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**Appendix 2 Example of the application of guiding principles at the  
local development scale using the Ambergate Development  
Investigation Area**

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# 1. The Strategy Area

## 1.1 Ambergate Development Investigation Area

The Busselton-Dunsborough Water Resources Management Strategy seeks to apply the principles described in Section 6.3 of the main report to a specific area within the Shire of Busselton (Figure A2\_1). This area has been identified as a Priority 1 Development Investigation Area (DIA).

### 1.1.1 Landform

The Ambergate DIA is located to the south of the Busselton townsite. It is bounded on the north by the Inner Busselton Bypass and on the south by Ambergate Road. On the west it is bounded by Queen Elizabeth Avenue and on the east by Vasse Highway. The area is traversed from north to south by the Vasse Diversion Drain and the Vasse River and east to west by the proposed Busselton Outer Bypass Route and a 66kv overhead power line.

The Ambergate DIA is generally flat (Figure A2\_2) with some constructed drains traversing the site discharging to the Vasse Diversion drain (Figure A2\_1). The land rises from a low point of 4.3 metres AHD in the north western corner to 7.5 m AHD on its south eastern boundary. The land is within the Ludlow soil landscape unit. The area of Ludlow Flats are similar to the Spearwood Sands of the Perth Metropolitan Region comprising flats and very low dunes with deep yellow grain siliceous sands over limestone.

The Ludlow Flats are confined to a small ridge running east-west across the middle of the northern portion of the DIA. The remainder of the northern portion is within the Ludlow Wet Flats Unit and the Ludlow Wet Clayey Flats which are both poorly drained. The southern portion of the DIA rises from 8.0 m AHD to high points of 20.0 m AHD towards the southern boundary.

The low relief of the Ambergate DIA has implications for establishing stormwater management infrastructure. A lack of fall across a development site means that constructed channels, drains and retention structures must be shallow and broad to treat and convey storm flows particularly during peak rainfall and runoff events.

### 1.1.2 Soils

Soils or nutrient management units (NMUs) for the Ambergate DIA (Figure A2\_3) indicate some constraints in terms of their ability to retain applied nutrients or to bind nutrients generated through storm flows.

The NMUs for the DIA include:

*NM Unit 2 = Well drained phosphate retaining soils of the lowlands*

From previous investigations, these soils appear to be a source of NO<sub>x</sub>-N and TN and a sink for TP. Conductivity also produced a significant negative correlation meaning that soils of this nutrient management unit export low levels of dissolved salts compared to other nutrient management units. In some locations these soils are currently used for annual horticulture.

*NM Unit 3 = Bleached sands*

Soils of this unit have very limited ability to retain P compared to other soil types.

*NM Unit 4 = Imperfectly drained flats*

Soils of this unit have moderate ability to retain P compared to other soil types.

*NM Unit 5 = Poorly drained depressions*

These appear to be a sink of NO<sub>x</sub>-N and TN and a source for TP. This is consistent with the current understanding of poorly drained seasonally inundated depressions, which are accumulation and storage areas for P and have active denitrification processes, due to the moist conditions.

### 1.1.3 Environmental management units

The Ambergate DIA (Figure A2\_4) falls within the Vasse Catchment with the majority being within the Vasse Diversion Drain Environment Management Unit (EMU). The remainder is in the Vasse Sabina EMU and the Vasse Wonnerup EMU.

### 1.1.4 Land capability

*Land Capability* refers to the ability of the land to support a particular land use without leading to land degradation. Land capability assessment uses the results of field surveys to describe qualities of the land and when combined with historical information, can establish a classification of areas on the basis of their capability for a range of land uses. From the capability classification, a picture of potential degradation or other adverse impacts arising from inappropriate land management may also emerge.

A land capability assessment for urban residential has **not** been prepared for the DIAs although a capability assessment for on-site residential effluent disposal (Figure A2\_5) has been by way of giving a broad assessment of the likely nutrient retaining capacity of the soils. This applies mainly for septic tank leachate in rural areas. Clearly this assessment will not apply for urban development areas that will be deep sewered.

### 1.1.5 Capability audit

The concept of a 'Land Capability Audit' has been used as a tool to identify potential problem areas (hot spots) requiring improved land management practices. The land capability audit identifies land uses throughout the catchment that are located on soils with a low capability to support the particular land use, based on the land capability methodology commonly used by the Department of Agriculture and Food, Western Australia.

Land uses located on soils with a low capability for the existing land use are areas thought to have the highest probability of experiencing land degradation problems. It should be pointed out that innovative land managers may have developed techniques to avoid and manage land degradation in some situations and this desk top analysis needs to be validated by ground truthing.

