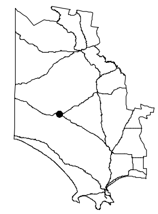
DARTMOOR

TOWN REPORT

March 2009



INTRODUCTORY COMMENTS

Dartmoor is a small town (~250 people) located on the Glenelg rover. Hamilton is 75km (1 hr) to the east, Casterton 45km (40 mins) to the north and Portland 70km (50 mins) to the south. Services include town water and electricity but no sewerage. There is a kindergarten and primary school, as well as police, CFA and basic retail and sporting facilities.

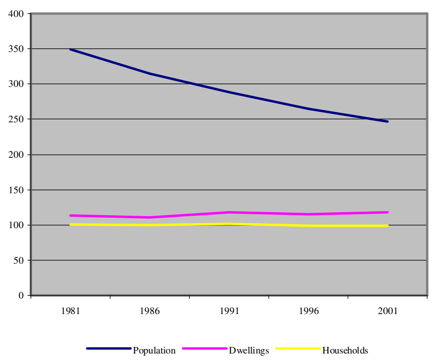


Figure 1: Population and housing trends between 1981 and 2001

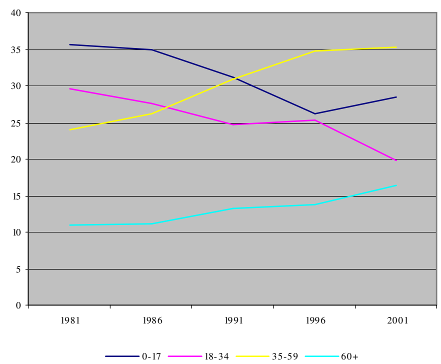


Figure 2: Population trends for four age groups between 1981 and 2001.

Figure 1 shows that in 2001 there were 118 dwellings in Dartmoor, 19 of which were vacant. The vacancy rate of 16% is high (Portland's is 11% and the overall Victoria figure is 10.4%). Perusal at air photos reveals a number of vacant parcels, so there is some potential for additional dwellings in Dartmoor. Considering the high vacancy rate, it is unlikely that there will be demand for this in the short term. In Figure 2 Dartmoor's total 2001 population of 246 (in steady decline between 1981-2001) is broken into four age groups. Over the period there has been a steady decline in the 0-17 and 18-34 age groups, but a recent reversal of this trend for the 0-17 group - probably a reflection of an increase in the 35-59 age group. The decline of the 18-34 age group might be explained by the lack of local opportunities for tertiary education and employment. The 60+ age group is also on the increase. As with all demographic statistics, local knowledge should be incorporated in order to confirm these assumptions.[1]

[1] This commentary is a measure of net population change based on the Department of Sustainability and Environment's census derived Towns-In-Time dataset. It should be interpreted with caution because in the absence of custom census tables and local knowledge, it is impossible to say whether the change relates to the same population in each census period. The data should also be interpreted with an understanding of drivers for change and their relevance for different groups (eg homemakers versus retirees). For example, housing affordability is a driver that might motivate some to seek housing in small towns, but for others, barriers such as the lack of education or employment opportunities might be too great. Barriers can also change in response to new regional employment or education opportunities, or technologies such as high speed internet.

The terrain around Dartmoor (map 1) has four distinct parts. Qrs geology (Qrd/Qrs in some maps), also mapped as Follett Land System in the Glenelg-Hopkins Rivers Catchment Soil Health Strategy, is an elevated undulating plain of low dunes with dark grey fine sandy soils often with clay subsoils deeper down. The mapping unit also has some localized inter-dune depressions within which soil drainage is poor. Qpb geology, also mapped as Nelson Land System, is a strongly undulating area with dark brown sandy soils having reddish brown sandy clay subsoils. Qra2 geology, also mapped as Wannon Alluvial, is a component of that land system, an elevated alluvial terrace along the Glenelg river. It has deep fine sandy soils. Qra1 geology, also a component of Wannon Alluvial Land System, is Glenelg River's present floodplain and it has sandy soils. Tmg geology, mapped as Branxholme Land System, is exposed as marly limestone along some of the steep slopes below the undulating plateau on which Dartmoor is situated, but it appears that it has no development and also should be avoided for development on account of steepness.

