdoors via surface and subsurface irrigation.

Absorption: the disappearance of a liquid through its incorporation into solid material, i.e., the uptake of effluent into the soil by capillary action.

Accredited service agent: a person who has been suitably trained by the system manufacturer in the installation, operation and service requirements of the system and is accredited by the system manufacturer in writing to undertake the service.

Aerated wastewater treatment system (AWTS): a system that bubbles air through the wastewater held in a tank in order to provide the micro-organisms with a source of oxygen to facilitate aerobic biological digestion of organic matter.

Aerobic: 'organisms and processes that require oxygen', i.e., microbiological digestion and assimilation of organic matter through the use of oxygen.

Allotment: See Parcel

Anaerobic: 'living or occurring without oxygen', i.e., microbiological digestion and assimilation of organic matter in the absence of oxygen.

Australia/New Zealand Standard: A document produced by Standards Australia or Standards New Zealand. A voluntary national standard code or specification prepared under the auspices of Standards Australia or Standards New Zealand. Standards are mandatory when referred to in regulations, and are enforceable in contracts when called up in contract documents.

Biochemical oxygen demand (BOD5): the amount of oxygen consumed by chemical processes and microorganisms to break down organic matter in water over a five-day period, measured in milligrams per litre (mg/L).

Blackwater: wastewater from toilets containing faeces and urine.

BOD5: see biochemical oxygen demand.

CA: see 'Certificate of approval'.

Certificate of approval (CA): A statutory document that allows for the installation of onsite wastewater treatment systems or, in some instances, onsite wastewater disposal/recycling systems in Victoria. Current CAs, including associated documentation (installation manual, maintenance/service manual and owner/occupier's operation instruction manual), can be obtained from www.epa.vic.gov.au/water/wastewater/onsite.asp).

cfu: colony-forming units.

Council: a municipal council/local government body.

Desludging: see 'Pump-out'.

Disposal field: the area of land utilised for the disposal of partially treated sewage to groundwater via a soil absorption trench. The base of the trench is typically dug 600 mm below the ground surface. The trench is built up to a height of 300 mm and then a layer of 300 mm of native soil is backfilled on top to bring the soil up to the original ground level. The trench location and design will include setback distances from existing and proposed buildings, patios, driveways, fences etc.

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[2] Most items in this glossary were sourced from EPA, 2008, Guidelines for Environmental Management – Septic Tanks Code of Practice, Publication 891.2, December.

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), with no intention of beneficial reuse.

Domestic wastewater: see 'Sewage'.

Drinking water: water suitable for human consumption without any risks to health.

E.coli: *Escherichia coli* — a species of bacteria in the faecal coliform group that is found in large numbers in the intestines of animals and humans. Its presence in freshwater indicates recent faecal contamination and is measured in 'colony-forming units' (cfu) per 100 mL of water.

Effluent: water flowing out of a wastewater treatment system.

Ephemeral stream or channel: a stream or channel that carries water for a considerable portion of time, but that occasionally or seasonally ceases to flow.

Full water-reduction fixtures: include the combined use of reduced-flush 6/3-litre water closets, shower flow restrictors, aerator faucets, front-load washing machines and flow/pressure control valves on all water-use outlets. Additionally, water reduction may be achieved by treatment of greywater and recycling for water closet flushing (reclaimed water cycling).

Greywater: domestic wastewater from sources other than the toilet, urinal or bidet (i.e., from showers, baths, spas, hand basins, washing machines, laundry troughs, dishwashers and kitchen sinks).

Groundwater: underground water contained in or flowing through soil or rock.

Infiltration: the gradual movement of water into the pore spaces between soil particles.

Irrigation: the artificial supply of water to land and vegetation.

Micro-organism: an organism that is invisible or barely visible to the unaided eye (e.g., bacteria, viruses, protozoa).

Nutrients: substances that are used in an organism's metabolism and that must be taken in from the environment; for example 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.

Onsite domestic wastewater system: see 'Onsite wastewater system'.

Onsite wastewater disposal/recycling system: the system or method for disposal/recycling of treated wastewater.

Onsite wastewater recycling: recycling of domestic wastewater sourced from, treated and used at a single residential site.

Onsite wastewater system: is the same as a 'septic tank system' as defined in the *Environment Protection Act 1970*. It includes an onsite wastewater treatment system plus the subsequent disposal/recycling system.

Onsite wastewater treatment system: a treatment system that treats up to 5000 L/day of wastewater.