The landuse capability audit for the Ambergate DIA (Figure A2\_6) shows the capability rating for existing landuses at these locations. Landuses that were situated

on soils with a very low capability for that particular landuse are shown in red. These are those most likely areas to be experiencing some form of land degradation or excessive loss of nutrients or sediments offsite because of the low capability for the existing land use at that location. Alternatively, landuses situated on soils with a very high capability for that particular landuse (shown in green) were least likely to be experiencing land degradation or pollutant exports.

The landuse capability audit for the Ambergate DIA shows that the existing land uses have fair to very low capability. This has implications for any proposed land use change because it means that any areas to be redeveloped for urban residential may already be experiencing land degradation and probably have existing high levels of sediment and nutrient export. Stormwater management systems will have to accommodate both the areas low capability for on-site treatment of nutrients and a possible pre-existing condition of unacceptable nutrient or sediment loss.

#### 1.1.6 Zoning

The Ambergate DIA is predominantly zoned for agriculture in the Shire of Busselton's current Town Planning Scheme No 20. Part of Ambergate falls within the mid-term urban and rural living development areas identified in the Shire's Urban Growth Strategy (BSC 1999, 2002).

The western part of the Ambergate DIA is predominantly rural and special rural, with the Busselton Waste Water Treatment Plant (WWTP) located on adjoining land immediately to the west. The WWTP buffer extends into the DIA. Land to the north is zoned residential. The Inner Busselton Bypass defines the current southern limit to the urban expansion of Busselton. Land to the east of the Vasse Diversion Drain in the DIA is rural.

## 2. Surface Water Quantity Management

The following guidelines, though generally applicable to other DIA's, have been tailored to the Ambergate area, particularly Ambergate West where pressure for development is highest.

A draft Structure Plan has been previously prepared for the southern portion of the Ambergate DIA. The proposed outline for development includes the urbanisation of a large area of land that will generally result in increased rates and volumes of runoff.

Should this development proceed, a surface water management plan needs to ensure that flow rates and flood levels downstream of the development are not increased, and that flood levels within the Structure Plan area are managed.

Whilst no detailed hydrological and hydraulic modelling has been undertaken at this stage, a number of general stormwater management strategies can be set to guide development.

### 2.1 Stormwater Detention Criteria

#### 2.1.1 Stormwater General Criteria

Post-development water quantity criteria for the Structure Plan area should be both practical and sustainable and be based on industry standard practice and consultation with agencies such as the Water Corporation, Department of Environment (DoE) and the Shire of Busselton.

#### 2.1.2 Stormwater Quantity Criteria

Based on these considerations the following surface water flow and flood level criteria should be set for the Ambergate Structure Plan area:

1. Direct drainage or discharge of stormwater shall not be permitted into any wetland with conservation value (receiving environment), including its designated buffer area. (Conservation value are those wetlands rated as conservation status under the DEC's 'Geomorphic Wetland, Management Categories' dataset).
2. Stormwater runoff within a development area, including its associated road reserves, generated from up to 1 in 1 year, 1 hour Average Recurrence Interval (ARI) rainfall events shall be retained as close to its source as possible, using techniques such as soakwells, porous paving, vegetated swales or shallow depressions.
3. Runoff from greater than 1 in 1 year Average Recurrence Interval (ARI) events shall be mitigated through the use of landscaped retention or detention areas that are integrated within public open space / linear multiple use corridors. Runoff overflows from larger rainfall events are directed via overland flow pathways into regional drainage systems or into wetlands (subject to the pre-development hydrologic regime of the wetland being unaltered).

Flow rates to be attenuated through a series of management practices (see Figure 2 main report). These include the following:

- Lot Level – Soakwells/Infiltration & Rainwater Tanks
- Streetscape – Detention and Infiltration (wider road reserves may be required)
- Multiple Use Corridors – Detention (Pool & Riffle) and Infiltration

At the lot level, flow rates will be attenuated by the common use of soakwells installed at the building stage to infiltrate roof runoff. It is not recommended, nor should the Shire accept the direct connection of lots to the road drainage network.

It is recommended that the use of rainwater tanks be promoted for both potential infrastructure-related and environmental benefits (some local authorities encourage the use of rainwater tanks at the lot level through policy, which can include offering grants upon their installation).

At the streetscape level, dual carriageways will shed runoff to a central median to assist infiltration, provide detention storage and reduce times of concentration. The central median will incorporate a bio-retention system to treat water quality and further enhance infiltration. Investigations should be undertaken into the feasibility of reusing infiltrated surface water for irrigation of landscaped areas.

Multiple use corridors will assist infiltration, detain stormwater and reduce times of concentration. Degraded wetland vegetation can be reshaped and landscaped to incorporate linear constructed ephemeral wetlands. As part of the construction design, riffle - pool profiles can be designed to slow velocities, assist infiltration and detain stormwater.