Dartmoor's planning zones are shown in map 2. There are 167 properties (223 parcels) in the township zone. Given that in 2001 there were 118 dwellings in the town, and that in the Township zone there are 223 parcels, there is the potential for an additional 105 dwellings in the town (a 89% increase in number of dwellings). There are many small properties and parcels in the town.

Map 11 indicates that there are many properties in Dartmoor that are on the cusp of being too small to contain wastewaters onsite regardless of whether trench or irrigation technologies are used. We are concerned that cumulatively, these may cause problems to groundwater.

Figure 1 shows that between 1981 and 2001 there was little residential development in Dartmoor so it is likely that the majority of wastewater systems are old. Dartmoor is probably dominated by systems that treat blackwater only and dispose of greywater to a ditch or gutter. There may also be some all-waste systems in the town. Where such systems have been maintained they are likely to continue working effectively for many years to come.

WASTEWATER MAPPING

In the following text we relate the AS/NZS and Septic Tank Code Of Practice to Dartmoor. Map 3 through map 10 (present for the towns of Allestree / Dutton Way, Cape Bridgewater, Narrawong and Nelson) were not produced for Dartmoor.

Table 1: The implications of the disposal area requirements for Dartmoor's soils. Because constraints are not incorporated, blocks close to the minimum size requirement set out in this table might not conform to the Code of Practice. Comments relate to the shading in map 11 and map 12.

Soil and technology	Loading rate (l / pp / day)	(a) Impervious surface allowance	(b) Required disposal area (3br home)	(c) Required reserve area	(a+b+c) Minimum block size required	In map 11 and map 12, closer scrutiny is required on blocks shaded…
1: Trench (existing)	180	450	385	385	1220	Pink, orange, light green
2a: Trench (existing)	180	450	385	385	1220	Pink, orange, light green
2b: Trench (existing)	180	450	532	532	1514	Pink, orange, light green
4b: Trench (existing)	180	450	1218	1218	2886	Pink, orange, light green, dark green
2b:Trench (new)	115	450	336	336	1122	Pink, orange, light green
4b:Trench (new)	115	450	777	777	2004	Pink, orange, light green, dark green
1: Irrigation	115	450	185	0	635	Pink
2a: Irrigation	115	450	185	0	635	Pink
2b: Irrigation	115	450	185	0	635	Pink
4b: Irrigation	115	450	336	0	786	Pink

The category ranges in map 11 and map 12 were formulated to reflect the capability of the local soils to deal with domestic wastewaters onsite and do not consider setbacks. In order to gain a strategic understanding of the implications of existing and future development in Dartmoor, table 1 has been formulated to compliment map 11 and map 12.

For each technology (trench and irrigation), the map showing properties (map 11) and table 1 can be used to represent the ability of the local soils to deal with wastewater onsite if no further development were to ever occur in the town. In contrast, the map showing parcels (map 12) and table 1 can be used to represent the ability of the local soils to deal with wastewater onsite if the town were to be fully developed at some point in the future.

Trench performance

When read in conjunction with table 1, Map 11 and map 12 illustrate where trench technologies would be sustainable in the long term, and the extent of problems that might arise should Council continue to approve trench systems. The maps give some indication how existing systems might be performing in terms of surface runoff potential but do not account for impacts on groundwater. Concerns for properties that seem to have minimal ability to adequately deal with their wastewater onsite need to be tempered by the comments relating to blackwater-only systems in the report introduction.

A major concern is that there are clusters of blocks on category 2b soils where trench systems are unlikely to perform well – in particular, areas in the north-west of the town that are in close proximity to watercourses. Most of the properties shaded pink, orange and light green are already developed, indicating that they are too small to sustainably deal with wastewaters from a 3 bedroom house using trench systems (map 11). Additional blocks emerge as causing concern if Dartmoor's 2b soils were to be fully developed using traditional trench technologies (map 12).

Irrigation performance

Most of the blocks identified as being concerning when trench systems are used, are less of a concern when irrigation technologies are used. For all blocks in the township zone, those shaded pink give the greatest cause for concern if upgraded to irrigation systems. However, in the north of the town there are many blocks shaded orange that are only "just" in this category and so may not be sustainable with irrigation systems once the constraints prescribed in the Code are incorporated.

