Table 5-2 Previously recorded sites within the searched area surrounding the Project Area

Site Type	Number	% Frequency
Open Camp Site	29	49.2
Modified Tree	9	15.2
Aboriginal Ceremonial and Dreaming	7	11.8
Rock Shelter with Art	3	5.1
Aboriginal Resource Gathering Site	3	5.1
Burial Ground	3	5.1
Rock Shelter/Caves	1	1.7
Rock Shelter with Deposit	1	1.7
Stone Arrangement	1	1.7
Quarry and open site	1	1.7
Ochre Quarry	1	1.7
Total	**59**	**100**

Methodology: Predictive Model

A predictive model is based on the predominant patterns of Aboriginal site distribution that have their roots in theoretical archaeological models and on the more localised results of the regional and local contexts of the Project Area (**Appendix E**).

In discussing the Project Area, the proposed transmission line would traverse a variety of landform types from the well watered undulating hinterland of Lismore to the steep slopes of the foothills of the Great Dividing Ranges to the plateaux landforms around Tenterfield and finally the steep terrain of the tablelands adjacent to the riverine corridors of the Dumaresq / Macintyre river system of Tenterfield Creek. The variability in landforms means that a variety of predictive models need to be applied that acknowledge differences in site patterning based on available landforms.

Proximity to a permanent water supply is the primary factor appearing to determine the location of Aboriginal Campsites. In rises along either side of the Great Dividing Range, ridgelines are suggested to provide access tracks through the rugged hinterland and from the escarpment country down to the west of the mountains where flats and saddle were favoured as site locations.

Results: Predicting Aboriginal Site Location

Using the concept of stream ordering, some general predictions can be made regarding the nature of sites and their location in the Project Area. The predictive model saw occupation sites as likely to occur within several hundred metres of water, either on the low hill slopes/toe slopes, on terraces of watercourse or on low spurs leading down to water, with the highest concentrations occurring near the confluences of two or more waterways. Ceremonial sites such as bora grounds appear most likely to occur on ridge tops and hills while modified trees will be restricted to areas where land clearing has not been wholesale, but there does appear to be a correlation with occupation sites and waterways where patterning has not been completely destroyed. Other site types such as rock shelters, grinding grooves, quarries and to a lesser extent burial sites, will occur where appropriate geology and geomorphology settings allow.

Modelling aids in predicting where a site may be located, but various site types are likely to occur within all components to a greater or lesser extent and aerial photography can only offer broad landform assessment.

Information with regard to key areas for avoidance is presented in **Appendix E.** A summary is provided below.

C1: This component lies close to and south of the Bruxner Highway for the majority of its length and is constricted to the south by steep terrain and to the north by the Dumaresq River. Overall high levels of agriculture have disturbed the foothills of the ranges to the south and the extent of the arable land between this margin and the Dumaresq River, decreasing the potential for intact sub-surface sites and clearing has reduced the potential for scarred trees.

C2: This component is transacted by the Mole River. Its northern boundary is in close proximity to several bends in the Mole River, as well as traversing an area known as Boggy Camp Flat. The semi-cleared, undulating agricultural land of the northern portion of C2 has high potential for occupation sites although these have a moderate likelihood of being disturbed. Some scarred trees may be present and artefact sites are likely within c. 300m of the Mole River.

C3: This component crosses the Mole River and associated agricultural lands, before crossing less cleared hills before reaching land adjacent to Tenterfield Creek in the east. The cleared, flat agricultural land has overall higher potential for occupation sites (not likely to be intact) and the possibility for scarred trees. On the mountainous areas, a range of Aboriginal sites have the potential to occur, although steep slopes have lower archaeological sensitivity.

C4 and C5: These components track closely to the south of Tenterfield Creek. There is a comparatively high level of clearing, especially over the northern portions of C4. Tenterfield Creek is a more permanent water source and may have more complex sites, although few will be undisturbed due to agricultural practices and flooding, although it may be possible to encounter scarred trees.

