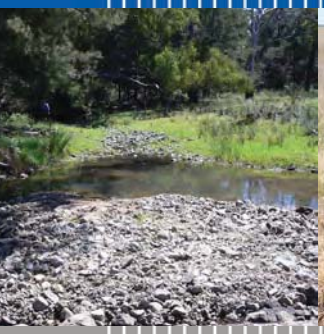
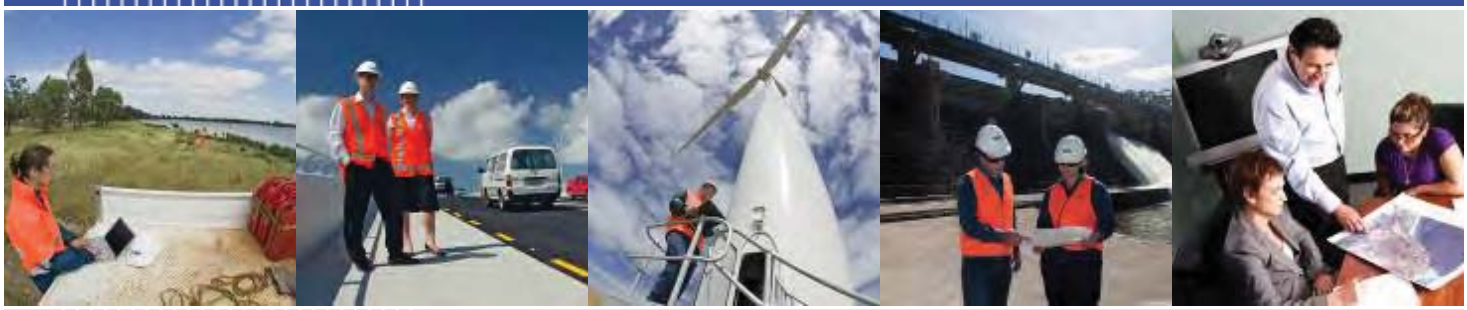




Appendix E
Surface Water and Hydrology



Dumaresq to Lismore 330kV Transmission Line Surface Water and Hydrology Assessment

JUNE 2011

Prepared for
TransGrid

43177662

URS

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Abbreviations

Abbreviation	Description
AP	Angle Positions
ARC	Assessment of River Condition
ARCB	Assessment of River Condition – Aquatic Biota
ARCE	Assessment of River Condition - Environment
ASM	Acid Sulfate Material
ASR	Acid Sulfate Rock
ASRIS	Australian Soil Resource Information System
ASS	Acid Sulfate Soils
ASSMAC	Acid Sulphate Soil Management Advisory Committee
CEMP	Construction Environmental Management Plan
CMA	Catchment Management Authority
DECCW	NSW Department of Environment Climate Change and Water
DEWHA	Commonwealth Department of Environment, Water, Heritage and the Arts
DLWC	The Former Department of Land and Water Conservation
DNR	The former Department of Natural Resources
DWE	Department of Water and Energy
EA	Environmental Assessment
EMP	Environmental Management Plan
EP&A Act	NSW Environmental Planning and Assessment Act 1979
GDS	Groundwater Data System
km	Kilometre
km^2	Kilometre squared
kV	Kilovolts
LGA	Local Government Area
m	Metre
m^2	Metres squared
MBO	Monosulfides and Monosulfidic Black Ooze
NOW	The NSW Office of Water
NPWS	NSW National Parkes and Wildlife Service
NRCMA	Northern Rivers Catchment Management Authority
NSW	New South Wales
NW Act	NSW Noxious Weeds Act 1993
^oC	Degrees Celsius
PASS	Potential Acid Sulfate Soils
QLD	Queensland
SEPP	State Environmental Planning Policy
URS	URS Pty. Ltd.
WSP	Water Sharing Plan

Executive Summary

The Project traverses the catchment areas of the Border Rivers, Clarence River and Richmond River Basins. The Project spans varied terrain and topography ranging from the coastal lowlands in the east, across floodplains through to low foothills and ranges in the west. This assessment identifies 41 named watercourses and approximately 140 first order intermittent or ephemeral creeks that are intersected by the alignment and the access tracks. The new Tenterfield 330kV Substation would be located close to the borders of the Border Rivers and Clarence River basins.

The scope of the Project includes the following:

- a 205km, 330kV easement incorporating pole and tower structures and comprising:
  - construction of a new 96km 330kV transmission line and 60m easement through greenfield areas from Dumaresq Switching Station to the proposed location of the new Tenterfield 330/132kV Substation (Tenterfield 330kV Substation);
  - construction of a new 109km 330kV transmission line between the Tenterfield 330kV Substation and the Lismore Substation through the existing easement. Between the Tenterfield 330kV Substation and Casino (95km), the 330kV transmission line would be located on the route of the former 132kV transmission line. The existing 45m easement would be extended to 60m. Between Casino and Lismore Substation (14km), the new 330kV transmission line would run adjacent to the existing 132kV transmission line (which would remain operational on completion of construction). The existing 45m easement would be extended to 90m for this section.
  - removal of 95km of the existing 132kV transmission line between the proposed Tenterfield 330kV Substation and structure 395 to the south of Casino;
- upgrades to the Lismore Substation and the Dumaresq Switching Station. Upgrades would be within the existing sub/switching station footprints;
- establishment of a new 330/132kV substation approximately 14km north east of Tenterfield to maintain the existing 132kV connection to the Tenterfield 132kV Substation;
- establishment of access tracks both within the easement and outside the easement for the purposes of transmission line construction and operational maintenance; and
- replacing and restringing the existing earthwire between the new Tenterfield 330kV Substation and the existing Tenterfield 132kV Substation with optical ground wire (OPGW).