RECOMMENDATIONS AND CONCLUSIONS FOR IMPROVING SUSTAINABILITY

Failing or inappropriate onsite wastewater systems create concerns for human health and the health of the environment.

Towns of Dartmoor's age tend to use trench systems. Where these are all-waste systems, in some areas there is potential for surface runoff, and where they are blackwater only, grey-water is being disposed of as street drainage. Neither situation is acceptable either from a health or an environmental perspective. Nobody knows for sure the extent of the various types of wastewater systems being used in Dartmoor, whether they have been appropriately maintained, or how they are performing. The establishment and maintenance of baseline information in order to understand this issue should be a high priority for council.

If at some point in the future Dartmoor were to be fully developed using onsite wastewater systems, map 12 and table 1 indicate that the clustering of blocks that are of concern for trench systems, would be far less concerning if they were using irrigation systems, particularly in the north (but also in the centre) of the town. However, many of those blocks shaded orange are on the cusp of being shaded red so a CED scheme might be worth investigating, particularly in the town's north-west. If the domestic wastewater can be satisfactorily disposed or re-used on other land within reasonable distance, Dartmoor's small blocks would become more comfortably sustainable.

In the short term, we believe it is important for Council to gain an understanding of the wastewater technologies in use in Dartmoor and prioritize a response with reference map 11. In the absence of a CED scheme, blocks shaded pink would still benefit from AWTS technology because the wastewater is treated to a much higher standard. A more economical upgrading process would involve disposing of AWTS treated wastewater to existing trenches. Also, the

EPA allows double the loading rate into trenches for AWTS treated wastewater, meaning that only half the trench area would be required as would be the case for a septic system.

Recommendation: The maps indicate that the trench systems that are likely to be installed throughout Dartmoor are unsustainable on many blocks, and also that wastewater issues should be approached differently in different areas of the town. We suggest three approaches to dealing with this. Our most preferred is Approach 1 and our least preferred is Approach 3.

- **Approach 1:**
  - Sewer the two clusters of blocks shaded pink, orange and light green in the north west of the town. A Common Effluent Drainage system would be the most practical.
  - For the remainder of the town, permit approval should be used as a trigger to upgrade blocks shaded pink, orange and light green to be irrigation systems.
  - Manage remaining problems.
- **Approach 2:**
  - Upgrade the two clusters of blocks shaded pink, orange and light green in the north west of the town to irrigation systems.
  - For the remainder of the town, permit approval should be used as a trigger to upgrade blocks shaded pink, orange and light green to be irrigation systems.
  - Manage remaining problems.
- **Approach 3:**
  - Use permit approval as a trigger to upgrade blocks shaded pink, orange and light green to be irrigation systems.
  - Manage remaining problems.

Problems to manage

- Audit of existing systems in areas shaded pink, orange or light green in Map 11.
  - Document onsite technology being used
  - Initial desludging of all tanks
  - Establish system to monitor future desludging
- Begin a community awareness campaign to encourage…
  - The use of water saving devices and practices. The motivation for this is wastewater reduction rather than reduced water consumption.
  - The maintenance and care of septic tanks.
  - Effective operation of trenches through the installation of dosing pumps.
- Full Land Capability Assessment to be undertaken for development proposals that deviate from the wastewater technologies discussed in this document, or are shown to be unsustainable in Map 11 or Map 12.
- Ensure the regular maintenance of AWTS in accordance with certificate of approval.

Notes on upgrading existing septic tank systems

- Irrigation technology is the preferred option and implies the installation of AWTS. Wastewater should be treated to a 20/30 standard.
- A professionally designed and constructed sand filter would be an acceptable alternative technology.
- A dosing pump provides intermittent loading and uniform distribution of effluent. It is a relatively inexpensive option that would give immediate benefit to most blocks. It will not

make a trench system more sustainable, but rather will ensure that it is performing the best it possibly can. A dosing pump might be connected to existing trenches or extended trenches.

- Aerated Wastewater Treatment System (AWTS) in combination with extended trenches and a dosing pump would be another option.

REFERENCES

Australian / New Zealand Standard, On-site domestic-wastewater management – AS/NZS 1547:2000, 2000

EPA, Guidelines for Environmental Management – Septic Tanks Code of Practice, Publication 891, March 2003

EPA Victoria, State Environment Protection Policy (Waters of Victoria), 2003

van de Graaff & Associates Pty Ltd, Geocode Mapping & Analysis Pty Ltd and Patterson Rural Business Management Pty Ltd, 2006, Glenelg Hopkins Catchment Regional Soil Health Action Plan

ACKNOWLEDGEMENT

Extensive use has been made of an earlier wastewater report produced by Mr Larry White.