C6: This component crosses Sunnyside Creek, Blacksmith Creek, Saltwater Gully, Pitkins Swamp Creek, Cataract River and Barneys Down Creek east of Tenterfield. Numerous other creeks and ephemeral drainage lines also exist in close proximity to C6. Smaller landholdings within the proximity of Tenterfield will most likely result in higher/more intensive levels of disturbance. C6 does not follow watercourses but is transacted by them. This may make potential watercourses, if present, easier to span.

C8: This component extends in an east-west direction north of and parallel to Tenterfield Creek and crosses many major tributaries such as Washpool Creek and Gosling Swamp Creek, bounded to the north by foothills of Girraween State Forest, Bald Rock National Park and Boonoo Boonoo State Forest. Forested slopes along the northern boundary of C8 have a low potential for occupation sites, however elevated terraces and low spur tops that overlook water along the southern extent of C8 are archeologically sensitive and more likely to contain intact Aboriginal sites due to the lower levels of disturbance. Cleared small creek lines (Macnamara Swamp Creek, Tarban Creek and Gosling Swamp Creek etc.) have potential for sites, although most are likely to be disturbed through agricultural practices. Tenterfield Creek is a more permanent water source and may have larger more complex sites, although few will be undisturbed or in situ as a result of agricultural practises and flooding events.

C9: This component is the existing 132kV 45m wide easement from where it meets up with C8 and is generally cleared. This component is long and traverses a wide variety of landforms. In agricultural areas where cropping and grazing has taken place (between Lismore and Casino) within the Richmond River floodplain, archaeological evidence may be sparse. Cleared small creek lines have potential for sites, most are likely to be disturbed through agricultural practices e.g. Shannon Brook and Mummulgum Creek between Lismore and Casino. Areas where this component transects rugged hilly country in several National Parks, a variety of site types may be present and undisturbed including Bora / ceremonial sites. Areas of relatively flat elevated land with sparse if any remnant vegetation may have a variety site types however scarred trees are unlikely. Areas of rugged and densely vegetated terrain over TungleBung Creek and Teatee Creek have a higher potential for scarred trees, however wooded slopes in general have a low potential for occupation sites. Many other ephemeral creeks transect this corridor component, which have moderate potential for small sites, especially on associated elevated flat areas / low spurs. There is a greater likelihood of sites where remnant vegetation exists along the riparian corridor and rock shelters in area of stone outcropping (Tabulum). More permanent water source and may have larger more complex sites, although few will be undisturbed. Some outcropping stone (volcanics) occur in this area and may have provided raw material resources for stone tool manufacture.

5.3.2 Non-Indigenous Heritage

Previous Studies: Site Context and Register Searches

European Heritage searches were undertaken on the NSW Heritage Office State Heritage Register and State Heritage Inventory; the National Trust of Australia (NSW) Register; the Australian Heritage Database and the Inverell, Tenterfield, Kyogle, Richmond Valley and Lismore Local Government LEP's.

Obtaining GPS co-ordinates for these historic sites is challenging as detailed location information is rarely presented with listings. The majority of items listed, however, are located within townships. As larger more important items of heritage that have helped shape rural towns are often well known, it is usually only smaller, unregistered historic sites that may be encountered during future survey. These will be able to be managed within the context of the project I mpacts and are not predictable such that a model can be developed for their potential location.

Historical review of the Study Area shows it has a rich agricultural and mining history, with major transport infrastructure, the Main Northern Railway being constructed to Wallangarra north of Tenterfield, as well as various historic road alignments and road bridges.

Results: Potential for European Heritage

There is potential for the following types of historic heritage:

- historic buildings (domestic and agricultural), pieces of farm equipment (moveable heritage), remnants of flour milling industry around Tenterfield, fences and stock corralling structures etc. that may relate to the early pastoral phase of settlement;
- mining remnant that may relate to early mineral extraction activities such as the Arsenic Mine on Mole River south of the proposed transmission line corridor; gold mines, etc.; and
- evidence related to the establishment of the Main Northern Railway.

A number of European Heritage items have also been identified as part of the community consultation process.