### 2.1.3 Flood Conveyance – Waterways

Across the majority of the southern portion of the site, fill and/or subsoil drainage will be required to raise development levels above both groundwater levels and 100 year flood levels. During the next phase when detailed hydraulic modelling is undertaken, outlet hydrographs will be required to define storage volumes. This will determine fill or floor levels for development. It may also help in designing the type of storage. Using constructed wetlands is only one option for achieving storage volumes and other methods should be investigated as a matter of priority. These may include temporary storage in various elements of the multiple use corridors such as playing fields etc.

The locations of multiple use corridors need to be selected to maintain the natural flow path and thus be used as a flood management path for significant storm events. Post development flows need to be attenuated to match pre-existing conditions so that the downstream hydraulic regime will not change. Proposed multiple use corridors will include water management function as well as other uses such as recreation.

## **3. 3. Surface Water Quality Management**

### **3.1 Identifying Water Sensitive Urban Design Opportunities**

The hydrology of the Ambergate area is likely to be altered by the proposed development with surface runoff and sub-surface drainage systems' changing the rate at which runoff from the site is conveyed to the Vasse Diversion Drain. The underlying sands typically have low phosphorus retention capacity and nutrients generated from the proposed development can be expected to leach out in a relatively short time. It will be necessary for stormwater management practices to intercept and treat stormwater runoff for suspended solids and nutrient removal near to its source before conveying the stormwater runoff to the Vasse Diversion Drain via multiple use corridors or into groundwater. As a broad principle, it is recommended that urban stormwater (other than roof runoff) should not be discharged into the groundwater without first receiving appropriate treatment, irrespective of the water quality inherent in the groundwater.

In 1998 a detailed flood management study confirmed Busselton has only 20 year ARI flood protection and consequently the level of flood protection is considered inadequate. The increase in the 100 year ARI flow in the Vasse Diversion Drain can be attributed to the availability of more river flow data, a more efficient rural drainage system and some increased land clearing of the upper catchment. The preferred option for increasing the level of flood protection for Busselton is a combination of retaining floodwaters in the upper catchment and minor upgrading of the Vasse River Diversion.

The first detention basin at the Vasse Research Station has been completed. The Water Corporation is responsible for the overall management of the construction of additional detention basins and for the Vasse River Diversion Drain. Any drainage design proposing discharge into the Vasse River Diversion Drain will need to be cognisant of flood levels in the drain. Sufficient storage of local flood events may be necessary until flood levels subside in the diversion drain.

Groundwater fluctuation in the region can be expected to lead to expression of groundwater to the surface in a complex network of palusplains, damplands and sumplands throughout the site, particularly during the peak winter months when rainfall (and stormwater runoff) is expected to be at its highest. During this period, stormwater runoff from the Ambergate development will be conveyed, together with a significant volume of groundwater, out of the site along the Vasse Diversion Drain.

### **3.2 The Use of Multiple Use Corridors for Stormwater Quality Treatment**

Central to the Water Sensitive Urban Design (WSUD) layout of the proposed development is the local ponding of water over the site. This ponding and associated waterlogging is due to inundation by rising groundwater during the winter months. Low points are logical drainage focal points for the proposed development that can also serve as multiple-use corridors that can be used to incorporate a number of stormwater treatment measures. These may include linear ephemeral wetlands or other storage and detention structures.

Due to the constraints of the Ambergate area, a design concept involving the use of an ephemeral constructed wetland system for the treatment of stormwater runoff from

urban development is recommended. The constructed wetland treatment scheme involves the construction of vegetated channels along drainage/ponding areas with appropriate soil remediation (use of underlying clays) to promote the establishment of ephemeral wetland plants. The depth of these channels may need to be set such that the minimum groundwater level is within 0.5 m to 0.7 m below the invert of the channels thus ensuring that the vegetation is sustained throughout the year.

For this area, the use of ephemeral wetland systems is considered to be most suitable for multiple use corridors and public open spaces in the site owing to its highly seasonal inflow and the potential to overcome many of the concerns currently held by the Department of Water on the operation of constructed wetlands in Western Australia. The ephemeral wetland form will allow the surface area of the wetland that will be engaged by stormwater to vary according to the seasons to ensure that sufficient detention storage is provided during periods of high stormwater inflow without the associated problems of a large waterbody that cannot be sustained during the drier months.

Detailed site investigations may reveal that other types of storage and detention structures are possible for the Ambergate DIA. In addition to the adoption of ephemeral constructed wetlands discussed above, other stormwater management measures should be adopted whenever possible for the Ambergate DIA.