The principal environmental impacts with regard to surface waters relate to ground disturbance from the crossing of surface water features by plant and equipment which has the potential to cause sediment movement. Other potential impacts include the reduction in streamwater quality as a result of runoff, the spread of invasive weed species along watercourses, and erosion.

The primary activities with the potential to impact on groundwater across the proposed development area are boring or excavation works for the installation of support structures in locations where shallow aquifers exist. This could cause potential changes to hydrological conditions and water quality/contamination.

The Surface Water and Hydrology assessment has considered the expanses between the various work sites along the alignment and the proposed staging of construction works. The potential for works to significantly affect either the rate or volume of water entering natural drainage systems of catchment areas across the development footprint is considered low.

Executive Summary

This assessment has also found that there is limited potential for the Project to cause significant sedimentation of streams and watercourses within and in close proximity to the proposed alignment due to the following factors:

- route selection and Project design has endeavoured to minimise the number of supporting structure locations in close proximity to surface water features;
- watercourse crossings would be designed to minimise disturbance by construction vehicles;
- the number of vehicle movements associated with the Project at any one location would be low and dismantling and construction works would be successively staged; and
- erosion and sediment controls would be implemented at all sites where ground disturbance is required, in particular, those in proximity to surface water features.

The Project would not be expected to cause a significant disruption to the water table in terms of changes to hydrology or groundwater quality. Any potential impacts to hydrology (primarily through dewatering activities) would be expected to be short in duration and would be highly limited in extent due to the discrete nature of supporting structure footing requirements, the significant spacing between each structure, as well as the overall limited depth of the anticipated intrusion. No negative impacts to groundwater quality are anticipated as a result of the Project.

This Surface Water and Hydrology Report has concluded that the proposed works would not alter or impede the natural drainage of the three river catchment areas or affect other surface drainage patterns. Implementation of erosion and sedimentation controls in areas where soil disturbance would be required have been proposed in order to minimise the potential Project impacts on water quality across the Project area.

1

Introduction

1.1 Background

TransGrid is proposing to construct a 205km 330kV transmission line between existing sub / switching stations near Bonshaw and Lismore in far north New South Wales (**Figure 1-1**). The proposed Project is located across two Catchment Management Areas (CMAs); the Border Rivers/Gwydir and Northern Rivers CMAs. It traverses three major river catchments; the Border Rivers, Richmond River and Clarence River.

URS Australia Pty Ltd (URS) has been commissioned by TransGrid to prepare a Surface Water and Hydrology Assessment as part of the Environmental Assessment to accompany the proponent's Project application.

The Project consists of the transmission line, including conductors, earthwires and associated supporting structures, as well as the transmission line easement, establishment of a new substation and upgrade works to other existing infrastructure. The transmission line is required to improve the reliability of electricity supply to the far north coast of NSW.

The Project is shown within the **Figure 2** series presented at the end of this report. For the purposes of the EA and this assessment, the Project is divided into two sections:

- **Alignment West**: this section of the alignment would be approximately 96km long and would traverse eastward from the existing Dumaresq Switching Station just south of Bonshaw to a point on the existing 132kV alignment approximately 14km north east of Tenterfield. Within this area, there is no existing transmission line. To maintain the existing 132kV supply to Tenterfield, a substation (Tenterfield 330kV Substation) would be established at this point. Access to each structure for both construction and maintenance during operation would be required. This area is shown in detail on **Figures 2a – 2p**.

- **Alignment East**: the proposed alignment runs from the location of the proposed Tenterfield 330kV Substation to the Lismore Substation and would be approximately 109km in length. From the Tenterfield 330kV Substation to the south of Casino, the existing 132kV transmission line would be dismantled and replaced with the new 330kV transmission line. The existing easement would be widened from 45m to 60m. To allow the 330kV line to be built parallel to the existing 132kV transmission line, the easement would be 90m wide from south of Casino to Lismore (14km). This would maintain the existing 132kV supply to Country Energy's Casino Substation from TransGrid's 330/132kV Lismore Substation. The majority of access tracks in Alignment East are currently established to provide access to the existing 132kV line. A number of upgrades and/or re-alignment would be required in parts. Alignment East and the associated Project components are shown in detail on **Figures 2p - 2ae**.

Angle Positions (APs) are used for the purposes of this report as location markers and reference points along the alignment. They indicate the locations where the direction of the proposed transmission line changes, and are numerically ordered from west to east. A total of 70 APs have been identified along the 205km alignment (refer to **Figures 2a – ae**).