5.3.3 Further Study

Further and more detailed assessment (including field inspections) will be carried out prior to the completion of the Indigenous and Non-Indigenous Heritage Impact Assessment to be undertaken as part of the Environmental Assessment.

5.4 Visual

A visual constraints analysis (**Appendix F)** has been undertaken by GreenBean Design to describe and determine the nature of key landscape characteristics within the Study Area, including landform, landcover/landuse and the distribution of settlements and individual residential dwellings. The constraints analysis also considered the visual receptor category likely to occur within the Study Area. Recommendations are also provided in **Section 6.2** to assist TransGrid in determining an alignment for the proposed transmission line.

5.4.1 Previous Studies

The Dumaresq to Tenterfield 330kV Transmission Route Feasibility Study prepared by Connell Wagner in July 2006 highlighted the potential for visual impacts to occur along sections of road corridors and at residential dwellings located within the study area.

Whilst noting the strategy to use publicly owned corridors where practical, the Feasibility Study noted a preference to avoid major roads, but in some instances preferring to create visual impacts along short sections of road corridors in order to avoid locating the transmission line through steep or vegetated land.

5.4.2 Methodology

A desk top study was undertaken by reference to 1:25,000 topographic maps as well as aerial photographs together with general information relating to the study area provided by URS. A field inspection was undertaken in July 2009, with the general extent of landscape characteristics observed and recorded from public roads only. Each component has been assessed in relation to the distribution and pattern of key elements that occur consistently within them.

An evaluation of the key elements identified within each component, both singularly and as a combination gives rise to the landscape's overall robustness and the extent to which it could visually accommodate the transmission line.

The key elements include:

- landform;
- land cover; and
- settlement patterns and human influence.

5.4.3 Results: Key Constraints

Although a large extent of the alignment may be screened (principally sections between Lismore and Tenterfield), there is likely to be a range of visual receptor categories that may have views toward the

proposed transmission line, including rural residential dwellings and motorists.

The degree of visibility and resultant visual impact will vary between, and within, the receptor categories and be largely influenced by the key physical landscape elements, including landform, land cover and the distribution of settlements within the landscape.

Information regarding key constraints within each component is presented in **Appendix F.** A summary is provided below.

C1: Receptor categories within this component include rural residential, motorists and rural employment. There is likely to be some degree of visibility toward the proposed transmission line from residential dwellings and local roads where views extend across flatter and open farmland or where the transmission line crosses spurs and drainage lines, including the Beardy River. The degree of visibility will be largely dependent on the selection of a final alignment and the extent or screening potential of surrounding topography and vegetation.

C2: There is likely to be some degree of visibility toward the proposed transmission line from a small number residential dwellings and local roads including the Bruxner Highway. Visibility may also be higher where the transmission line crosses drainage lines and the Mole River. Subject to final alignment, the transmission line may pass through timbered areas covering sloping land rising to low ridgelines (between C2 and C4).

C3: The degree of landscape and visual constraint is generally limited by the small number of receptors within this component, although views toward the transmission line from sections of the Bruxner Highway are likely.

C4: There is likely to be some degree of visibility toward the proposed transmission line from a small number of rural residential dwellings as well as sections of the Bruxner Highway. The degree of visibility will be largely dependent on the selection of a final alignment and the extent or screening potential of surrounding topography and vegetation.

C5: There is likely to be some degree of visibility toward the proposed transmission line from a small number of residential dwellings and sections of the Bruxner Highway along the northern edge of the study area.

C6: This component has a relatively high density of rural residential dwellings located within the Study Area from which the transmission line would be visible. The transmission line would also cross a number of local road corridors including the New England Highway.

C8: There is likely to be some degree of visibility toward the proposed transmission line from a small number of rural residential dwellings as well as sections of the Bruxner Highway. The degree of visibility will be largely dependent on the selection of a final alignment and the extent or screening potential of surrounding topography and vegetation.

C9: The existing 132kV transmission line between the Lismore and Tenterfield Substations is located within this Component. As the proposed 330kV transmission line would replace and follow the alignment of the existing transmission line, the residual impact is lower than Components C1-C8. However, it is acknowledged that the design and scale of structures associated with the 330kV transmission line will result in greater visibility of the transmission line.