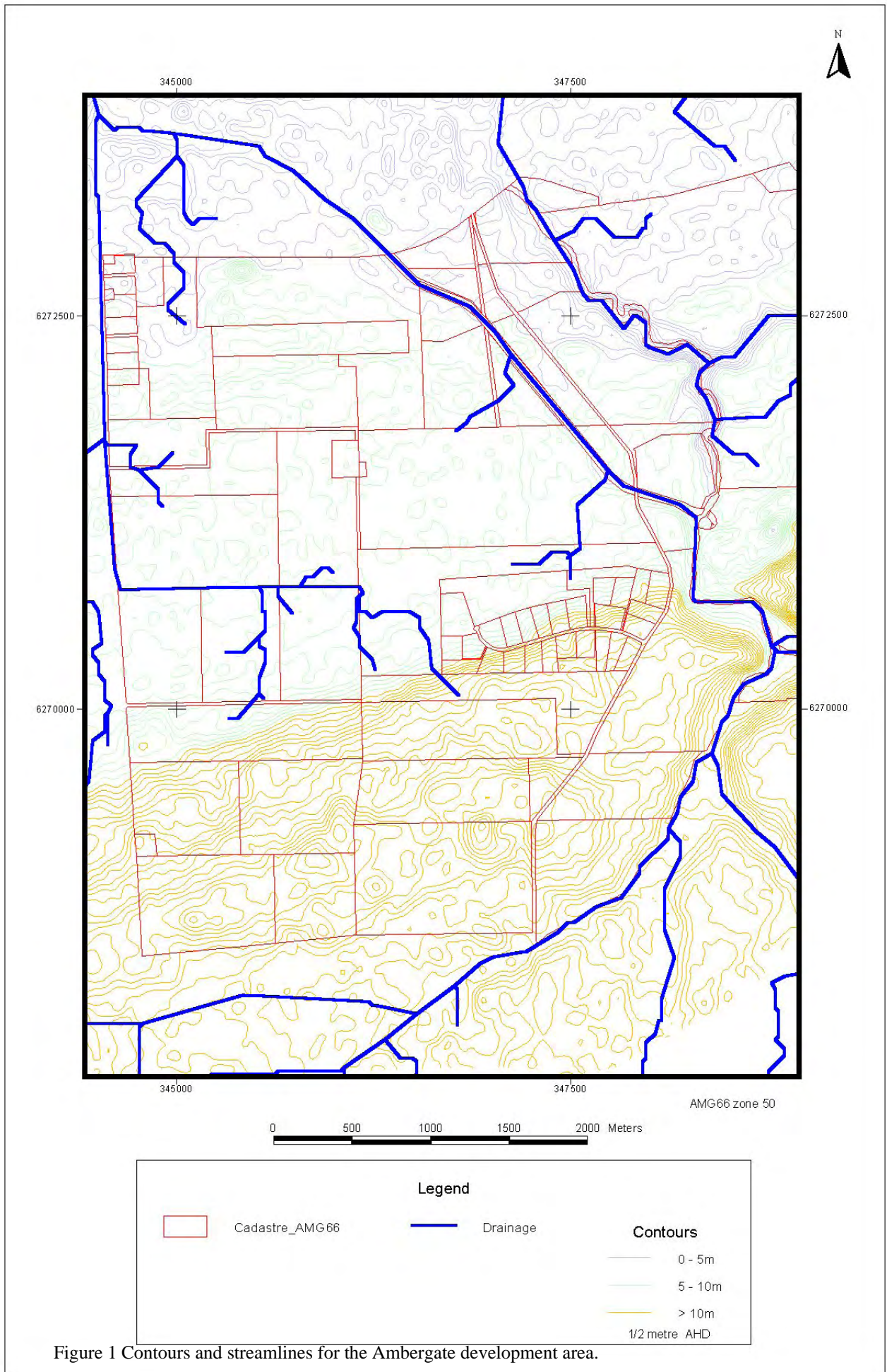


Figure 1 Contours and streamlines for the Ambergate development area.