Where access tracks to and along the alignment have been identified, these are shown as either Category 1, 2 or 3 access tracks, depending upon the degree of construction required or substrate type (i.e. Category 1 access tracks would require minimal excavation across flat paddock areas, Category 2 would require more substantial earthwork, and Category 3 access tracks would require construction to proceed across wet swampy areas). **Section 1.4.2** presents a discussion of these

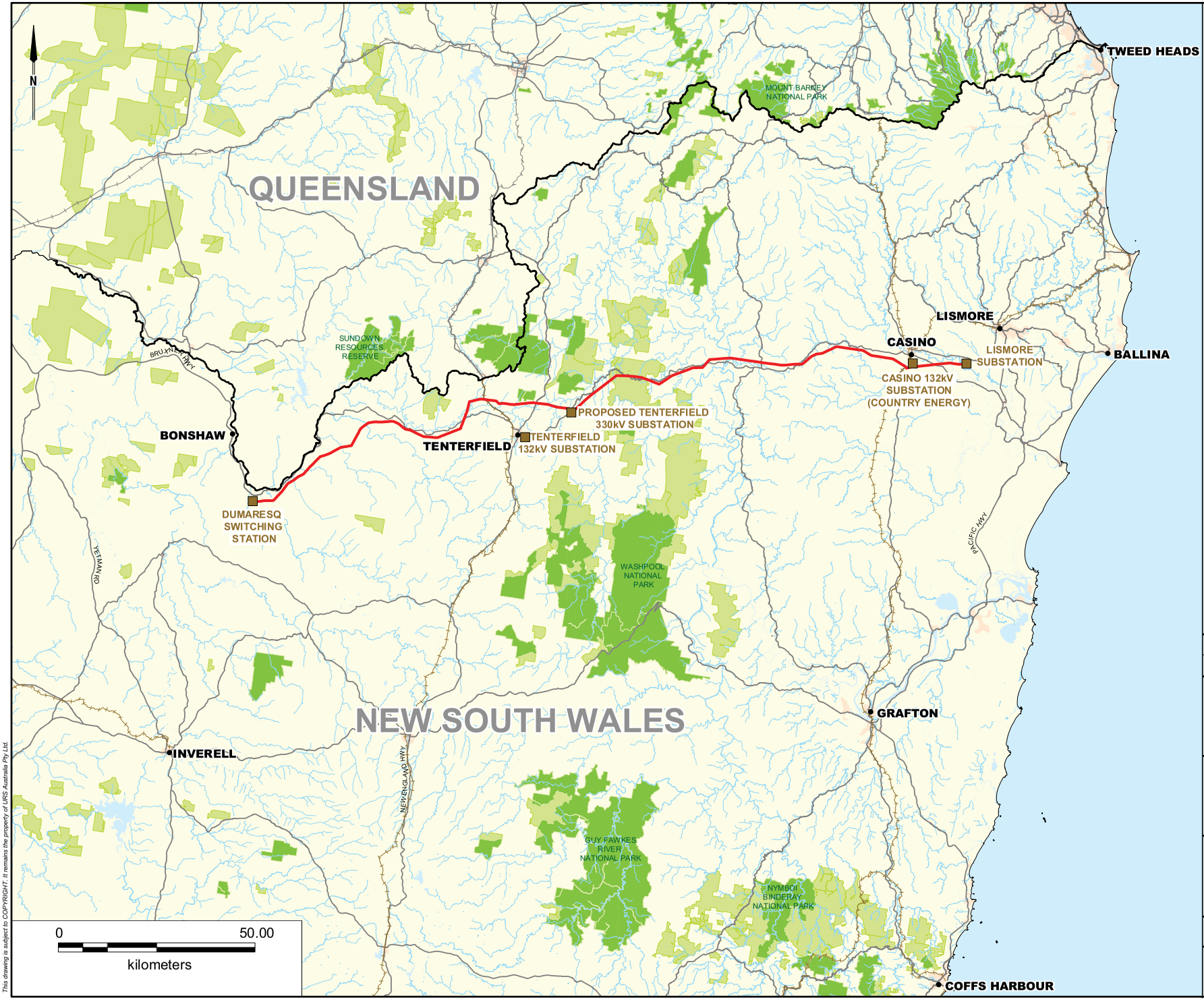
1 Introduction

categories in greater detail. Locations likely to require the installation of new or upgraded creek crossings are also marked across the **Figure 2** series.

This technical report describes the existing environment of the Project and assesses the potential impacts of the Project's construction and operation on surface water and groundwater conditions.

The assessment is based on a review of the following information:

- publicly available CMA information and existing water quality reports from a range of sources;
- the statutory planning framework and appropriate legislative context;
- water quality and quantity information and other natural resources information available from online searches between September 2009 and February 2010 of the NSW Natural Resources Atlas Database (for surface water and groundwater);
- aerial and satellite imagery; and
- assessment of the Project against NSW Water Quality and Water Flow Objectives established by DECCW for relevant catchment areas. These water quality and water flow objectives are the agreed environmental values and long-term goals for the management of surface water within NSW.



Legend

- Proposed 330kV Alignment
- Substation / Switching Station
- Roads
- Railways
- National Parks
- State Forests

Datum: GDA94, Projection: UTM, Grid: MGA Zone 56

Drawn: AO	Approved: WM	Date: 17/11/2010
Job No: **43177662**	File: 43177662.104.wor	

Client

TransGrid

Project

FAR NORTH NSW (DUMARESQ - LISMORE 330kV TRANSMISSION LINE) PROJECT

Title

PROJECT LOCATION

Figure: 1-1

URS

1.2 Report Objectives

The objectives of this report are to:

- describe the surface water catchments, water quality, water quantities and water use in the study area;
- describe the groundwater condition within the study area;
- identify potential impacts of the Project on surface water and groundwater;
- recommend measures to minimise the impact of the Project on surface water and ground water across the study area; and
- address all relevant surface and groundwater related issues in the Director-General's Requirements as outlined by Government Agencies.