Further and more detailed field inspections will be carried out prior to the completion of the Landscape

and Visual Impact Assessment to be undertaken as part of the Environmental Assessment.

5.5 Land Use

Land use (including zoning, current and proposed developments/subdivisions, location of residents, grazing and cropping land and forested areas) is a key constraint for the development of a transmission line easement. Townships in the vicinity of the Study Area include Lismore, Casino, Tabulam, Drake, Tenterfield and Bonshaw.

Following field assessments and initial consultation with the community and local council, it was identified that there were a number of subdivision and residential dwelling development applications that had been submitted, had been approved, or were being considered within and in proximity to the Study Area and in particular within the Tenterfield Local Government Area. Recent subdivision and residential dwelling applications lodged with Tenterfield Council were obtained as part of the study. This information is discussed in **Section 5.5.1**.

Lot size within the Study Area has been investigated. **Figure 5-5a** and **5-5b** characterise the lots within the Study Area according to size. This information is discussed in **Section 5.5.1**.

5.5.1 Key Constraints

Key land use constraints identified within each component are discussed below.

C1: This component primarily contains rural properties with lot size between 250 and 3000 ha. Towards the centre of C1 there is a cluster of smaller lots (none less than 10ha). Landuse in this component includes grazing land and improved pastures, with vegetated ridges bordering the southern boundary of the component.

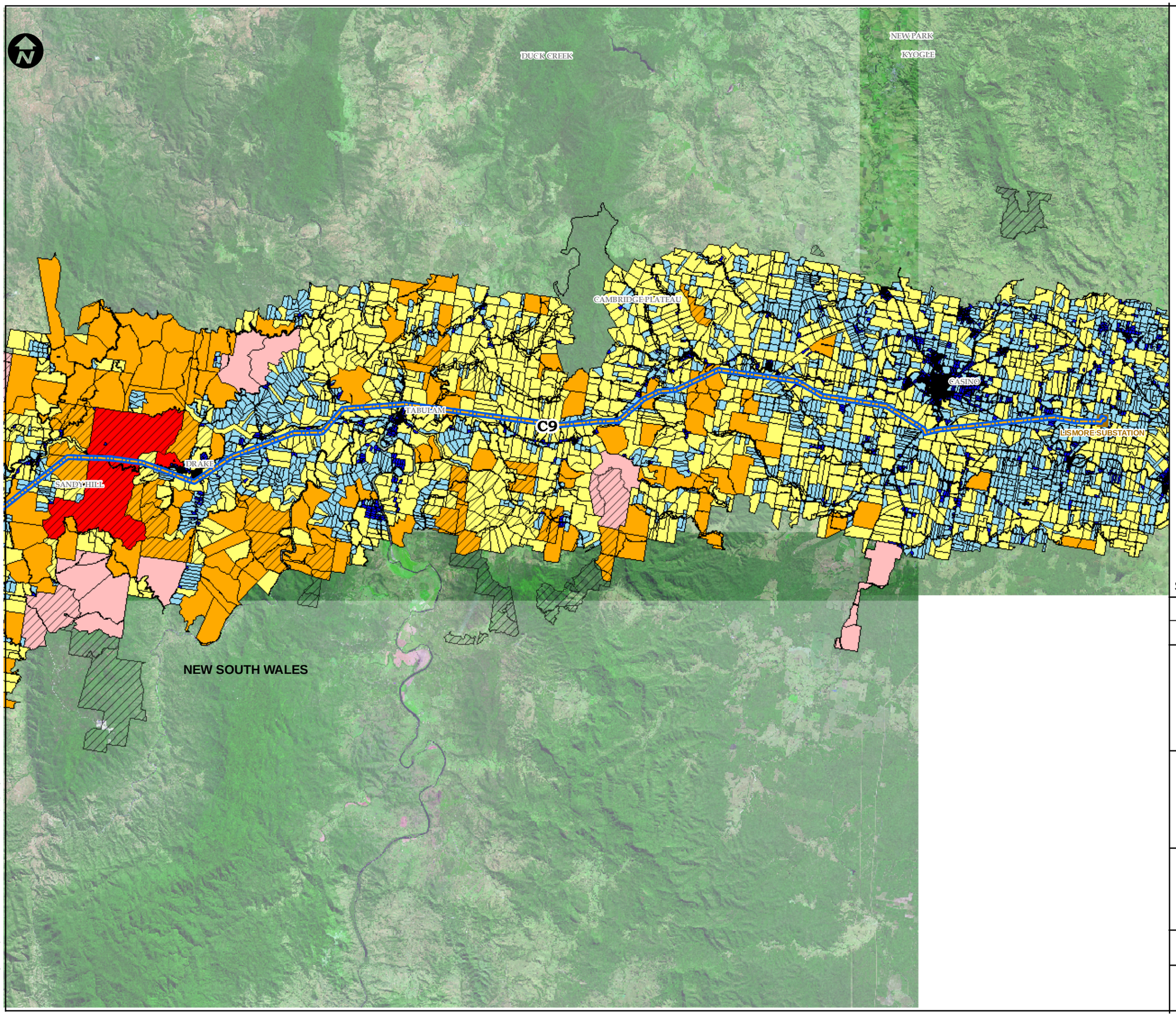
C2: This component contains both large lot sizes (250-3000ha) in the western section and smaller lots (10-250ha) where the component borders the Mole River. It has been identified that a number of subdivisions have occurred recently within C2, adjacent to the Mole River, where lot sizes are much smaller. Land use in this area predominantly comprises grazing land, with some improved pastures and a small rural residential area. The eastern end of this component is densely vegetated.