DARTMOOR PREFERRED MANAGEMENT OPTIONS

Table 2: Climatic Regime (mm) – Meteorological Stations: Dartmoor for rainfall, Mount Gambier and Hamilton for evaporation.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Mean Rainfall	33.5	29.6	40.8	65.5	79.1	90.5	99.9	98.4	80.8	67.3	53.6	42.5	780.5
Mean Pan Evap'n	208.9	187.5	150.5	87.9	52.2	35.8	42.3	58.5	77.7	110.0	135.6	176.6	1322.4
Crop Factor	0.70	0.70	0.70	0.60	0.50	0.45	0.40	0.45	0.55	0.65	0.70	0.70	
Mean Pot'l Evapotrans'n	146.2	131.2	105.4	61.5	36.5	25.1	29.6	41.0	54.4	77.0	94.9	123.6	926.2
Water Deficit	112.7	101.6	64.6	-		-	-	-	-	9.7	41.3	81.1	411
Water Excess	-	-	-	4	42.6	65.4	70.3	57.4	26.4	-	-	-	266.1
90-Percentile Rainfall	73.2	58.8	77.2	112.9	129.8	145	153.4	146.6	130.6	107	100	75	955.7

The 90-Percentile annual rainfall[2] is the total yearly higher than normal rainfall that on average occurs only once in ten years, and it is made up by some parts of the year having sufficiently higher than average rainfall. It is based on a long historical period of rainfall measurements. This index is used in EPA publications on irrigation of large scale industrial and municipal wastewater and also for grey water re-use schemes. In Dartmoor the 90-percentile high rainfall is about 22% higher than the mean annual rainfall.

During an average rainfall and evaporation year, there will be six months that have more rainfall than will be transpired by a grassed surface. The excess rainfall in these months is about 270 mm. The excess rainfall water will infiltrate into the soil and some of it will be

[2] The 90-Percentile annual rainfall is very much less than the sum of the 90-Percentile monthly rainfalls because the chance of having twelve months in succession each with the 90-Percentile high rainfall is vanishingly small. The chance of any one month having a 1 in 10 month high rainfall is 1:10 or 0.1 per definition. This is true for each month in the year. The chance that in one year two months will each have a 1 in 10 high rainfall therefore is 1:100, or 0.01 or 1 in 10^2. Thus for all twelve months in the year to have a 1 in 10 high rainfall is 1 in 10^{12} or 1 in a trillion years.

stored in the soil profile, becoming available for use during the six drier summer months when the total deficit amounts to approximately 410 mm. However, sandy soils such as in Qpb (Nelson land system), Qrd/Qrs (Follett land system) and the high-level river terrace in Qra (Wannon alluvium land system), of which the first two dominate the township, have a low water holding capacity and very high permeability and therefore much of the excess will be lost to deep drainage. The potential for irrigated vegetation to use up water and hence take up nutrients is significant only in the period from November to April.

The urban land is almost wholly restricted to the more gently sloping plateau spurs and very gently sloping alluvial fan, with very little development on alluvial flood plains. Three main terrain units and one minor terrain unit are distinguished.

- Elevated slightly undulating plain bordered by strongly undulating low dunes to the west and mapped geologically as Qrd - Qrs (Follett land system in Glenelg Soil Health Strategy(GSHS)). Soil Category 2b.
- Strongly undulating low dunes mapped geologically as Qpb (Nelson land system in GSHS); Soil Category 2a.
- Flood plains and alluvial terraces mapped geologically as Qra (Wannon Alluvial land system in GSHS). Soil Category 1.
- A narrow fourth terrain unit occupies the steeper slopes descending to the flood plain of the Glenelg River and is mapped geologically as Tmg, marl and marly limestone (Branxholme land system, GSHS). Soil Category probably 4b.

The soils in Qpb tend to have a little lime at depth and a pH > 7, while those in Qrd/Qrs are acidic throughout. All soils encountered in three inspection holes had sandy clay subsoil at depth of 0.6 to 0.8 m, which would slow down vertical percolating water and increase the protection of the groundwater.