Table 1-1 details where each of the relevant Director-General's Requirements have been addressed within this assessment.

Table 1-1 DG Requirements

Government Authority	Paraphrased Requirement	Relevant Report Section
Department of Environment, Climate Change and Water (DECCW) (09/09/2009)	The environmental outcomes for the project should be: • there is no pollution of waters during the construction and operational phases of the development;	Section 4.1.4 Surface Water Quality and Section 4.2.3 Groundwater quality
	• there is no inconsistency with any relevant Statement of Joint Intent established by the Healthy Rivers Commission.	Section 2.5 NSW Water Quality and River Flow Objectives and Assessment Guidance; and Section 4.3 Assessment Against Water Quality and River Flow Objectives
	• the project is acceptable in terms of the achievement or protection of the River Flow Objectives and Water Quality Objectives.	
	• the EA should document the measures that will achieve the above outcomes.	Section 5 Mitigation Measures
NSW Office of Water (NOW) (01/09/2009)	**Riparian Management**	
	• Any works within riparian areas should be consistent with the Department of Water and Energy's Controlled Activity Guidelines (2008) and State policies. The environmental assessment (EA) should outline all works affecting riparian areas including any clearing, creek crossings, roads and tracks etc. The EA should also outline any mitigation and management measures such as erosion and sediment control. The EA should also outline all creeks and rivers affected by the proposal and how each will be managed, in particular major rivers or creeks that require specific management measures.	Section 4.1.2 Watercourse Crossings Section 2.2.1 Watercourse Crossings and Controlled Activities
	Water Issues	
	• The EA should outline all water requirements for the development (i.e. during construction and post construction) and where the water will be sourced, that is groundwater or surface water. All water required for the development must be accounted for and appropriately licenced with the Department. Any monitoring bores associated with the development will need to be licenced. If all proposed sources are identified early, the Department is able to provide accurate advice regarding our requirements.	Section 1.4 Description of Proposed Works and Section 2.3 Water Act 1912- water use requirements and permitting

Government Authority	Paraphrased Requirement	Relevant Report Section
	• Dewatering of tower footings may become an issue in low lying areas particularly towards the coast. If groundwater is likely to be intercepted as a result of the works then a dewatering licence in required, which must be obtained prior to groundwater interception.	Section 4.2.2 Changes to groundwater Hydrology
	• At present, both the *Water Act* 1912 and *Water Management Act 2000* are active with water sharing plans guiding the management of water in some areas. If the proposal is within a gazetted water sharing plan area the assessment is required to demonstrate consistency with the rules of the water sharing plan. The development route *may* also be affected by current embargoes for new water licences, however further information can be provided on this if required.	Section 2.2 Water Management Act 2000
	• The EA will need to include an assessment of the potential effects of the development on groundwater and surface water quality and quantity, surface water hydrology, other groundwater and surface water users, acid sulphate soils and groundwater dependent ecosystems.	Section 4 Impact Assessment
	Acid Sulphate Soils	
	• The EA must identify all areas of acid sulfate soils (**ASS**) and identify mitigation and management options in accordance with the ASSMAC guidelines. DECCW has concerns about the potential effects of ASS on groundwater quality.	Section 3.3 Acid Sulfate Soils. Also Chapter 7 Soils, Geology and Topography (Volume 1 EA).
	Farm Dams	
	• Any dams, ponds or sediment basins to be constructed as part of the proposed development must be consistent with the NSW Farms Dam Policy.	N/A. No dams are required as part of the Project.
	Flooding Issues	
	The EA should address any flooding issues associated with the development and any impacts on landholders.	Section 3.2.4 Flood Prone Areas
	Groundwater	
	The EA should identify groundwater issues and potential degradation to the groundwater source and provide the following: • Details of the predicted highest groundwater table at the development site.	Section 3.4 Groundwater Information
	• Details of any works likely to intercept, connect with or infiltrate the groundwater sources.	Section 4.2 Groundwater – Potential Impacts
	• Details of any proposed groundwater extraction, including purpose, location and construction details of all proposed bores and expected annual extraction volumes.	Section 1.4.4 Project water use requirements
	• Describe the flow directions and rates and the physical and chemical characteristics of the groundwater source.	N/A.
	• Details of the predicted impacts of any final landform on the groundwater regime.	N/A.