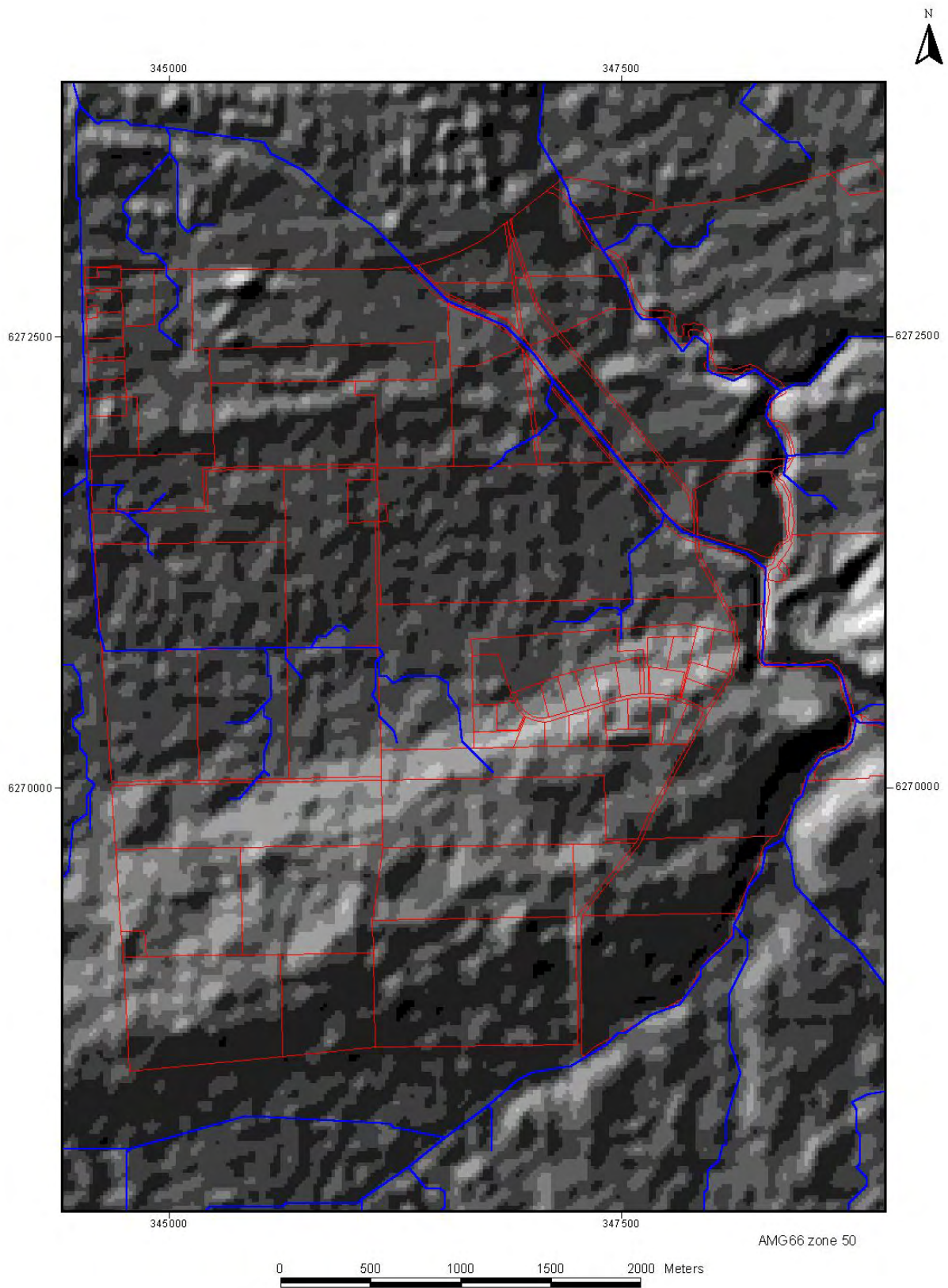


Figure 2 Relief shown as a hillshade for the Ambergate development area.