Parcel: a block of land identified on a plan that is capable of being registered with Land Victoria. Also known as an Allotment and a Title.

Pathogen: a disease-causing micro-organism.

Pollution: any harmful or undesirable change in the physical, chemical or biological quality of air, water or soil as a result of the release of chemicals, heat, radioactivity or organic matter.

Potable water supply catchment: means an area declared as a water supply protection area as defined in section 27 of the *Water Act 1989*.

Potable water: see 'Drinking water'.

Precautionary principle: a principle of the *Environment Protection Act 1970*: 'Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.'

Primary treatment of wastewater: the physical processes of screening, filtration, sedimentation, flocculation and flotation to remove organic and inorganic matter from wastewater.

Property: one or more adjoining Parcels / Allotments / Titles in the same ownership. Also known as a tenement.

Pump-out: the removal of biological sludge and inert sediment from a septic tank, including the surface crust (scum) material. A pump-out should not drain tanks dry, because some residual sewage is needed to provide a seed source of digesting micro-organisms.

Qualified person: a person who holds relevant qualifications, or a person who is experienced and accepted by a professional body to practise in the pertinent area.

Recycling: treating wastewater to a standard that is appropriate for its intended use; e.g., treating greywater to a 10/10/10 standard for use in toilet flushing, then using that water accordingly.

Reserve field: a duplicate land disposal area reserved for use when the original land disposal area needs to be rested.

Reticulated water: water suitable for human consumption that is delivered to a dwelling through a network of pipes.

Reuse: using a waste product in its present form for another purpose; e.g., diverting (reusing) untreated greywater to water the garden.

Scum: material that floats on top of the liquid in an anaerobic sewage treatment tank (i.e., septic tank).

Secondary treatment: biological treatment following primary treatment of wastewater. Disinfection to kill pathogens may also occur.

SEPP (WoV): *State Environment Protection Policy (Waters of Victoria).*

Septic tank system: as defined within the *Environment Protection Act 1970* (section 53J) '.means a system for the bacterial, biological, chemical or physical treatment of sewage, and includes all tanks, beds, sewers, drains, pipes, fittings, appliances and land used in connection with the system'. In essence this includes a wastewater treatment system (all types of onsite wastewater treatment systems, including septic tanks), as well as associated wastewater storage tanks, distribution pipes and the associated wastewater disposal/recycling system and area.

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.

Service agent: see 'Accredited service agent'.

Sewage: as defined within the *Environment Protection Act 1970* (section 53J) '.means any waste containing human excreta or domestic wastewater.'.

Sewerage: the pipework and ancillary equipment associated with the collection and transport of sewage, and the equipment and processes involved in treating and discharging the effluent.

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).

Soil absorption trench: an infiltration or soak-away trench installed at a depth of 300 to 600 mm below ground level, which facilitates the disposal of primary treated sewage.

Standard fixtures: non water conserving fixtures.

Standard water-reduction fixtures: include dual-flush 11/5.5-litre water closets, shower-flow restrictors, aerator faucets (taps) and water-conserving automatic washing machines.

Subsurface irrigation: the irrigation of water at a depth of between 100 mm and 300 mm below ground level, i.e. in the biologically active topsoil layer. Minimum water quality required for subsurface irrigation with treated sewage or greywater is 20/30 standard (20 mg/L BOD5 and 30 mg/L SS).

Sullage: household greywater that does not contain human excreta, but may still contain pathogens, nutrients and potentially harmful chemicals.

Surface irrigation: the irrigation of water to the ground surface. It includes the use of low-rise sprinklers, micro-sprayers, and drip systems under mulch, but excludes the use of hand-held hoses for treated sewage. Treated greywater can be connected to purple coloured child-proof taps that have a removable handle. Irrigation spray heads must not spray beyond the property boundary. Minimum water quality required for surface irrigation with treated sewage or greywater is 20/30/10 standard (20 mg/L BOD5, 30 mg/L SS and 10 cfu E.coli/100 mL).

Suspended solids (SS): a measure of the solids in water, expressed in milligrams per litre (mg/L).

Sustainable: able to continue indefinitely without any significant negative impact on the environment or its inhabitants.

Tenement: See Property

Title: See Parcel

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.

Treatment: a process or series of processes that remove contaminants from wastewater, whereby the physical, chemical and biological characteristics of wastewater are altered.

Turbidity: the cloudy or muddy 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 (NTU).

Water table: the surface of a body of groundwater, below which the geological parent material is completely saturated with water.