C3: This component mostly contains very large lot sizes (up to 3000ha), with some smaller lots concentrated around the Mole River. Land use in this area comprises mostly grazing land, with some improved pastures and patches of dense vegetation.

C4: This component contains large lot sizes at its western and southern boundaries, with a small concentration of lots between 10 and 250ha at its centre and northern boundary. Land use in this area comprises mostly grazing land, with some improved pastures and patches of dense vegetation.

C5: This component contains a high density of lots between 10 and 50ha. Land use includes grazing land, improve pastures and a small concentration of rural residential properties along the Bruxner Highway.

C6: This component contains a high concentration of smaller lots (up to 50ha), especially on the northern side of the Tenterfield township. It has been identified that there are a number of subdivisions that have occurred, been approved, have been applied for, or are being considered by owners within this component. Land use is primarily rural residential, with some larger lots towards the western end of the component.



Legend

- Study Area
- Existing Transmission Lines
- Existing Substation
- Crown Land (Conservation and Forestry)

Lot Size

- 0 to 10 ha
- 10 to 50 ha
- 50 to 250 ha
- 250 to 1000 ha
- 1000 to 3000 ha
- > 3000 ha

0 4 8 16

Kilometres

Source: TransGrid

Drawn: AJW	Approved: CB	Date: 23/09/2009
Job No.: 43177662	File No.: 43177662.036.mxd	

Client

TransGrid

Project

DUMARESQ SUBSTATION TO LISMORE SUBSTATION 330 kV TRANSMISSION LINE AND ASSOCIATED SUBSTATION WORKS

Title

STUDY AREA (EAST)
LOT SIZE

Figure: 5-5a

URS

QUEENSLAND

QUEENSLAND

NEW SOUTH WALES

C1

C2

C3

C4

C5

C6

C8

C9

TENTERFIELD

TENTERFIELD SUBSTATION

THE SCRUB

DUMARESQ SUBSTATION

Legend

- Study Area
- Existing Transmission Lines
- Existing Substation
- Crown Land (Conservation and Forestry)

Lot Size

- 0 to 10 ha
- 10 to 50 ha
- 50 to 250 ha
- 250 to 1000 ha
- 1000 to 3000 ha
- > 3000 ha

Note: Component C7 not shown.
(refer to Section 3)