1 Introduction

Government Authority	Paraphrased Requirement	Relevant Report Section
	• Details of the existing groundwater users within the area (including the environment) and include details of any potential impacts on these users.	Section 3.4 Groundwater Information
	• Assessment of the quality of the groundwater for the local groundwater catchment.	Section 3.4 Groundwater Information
	• Details of how the proposed development will not potentially diminish the current quality of groundwater, both in the short and long term.	Section 4.2.2 Changes to Groundwater Hydrology and Section 4.2.3 Changes to Groundwater Quality
	• Details on preventing groundwater pollution so that remediation is not required.	Section 5.3 Mitigation Measures Summary
	• Details on protective measures for any groundwater dependent ecosystems (GDEs).	N/A see Section 3.4.1
	• Details of proposed methods of the disposal of waste water and approval from the relevant authority.	Section 4.2 Groundwater Potential Impacts
	• Assessment of the need for an Acid Sulphate Soils Management Plan (prepared in accordance with ASSMAC guidelines).	N/A see Section 3.3 Acid Sulfate Soils.
	• Assessment of the potential for saline intrusion of the groundwater and measures to prevent such intrusion into the groundwater aquifer.	Section 4.2.3 Change to Groundwater Quality
	• Details of the results of any models or predictive tools used.	N/A. Not required for this Project.
	• Where potential impact/s are identified the assessment will need to identify limits to the level of impact and contingency measures that would remediate, reduce or manage potential impacts to the existing groundwater resource and any dependent groundwater environment or water users, including information on: • Details of any proposed monitoring programs, including water levels and quality data.	N/A. No potential impact identified.
	• Reporting procedures for any monitoring programs including mechanism for transfer of information.	N/A. Monitoring programs not required.
	• An assessment of any groundwater source/aquifer that may be sterilised as a consequence of the proposal.	N/A. No groundwater would be sterilised.
	• Identification of any nominal thresholds as to the level of impact beyond which remedial measures or contingency plans would be initiated (this may entail water level triggers or a beneficial use category).	N/A. Monitoring programs not required.
	• Description of the remedial measures or contingency plans proposed.	Section 5 Mitigation Measures
	• Any funding assurances covering the anticipated post development maintenance cost, for example on-going groundwater monitoring for the nominated period.	N/A. Monitoring programs not required.
	Surface Water	
	• The assessment is required to consider the impact of the proposal on the watercourses and associated riparian vegetation within the site and provide the following: • Identify the sources of surface water.	3.2.1 River Catchments

Government Authority	Paraphrased Requirement	Relevant Report Section
	• Details of stream order (using the Strahler System).	3.2.2 Surface Water Classification
	• Details of any proposed surface water extraction, including purpose, location of existing pumps, dams, diversions, cuttings and levees.	Section 1.4.4 Project water use requirements
	• Detailed description of any proposed development or diversion works including all construction, clearing, draining, excavation and filling.	Section 4 Impact Assessment
	• An evaluation of the proposed methods of excavation, construction and material placement.	N/A.
	• A detailed description of all potential environmental impacts of any proposed development in terms of vegetation, sediment movement, water quality and hydraulic regime.	Section 4 Impact Assessment
	• A description of the design features and measures to be incorporated into any proposed development to guard against long term actual and potential environmental disturbances, particularly in respect of maintaining the natural hydrological regime and sediment movement patterns and the identification of riparian buffers.	Section 4 Impact Assessment and Section 5 Mitigation Measures
	• Details of the impact on water quality and remedial measures proposed to address any possible adverse effects.	Section 4 Impact Assessment and Section 5 Mitigation Measures
Industry & Investment NSW (I&I NSW) (08/09/2009)	**Fisheries Issues**	
	• The EA should identify the location of proposed permanent and temporary watercourse crossings necessitated by the proposal and justify these against alternate access routes. Where crossings are to be installed a brief assessment of the waterway and a description or draft design of the proposed crossing is required. Waterway assessments and design of crossings should be consistent with fish friendly guidelines.	Section 4.1.2 Watercourse crossings
	• Where existing crossings can be used but require upgrading the EA should outline the scope of works and whether the works will exacerbate and prolong the life of an existing barrier to fish passage.	Section 4.1.2 Watercourse crossings
	• The likely height of transmission lines at waterway crossings should also be indicated with reference to existing riparian vegetation and endemic riparian vegetation. The EA should outline where ongoing management of riparian vegetation will be required and outline the regularity and scale of these works.	Section 4.1.2 Watercourse crossings Section 5.2 Operational Phase

1.3 Water Quality Assessment Framework

The National Land and Water Resources Audit has produced the Australian Water Resources Assessment 2000 (Commonwealth of Australia, 2001). The Audit's assessment is based on the best available information on water quality and quantity provided by State and Territory water management agencies. This assessment acknowledges that water quality data are limited. According to the Australian Water Resources Assessment 2000, there is only sufficient salinity, nutrient and turbidity data to assess water quality status for about 30% of Australia's 246 river basins.

The Australian Water Resources Assessment 2000 confirms that the major water quality issues in Australia are reflected in three key variables:

- Salinity – the salt concentration in water as measured by electrical conductivity;
- Nutrients – primarily the concentration of phosphorus and nitrogen in water; and
- Turbidity – the clarity or "dirtiness" of the water (roughly proportional to the concentration of suspended solids) (Commonwealth of Australia, 2001).

For the purposes of this assessment, pH has also been included where information has been available.

The acceptability of water quality variables must be determined with reference to the uses, or 'environmental values', of that water. Environmental values are derived from both human uses (such as for drinking water, irrigation and swimming) and ecological uses (to support a healthy ecosystem) (Healthy Rivers Commission, 1999).