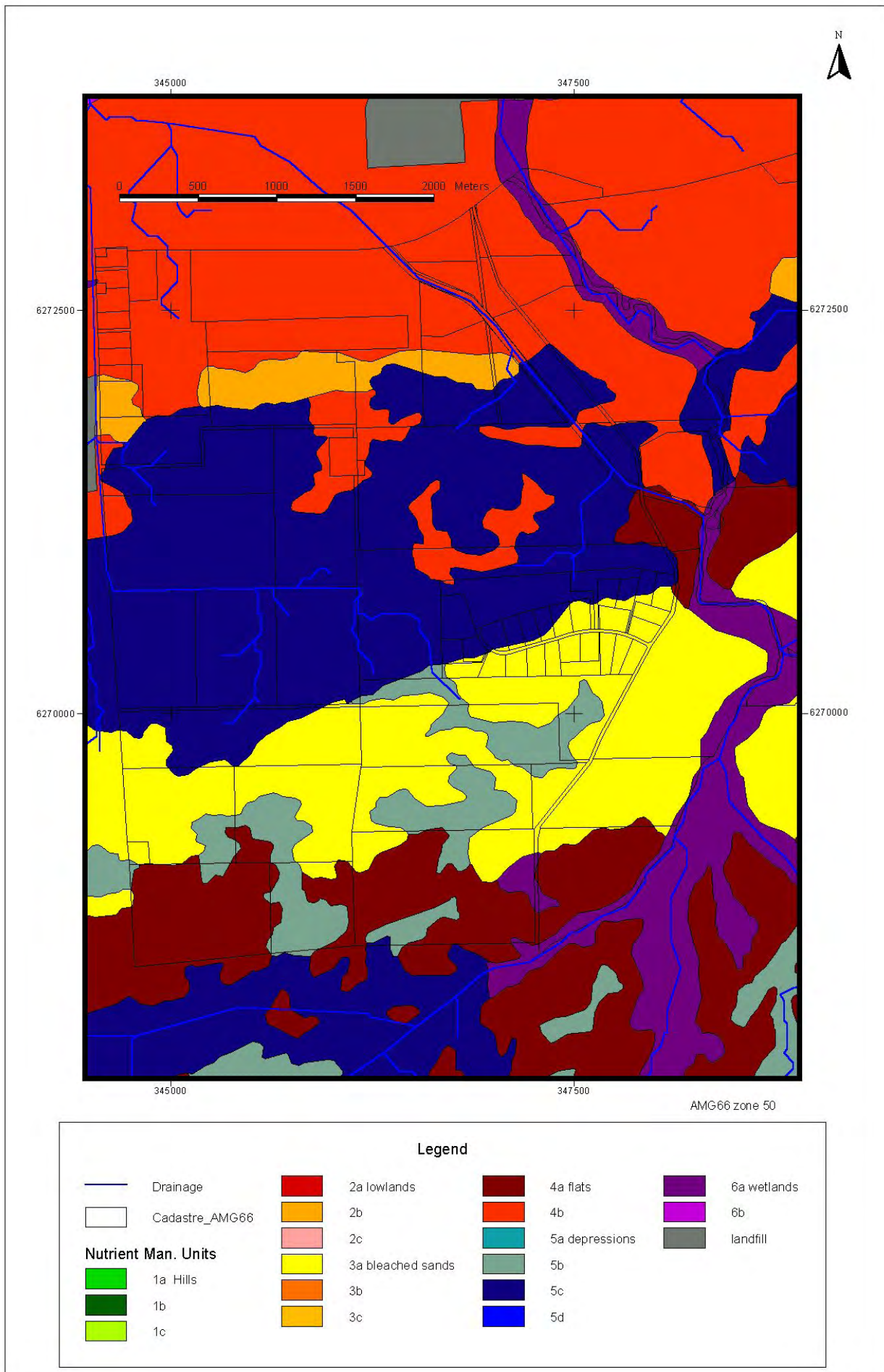


Figure 3 Nutrient management units for the Ambergate development area.