The adjacent alluvial terraces and flood plain of the Glenelg River are mostly outside the built-up area of the township, but the township does extend in a narrow strip on a high-level terrace towards the east, where there are a few houses. The soil there is a dark grey fine sand, which should be classed as Category 1.

Table 3.1 Management for vacant allotments					
Soil Category	Soil, Geology & Topography	Indicative permeability (Ksat)	Waste water management system	Design Loading rate	Area required for waste water management system
2b	Windblown sand sheets interspersed with former swamp deposits, sand, silt some clay. Qrd & Qrs. Follett land system Fine acidic sands resting on orange clay at depth, probably deeper than 0.8 m in most cases Gently undulating surface	1.4 – 3.0 m/day	Absorption trenches & beds Standard 0.5 m wide; unit length 10 m; spacing 3 m + 2 m envelope	15 L/m^2.day Special design Water balance	Only blocks shaded dark green in map 11 or 12. 1 br: 230 L/day – 31m, 189 m^2 2 br: 345 L/day – 46m, 287 m^2 3 br: 460 L/day – 61m, 336 m^2 4 br: 575 L/day – 77m, 434 m^2
			Evapo-Transpiration Absorption – Seepage Trenches & Beds EPA CA 01.2/3 for annual rainfall 780 mm	Not suited, too permeable	n/a
			AS/NZS 1547:2000 Annual rainfall is not a factor for sizing in AS/NZS.		
			Mounds AS/NZS 1547:2000		Customise to local conditions
			Irrigation Systems AS/NZS 1547:2000 Secondary treated effluent only 2 m envelope	Irrig'n area DIR = 5 L/m^2.day but preferably less	1 br: 230 L/day – 120 m^2 2 br: 345 L/day – 153 m^2 3 br: 460 L/day – 185 m^2 4 br: 575 L/day – 217 m^2
			Irrigation Systems MAV Model for Sensitive Sites Secondary treated effluent only		MAV Spreadsheet; Parameters: Crop N Uptake 150 kg/ha; Crop P Uptake 40 kg/ha; P sorption 400 mg/kg soil; Bulk Density 1.5 c/cm^3; Depth of soil allowing for rock 2.0 m

Table 3.1 Management for vacant allotments - Continued

Soil Category	Soil, Geology & Topography	Indicative permeability (Ksat)	Waste water management system	Design Loading rate	Area required for waste water management system
2a	Ancient dunes and dune limestone, Qpb [Nelson land system] Deep sand, orange coloured in subsoil, may be calcareous at depth Gently to moderately sloping surfaces	>3.0 m/day	Absorption trenches & beds Standard 0.5 m wide; unit length 10 m; spacing 3 m + 2 m envelope	Too permeable for trenches	n/a
			Evapo-Transpiration Absorption – Seepage Trenches & Beds EPA CA 01.2/3 for annual rainfall 780 mm AS/NZS 1547:2000 Annual rainfall is not a factor for sizing in AS/NZS.	Not suited, too permeable	n/a
			Mounds AS/NZS 1547:2000		n/a
			Irrigation Systems AS/NZS 1547:2000 Secondary treated effluent only 2 m envelope	Irrig'n area DIR = 5 L/m^2.day but preferably less	1 br: 230 L/day – 120 m^2 2 br: 345 L/day – 153 m^2 3 br: 460 L/day – 185 m^2 4 br: 575 L/day – 217 m^2
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Table 3.1 Management for vacant allotments - Continued					
Soil Category	Soil, Geology & Topography	Indicative permeability (Ksat)	Waste water management system	Design Loading rate	Area required for waste water management system
1	Deep sandy flood plain soils (Qra2) [Wannon Alluvial land system] Uniform dark to black clay soils, often with a shallow water table Near level flood plains	>3.0 m/day	Absorption trenches & beds Standard 0.5 m wide; unit length 10 m; spacing 3 m + 2 m envelope	Too permeable for trenches	n/a
			Evapo-Transpiration Absorption – Seepage Trenches & Beds EPA CA 01.2/3 for annual rainfall 780 mm AS/NZS 1547:2000 Annual rainfall is not a factor for sizing in AS/NZS.	Too permeable for trenches	n/a
			Mounds AS/NZS 1547:2000	Too permeable for trenches	n/a
			Irrigation Systems AS/NZS 1547:2000 Secondary treated effluent only 2 m envelope	Irrig'n area DIR = 5 L/m^2.day but preferably less	1 br: 230 L/day – 120 m^2 2 br: 345 L/day – 153 m^2 3 br: 460 L/day – 185 m^2 4 br: 575 L/day – 217 m^2
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<table>
<tr><th colspan="6">Table 3.2 Management for existing allotments</th></tr>
<tr><th>Soil Category</th><th>Soil, Geology & Topography</th><th>Indicative permeability (Ksat)</th><th>Waste water management system</th><th>Design Loading rate</th><th>Area required for waste water management system</th></tr>
<tr><td rowspan="6">2b</td><td rowspan="6">Windblown sand sheets interspersed with former swamp deposits, sand, silt some clay. Qrd & Qrs. Follett land system