The NSW Water Quality Objectives (DECC, 2006) are the agreed environmental values and long-term goals for NSW surface water. These guidelines provide an agreed framework for the assessment of water quality in terms of the suitability of water for a range of end uses (including human uses). These are further discussed in **Section 2.5** and **Section 4.3**.

1.4 Description of Proposed Works

This assessment has considered the nature and extent of all Project elements proposed for the Far North NSW (Dumaresq to Lismore 330kV transmission line) Project. The scope of the Project includes the following:

- a 205km, 330kV easement incorporating pole and tower structures and comprising:
  - construction of a new 96km 330kV transmission line and 60m easement through greenfield areas from Dumaresq Switching Station to the proposed location of the new Tenterfield 330/132kV Substation (Tenterfield 330kV Substation);
  - construction of a new 109km 330kV transmission line between the Tenterfield 330kV Substation and the Lismore Substation through the existing easement. Between the Tenterfield 330kV Substation and Casino (95km), the 330kV transmission line would be located on the route of the former 132kV transmission line. The existing 45m easement would be extended to 60m. Between Casino and Lismore Substation (14km), the new 330kV transmission line would run adjacent to the existing 132kV transmission line (which would remain operational on completion of construction). The existing 45m easement would be extended to 90m for this section.
  - removal of 95km of the existing 132kV transmission line between the proposed Tenterfield 330kV Substation and structure 395 to the south of Casino;
- upgrades to the Lismore Substation and the Dumaresq Switching Station. Upgrades would be within the existing sub/switching station footprints;
- establishment of a new 330/132kV substation approximately 14km north east of Tenterfield to maintain the existing 132kV connection to the Tenterfield 132kV Substation;
- establishment of access tracks both within the easement and outside the easement for the purposes of transmission line construction and operational maintenance; and
- replacing and restringing the existing earthwire between the new Tenterfield 330kV Substation and existing Tenterfield 132kV Substation with optical ground wire (OPGW).

1.4.1 132kV line Dismantling

The existing 132kV transmission line would be dismantled from the proposed Tenterfield 330kV Substation to a point referred to along the line near Casino at the Casino Tee (STr395). Pole structures would be dismantled and the poles removed from the ground between these points. A wider easement containing the proposed 330kV line and the existing 132kV line would proceed in parallel to Lismore Substation.

As discussed in **Chapter 7 Soils, Geology and Topography (Volume 1 EA)**, the Contractor would implement a systematic soil sampling program at representative pole locations to determine whether pesticides had been used or applied to protect the timber poles. Should the results confirm that pesticides are present, sufficient soil would be excavated from each pole location during the dismantling of the structures to ensure no residual contamination of the soils. Spoil would be appropriately managed and stockpiled prior to offsite disposal in accordance with the CEMP. Should the sampling procedure not indicate pesticide presence, soil from the surface around existing poles would be disposed of in the bottom of pole holes, with clean soil used for the final backfill obtained from excavations for the new line.

1.4.2 Construction

Easement Requirements

An easement width of at least 60m is required to maintain the necessary clearance for a 330kV transmission line. Where the 330kV transmission line proceeds in tandem with the existing 132kV line, a 90m wide easement incorporating both lines would be required. Easements are required to ensure safe clearances between conductors and vegetation and to eliminate the risk of lines causing bushfires. The role of electrical easements helps to ensure public safety and to maintain high levels of system reliability. While the establishment of easements involves the clearing of vegetation in some areas, in selected sensitive areas and where topography allows, the structures have been designed and located to span over these areas to minimise the degree of vegetation clearing required to establish the easement.

Establishment of Access Tracks

Access to each new structure along the proposed alignment would be required for construction and ongoing maintenance purposes. Access tracks have been placed into three categories depending on the level and types of works required. The three categories are:

- **Category 1**: minimal work required. This would include removal of surface obstacles and/ or minor upgrades to existing tracks (i.e. resurfacing, widening etc.). Some imported sand and gravel may be required.
- **Category 2**: earth works required. Construction of tracks through flat or undulating timbered / rocky areas where existing tracks do not exist. These can range from tracks required over flat plains country, or involve the formation of tracks after cut and fill, rock removal and / or levelling. Newly constructed Category 2 access tracks would typically be topped with approved gravel. Access tracks would be appropriately compacted and graded and include drainage in the direction of the cross fall to ensure tracks could be maintained and erosion impacts from run off minimised.

- **Category 3**: earth works required in wet or swampy areas. Typically construction would require excavation of unstable material, drainage works and the import of rock material. This rock would be placed upon a geotextile material to provide a stable surface to facilitate the movement of required construction plant and equipment.

Stream and Drainage Line Crossings

Plant and equipment as well as vehicles used during the construction of the line would require the upgrade or construction of a number of creek crossings within the easement. The design and construction of access tracks across waterways would be in accordance with TransGrid's Specifications and would be in accordance with the NSW Department of Primary Industries *Policy and Guidelines for Fish Friendly Waterway Crossings* (2003) and *Why Do Fish Need to Cross the Road?* (Fairfull and Witheridge, 2003).

Watercourse crossing requirements identified to date through preliminary onsite inspection by TransGrid, contractor and technical specialists are included in this current assessment.

The Department of Primary Industries would be consulted regarding all proposed on and off easement watercourse crossings.