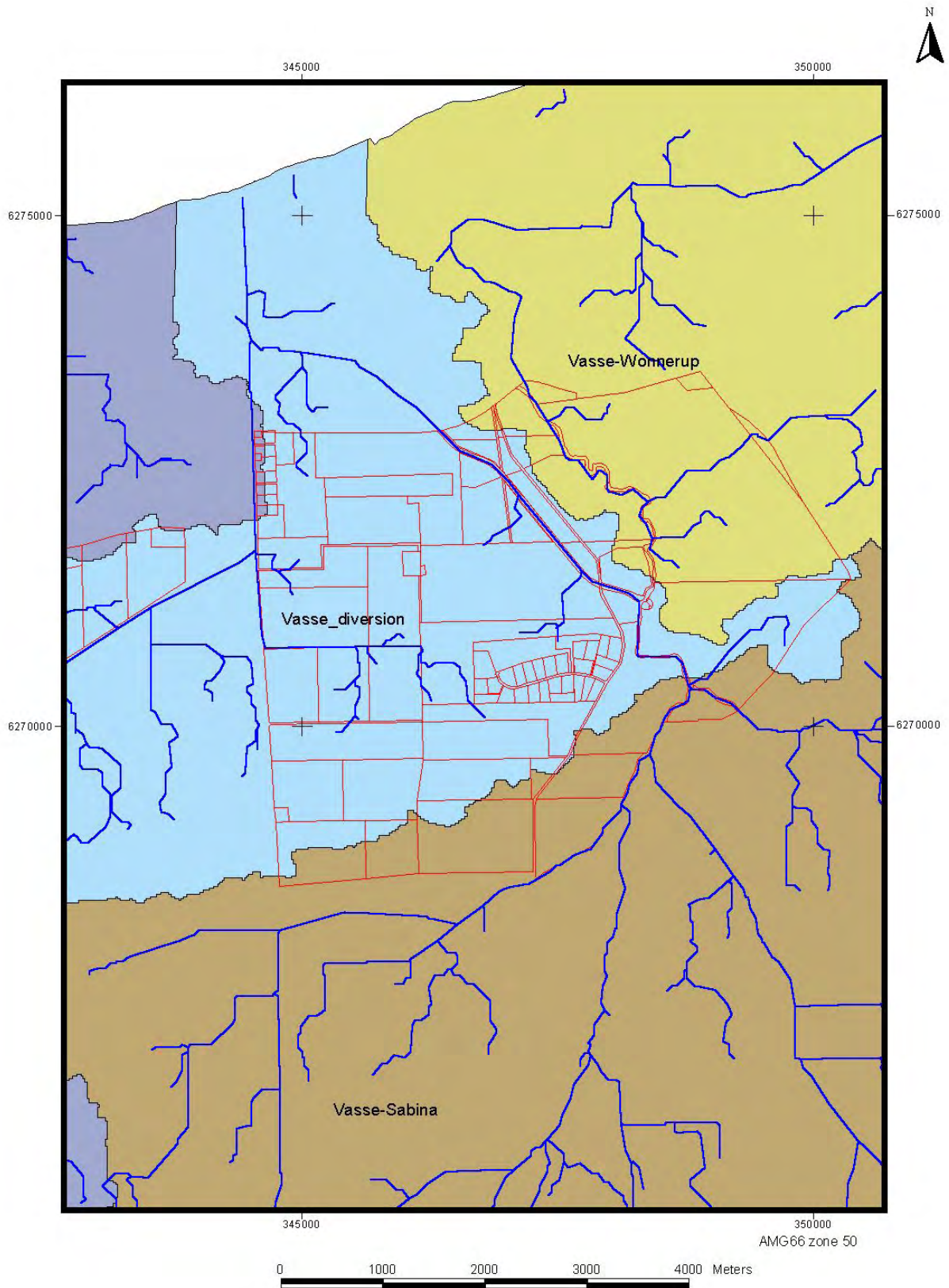


Figure 4 Environmental management units for the Ambergate development area.