Fine acidic sands resting on orange clay at depth, probably deeper than 0.8 m in most cases

Gently undulating surface</td><td rowspan="6">1.4 – 3.0 m/day</td><td>Absorption trenches & beds
Standard 0.5 m wide;
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Secondary treated effluent only
2 m envelope</td><td>Irrig'n area DIR = 5 L/m^2.day but preferably less</td><td>Extend irrigation area where possible; reduce wastewater generation by water saving appliances and fixtures</td></tr>
<tr><td>Irrigation Systems
MAV Model for Sensitive Sites
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</table>

Table 3.2 Management for existing allotments - Continued					
Soil Category	Soil, Geology & Topography	Indicative permeability (Ksat)	Waste water management system	Design Loading rate	Area required for waste water management system
2a	Ancient dunes and dune limestone, Qpb [Nelson land system] Deep sand, orange coloured in subsoil, may be calcareous at depth Gently to moderately sloping surfaces	>3.0 m/day	Absorption trenches & beds Standard 0.5 m wide; unit length 10 m; spacing 3 m + 2 m envelope		Reduce wastewater generation by water saving appliances and fixtures; consider installing pressurised effluent distribution and/or aerated wastewater treatment system
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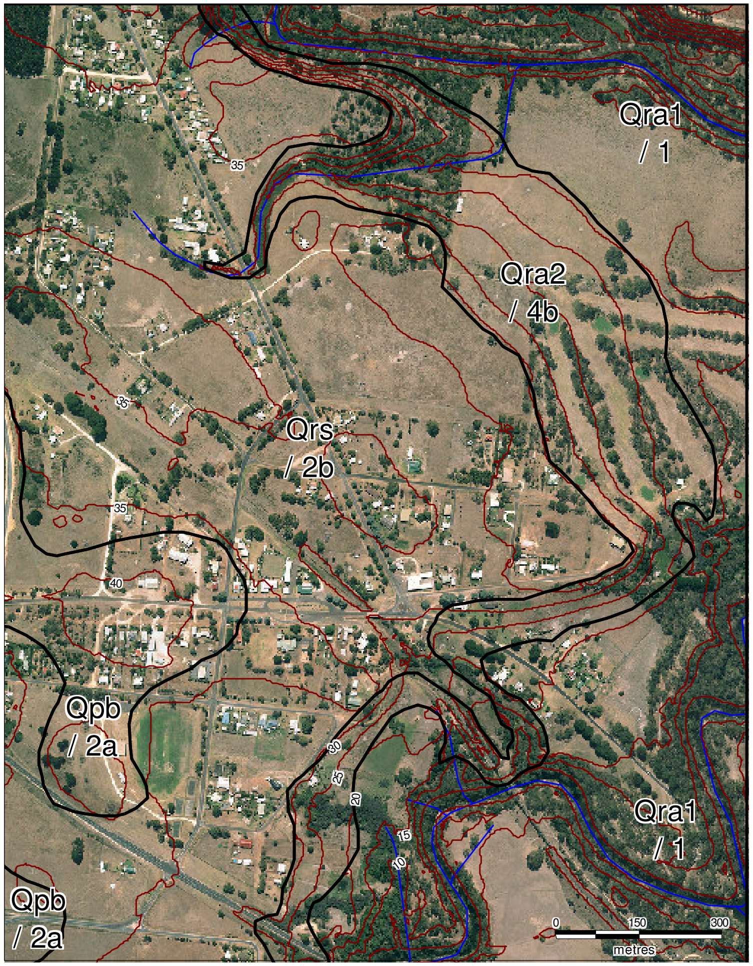
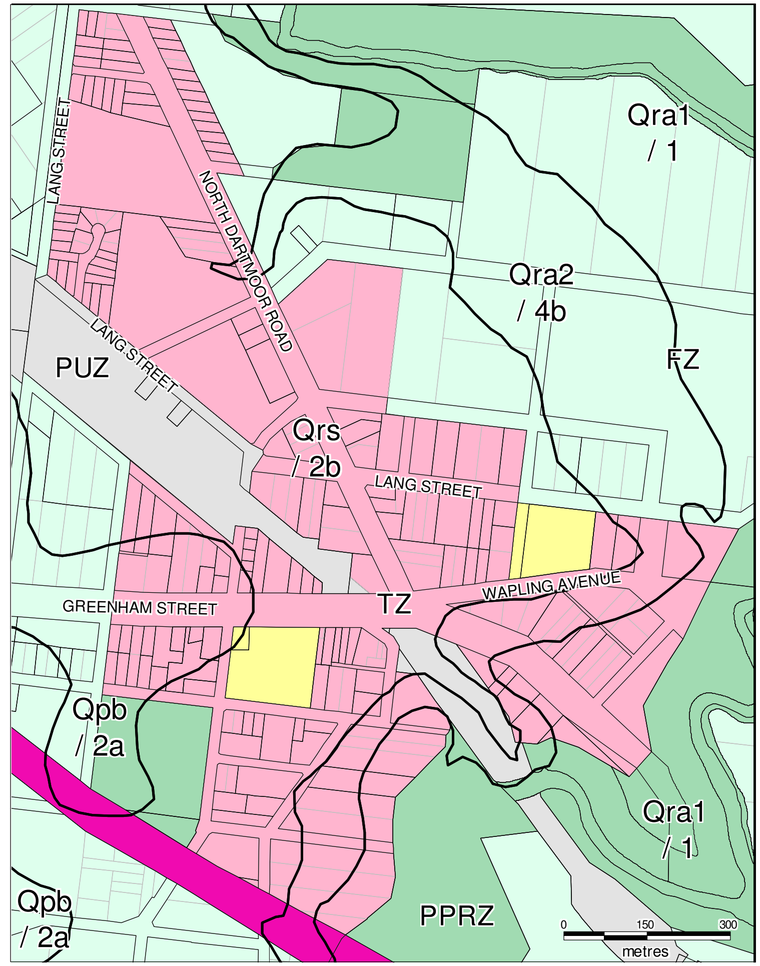
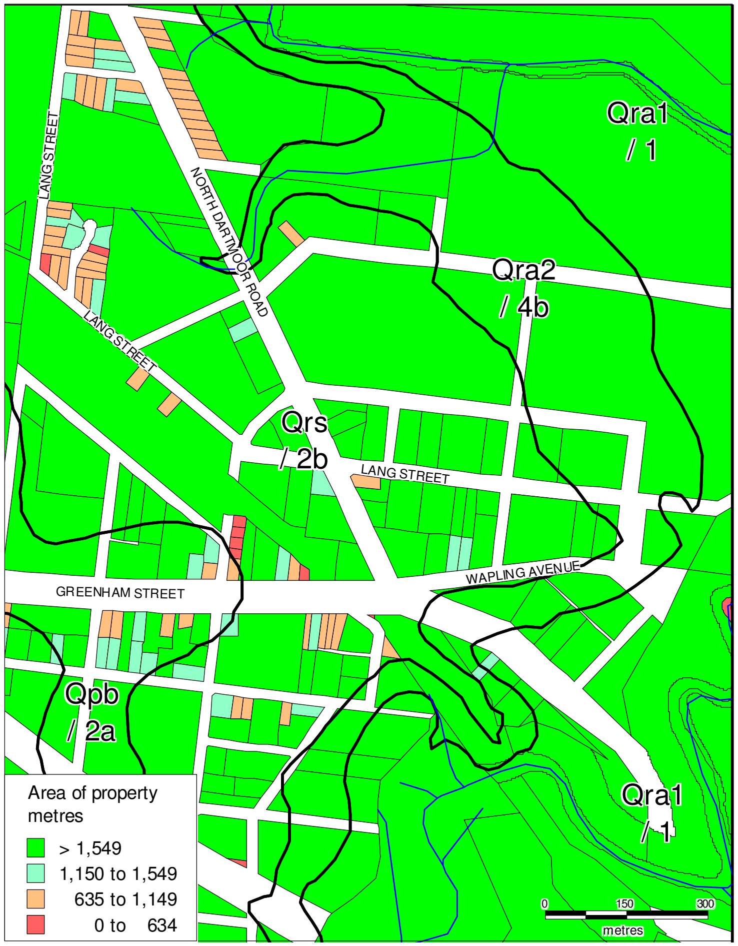