Establishment of Work Sites

Detailed design of structure locations and conductor heights would consider strategies to avoid or minimise impacts on environmentally sensitive areas. The extent of clearing required would also be dependent on terrain, other infrastructure and to some extent, landowner requirements and land uses. Work site areas include the location of each earthed supporting structure and the immediate surrounding area which would be used as a temporary lay-down or bench areas for plant and equipment used to erect each structure.

Tenterfield 330kV Substation Construction

The proposed works at the Tenterfield 330kV Substation would involve site preparation of the compound. The compound footprint is likely to have dimensions of 150m x 130m. Compound preparation would involve vegetation clearing and bulk earthworks. The construction and setup stage would encompass civil works, steel works, building works and electrical works. The substation electrical equipment would require transport and installation and overhead transmission line connections would need to be established prior to substation commissioning. Works would include the construction of internal access roads, primary and secondary oil containment systems, a services building, the construction and installation of appropriate switchyard drainage, and the installation of appropriate compound fencing, security and lighting. Any disturbed areas would be stabilised with vegetation as soon as possible following the completion of earthworks.

1.4.3 Operation

The operational phase of the proposed transmission line would be limited to periodic line inspection and maintaining access tracks and easement areas. Such work would predominantly involve the slashing of the shrub layer beneath conductors within the easement and a follow up application of herbicide where vegetation is identified as likely to infringe clearances before the next scheduled maintenance visit.

1.4.4 Project Water Use Requirements

Water would be used during the construction of the Project for concrete batching, access track construction, dust suppression activities, drilling work for footings and for earth staking installation. Exact water requirements would be determined at the detailed design stage, however it is estimated from previous projects that approximately 4 to 4.5 mega litres of water would be required for the entire Project. It is expected that sufficient water would be available from town water supplies and artificially constructed dams to service all construction water requirements. During the detailed design stage, consultation with NSW Office of Water (NOW) would be ongoing to ensure that any permitting requirements are met. Consultation with NOW is required as it is noted that an embargo presently applies to the making of applications for new licences under Part 2 of the *Water Act 1912*.

No groundwater would be extracted for use during the construction or operation phases of the Project. Minimal ongoing supply of water may be required for the proposed Tenterfield 330kV Substation. It is envisaged that this could be adequately supplied through rainwater capture within the compound footprint of the Tenterfield 330kV Substation. If staff facilities including toilet facilities are to be a permanent fixture at the substation, TransGrid would likely utilise standalone composting systems.

2

Legislative and Planning Context

In NSW, the *Environmental Planning and Assessment Act 1979* (EP&A Act), and its supporting legislation the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation), provide the framework for development and environmental assessment.

Currently, two different Acts administer access to water resources; the *Water Management Act 2000 (**WMA**)* and the *Water Act 1912.* These Acts impose different access and licensing requirements, and both are relevant to the assessment of surface water and hydrology impacts of the proposed Project. The proposed development also falls under the jurisdiction of both acts for water use, sharing and extraction provisions.

2.1 Environmental Planning and Assessment Act 1979

Part 3A of the EP&A Act provides the process for assessment of developments which are considered to be 'Major Projects' as declared by *State Environmental Planning Policy (Major Projects) 2005* or by order of the Minister in the Government Gazette.

As a Major Project, the Project is subject to the provisions of Part 3A of the EP&A Act and, accordingly, it will be subject to assessment by the Director-General of the Department of Planning (DoP) and determination by the Minister for Planning.

2.2 Water Management Act 2000

The *WMA* establishes a framework for managing water in NSW. The Act creates:

- mechanisms for protecting and restoring water sources and their dependent ecosystems;
- improved access rights to water; and
- partnership arrangements between the community and the Government for water management.

The Act recognises the importance of maintaining the environmental health of the State's water while encouraging innovative and efficient use of this scarce commodity.

2.2.1 Watercourse Crossings and Controlled Activities

Watercourse crossings are a controlled activity under the *Water Management Act 2000* (WMA). A controlled activity means:

- the erection of a building or the carrying out of a work (within the meaning of the *EP&A Act*);
- the removal of material (whether or not extractive material) or vegetation from land, whether by way of excavation or otherwise;
- the deposition of material (whether or not extractive material) on land, whether by way of landfill operations or otherwise; or
- the carrying out of any other activity that affects the quantity or flow of water in a water source.

The NSW Office of Water (NOW) is required to assess the impact of any proposed controlled activity to ensure that no more than minimal harm would be done to the bed and bank of any river, lake or estuary and to all land within 40 metres, (the prescribed distance away from the waterway), as a consequence of carrying out the activity (NOW, 2010).

Under Section 75U(1) of the EP&A Act, projects approved under Part 3A do not require a water use approval under Section 89, a water management work approval under Section 90 or an activity approval (which includes a controlled activity approval) under Section 91 of the *WMA*. Notwithstanding the Part 3A exemption from this formal requirement, all works in proximity to surface water features, including in stream works such as the installation of watercourse crossings, would be consistent with NOW *Controlled Activity Guidelines* (2010).

2.2.2 Water Sharing Plans

A Water Sharing Plan (WSP) is a legal document prepared under the *WMA*. The Catchment Management Authority's (CMA's) role in this process is to facilitate consultation between the community and NSW Government during the development phase of the plan. The outcome of the consultation establishes rules for sharing water between both the environmental needs of the river or aquifer and water users, and also between different types of water uses, such as town supply, rural domestic supply, stock watering, industry and irrigation.