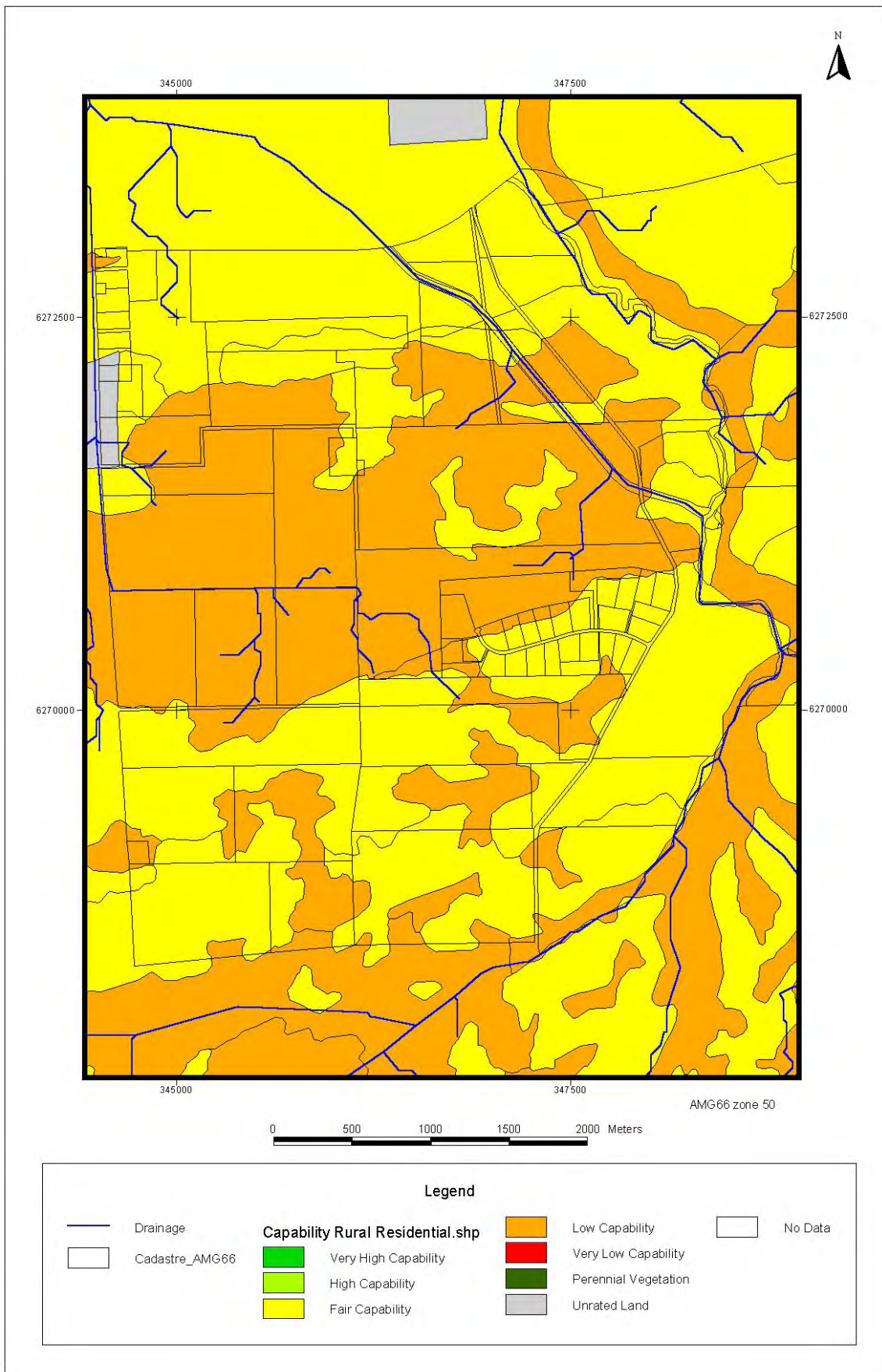


Figure 5 Land capability for residential effluent disposal for the Ambergate development area.

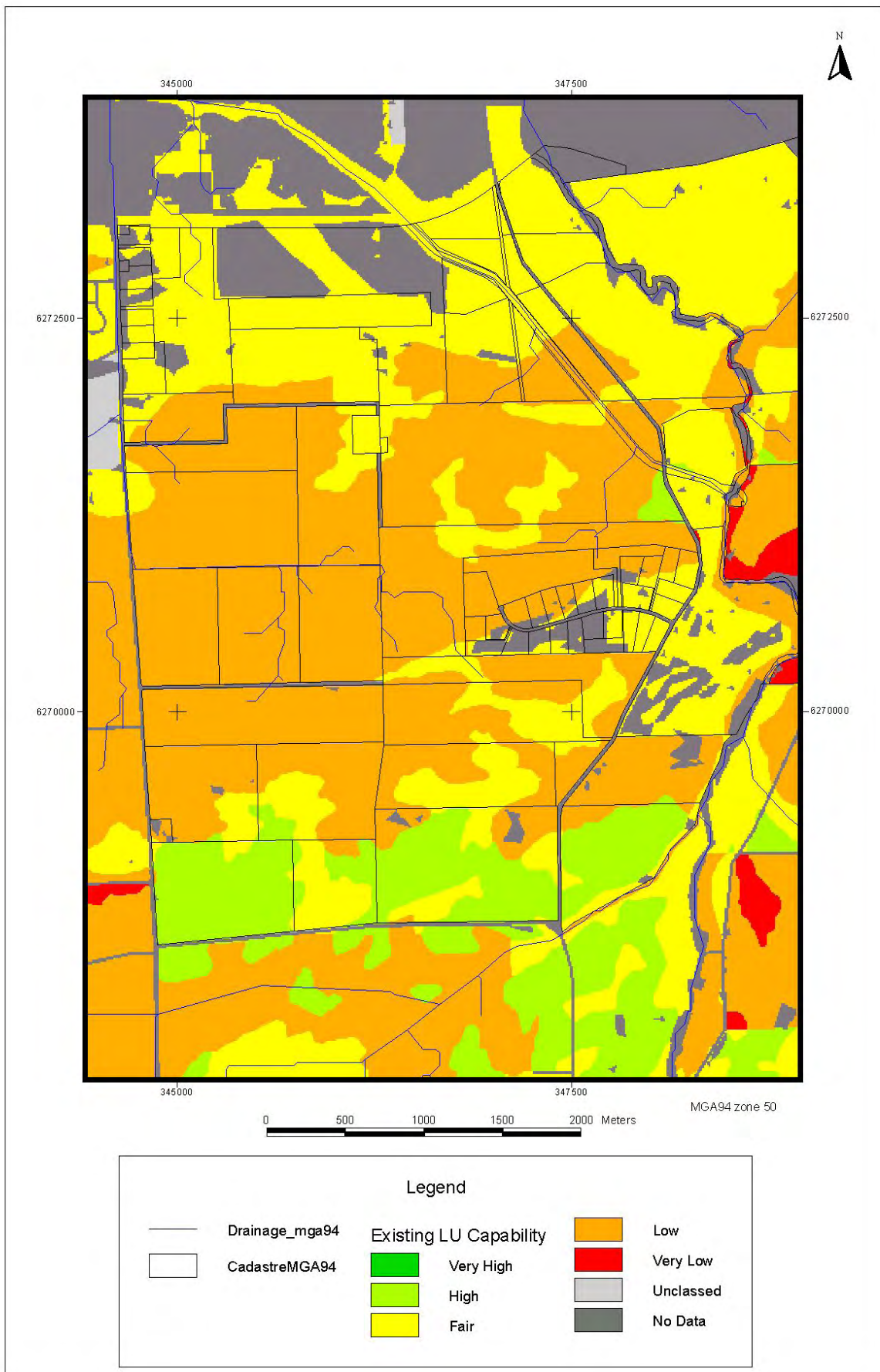


Figure 6  
area.

Land capability for existing land use for the Ambergate development