Map 1: Overview of Dartmoor showing 5m contours and soils. Soils are expressed in terms in terms of AS/NZS 1547:2000 categories for on-site domestic wastewater management.

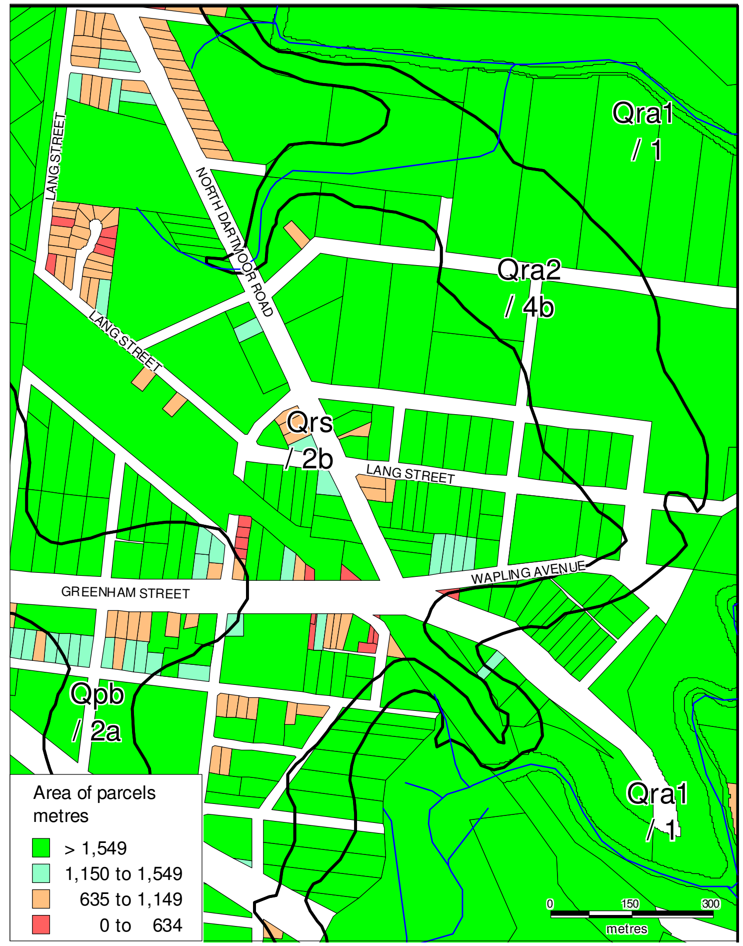


Map 2: Planning zones in the area are the Township Zone (TZ), Farming Zone (FZ), Public Use Zone (PUZ) and Public Park and Recreation Zone (PPRZ). Properties have black outlines and the parcels within them grey outlines.



Map 11: Legend classes are sensitive to soil category area requirements for a 3 bedroom home.

Soil and technology	**In map 11 and map 12, closer scrutiny is required on blocks shaded:**
1: Trench (existing)	Pink, orange, light green
2a: Trench (existing)	Pink, orange, light green
2b: Trench (existing)	Pink, orange, light green
4b: Trench (existing)	Pink, orange, light green, dark green
2b:Trench (new)	Pink, orange, light green



Map 12: Legend classes are sensitive to soil category area requirements for a 3 bedroom home.

Soil and technology	**In map 11 and map 12, closer scrutiny is required on blocks shaded:**
4b:Trench (new)	Pink, orange, light green, dark green
1: Irrigation	Pink
2a: Irrigation	Pink
2b: Irrigation	Pink
4b: Irrigation	Pink