0 3.5 7 14

Kilometres

Source:TransGrid

Drawn: AJW	Approved: CB	Date: 23/09/2009
Job No.: 43177662	File No.: 43177662.036.mxd	

Client

TransGrid

Project

DUMARESQ SUBSTATION TO LISMORE SUBSTATION 330 kV TRANSMISSION LINE AND ASSOCIATED SUBSTATION WORKS

Title

STUDY AREA (WEST)
LOT SIZE

Figure: 5-5b

URS

C8: This component primarily contains lot sizes typically between 10 and 250ha. A concentration of smaller lot sizes occurs at the western and central sections of the component. A small number of development applications (both subdivision and new dwellings) have also been identified in this component. Land use primarily comprises grazing land and improved pastures, with some smaller rural residential properties. Tenterfield Airfield is within the vicinity of this component. A number of smaller agricultural airstrips have been identified adjacent to and within the component.

C9: There is a concentration of smaller lots (between 0 and 50ha) around Casino. Lots typically increase in size towards the central part of this component, and then decrease again towards Tenterfield. There are a few portions within the central part of this component (such as around Drake and Tabulum) where lot density increases.

5.6 Surface Water and Groundwater

The Study Area is located within the Richmond River catchment and the Clarence River catchment, within the larger Northern Rivers catchment area and Border Rivers-Gwydir catchment. There are a number of river systems in proximity to the Study Area. These include the Richmond River and Wilsons River in the vicinity of Lismore and Casino, the Clarence River in the vicinity of Tabulam and the Dumaresq River in the western portion of the Study Area. The major rivers and watercourses within the Study Area are shown in **Figure 5-6a and 5-6b**.

As part of the Environmental Assessment, field and desk based studies will be undertaken to describe the existing hydrological and hydraulic environment. Assessment will be undertaken to determine and mitigate potential surface water impacts arising from the project.

5.7 Geology, Soils and Topography

A desktop assessment was carried out to determine areas of sensitivity with relation to soils, geology and topography.

Lismore to Tenterfield

The geology of the easement from Lismore to Casino consists of deep alluvial sediments – alluvium, clay and sand and fine-grained basaltic sediments predominate (Soil Landscapes of the Lismore to Ballina 1:100 000 Sheet).

Between Lismore and Tenterfield the easement lies within the North Coast bioregion and the New England Tableland Bioregion and it is part of the New England Fold Belt. Small bodies of granite have intruded the sedimentary rocks and there are three centres of tertiary basalt eruption (DECC 2008).

Soils within the North Coast Bioregion are typically red, friable loams or clay loams with high fertility, good structure and excellent water-holding capacity, on the basalts. Whereas shallow yellow earths are found on hillcrests, yellow and brown texture contrast profiles are found on the slopes, and organic loams or sandy loams are found on the alluvial plains, on granites and most of the quartz rich sedimentary rocks (DECC 2008).

Within the North Coast Bioregion, from the coastal lowlands in the east, the study area ranges from floodplains through to low foothills and ranges to the steep slopes and gorges of the Great Escarpment in the west (NSW National Parks and Wildlife Service 2003).

Tenterfield to Dumaresq Substation

The study area from Tenterfield to Dumaresq lies predominantly within the New England Tableland bioregion and is part of the New England Fold Belt. The geology of this region is described as consisting of several intrusions of granites each of slightly different composition. The soil type consists of siliceous sands amongst granite rock outcrops. Widespread mellow texture contrast soils of relatively low fertility and poor structure, prone to erosion (DECC 2008).

Soil in basalt areas consists of shallow stony loams on the steep areas, and red brown to black, fertile, well-structured loams are found on the flatter slopes. In the valley floors soils are sometimes waterlogged. Siliceous sands and red earths occur on tertiary sands and gravels (DECC 2008).

West of the North Coast Bioregion, the study area traverses the New England Bioregion. Topography within this area is generally described as a "stepped plateau of hills and plains" with elevations ranging from 600 to 1,500 m above sea level (NSW National Parks and Wildlife Service 2003).

An assessment of potential impact to soils, including the identification of erosion hazards, will be undertaken as part of the Environmental Assessment for the project.