In relation to water use, sharing and extraction, the *WMA* applies to the extent that a WSP has commenced in relation to a water source. The WMA therefore applies to the project footprint around the Tenterfield area (the central area of the proposed line between AP 18 and 34). This is the area covered by the Tenterfield Creek Water Source which came into force in 2003. In relation to all other areas of the Project (the approximate areas between AP 1 – 17 Alignment West, and AP 35 – 71 Alignment East), surface water allocation is administered under Part 2 of the *Water Act 1912* and groundwater is administered under Part 5 of the *Water Act 1912*. The WSP for Tenterfield Creek came into effect on July 1 2004.

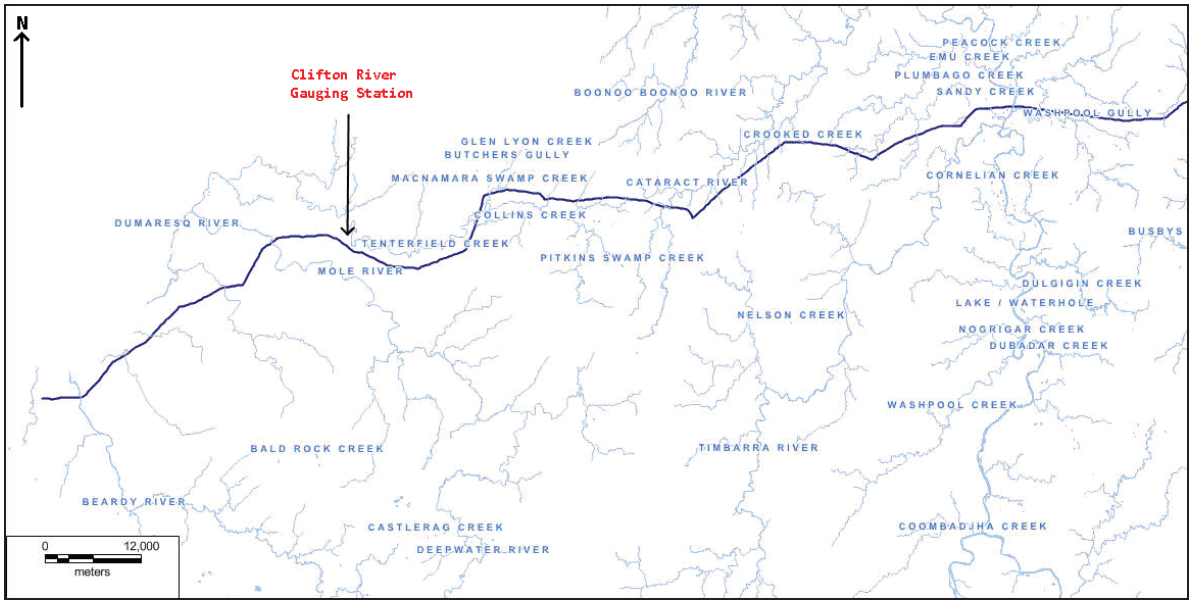
Water Sharing Plan for the Tenterfield Creek Water Source 2003

Tenterfield Creek Water Source is located on the northern tablelands of NSW. It is a tributary of the Dumaresq River, and is part of the Border Rivers Catchment. The town of Tenterfield is within the water source. The water source has an area of approximately 892 square kilometres (km^2) and is generally undulating cleared agricultural land.

A river flow gauging station has operated within Tenterfield Creek at 'Clifton' since 1921. This river gauging station has been considered in this assessment given the length of the record, and proximity to the Project. **Figure 2-1** shows the approximate location of this river gauging station.

2 Legislative and Planning Context

Figure 2-1 River Gauging Station at Clifton



Tenterfield Creek has a highly variable flow, responding rapidly to rainfall events, which are more frequent in summer. The water source experiences extended periods of low or no flow, the longest being 238 days in 1940. The greatest competition for water occurs between September to December. These are the critical months where extraction is at its greatest and when flows are at their lowest.

At the start of the Plan, there were 65 water access licences in relation to Tenterfield Creek. Of these, 56 were for irrigation, one for industrial, one for local water utility, one for recreation and six for domestic and stock purposes. Domestic and stock access licences are required for intensive stock raising purposes and for those landholders whose property does not front a river or creek (NSW Department of Infrastructure, Planning and Natural Resources, 2005).

Based on the WSP rules, the available water resources are shared throughout the year, allowing water for the environment and for consumptive use. However it is not anticipated that any water would be taken directly from Tenterfield Creek during the construction phase, consultation with NOW would also be undertaken to ensure that any permitting requirements are met. Any ongoing water requirements during operation of the Tenterfield 330kV Substation would be supplied by rainwater tanks.

2.3 Water Act 1912

The *Water Management Act 2000 i*s gradually replacing the planning and management frameworks within the *Water Act 1912*. In relation to all other areas of the Project not included in the Tenterfield Creek Water Source WSP, surface water allocation is administered under Part 2 of the *Water Act 1912* and groundwater is administered under Part 5 of the *Water Act 1912*. There are no exemptions under the *Water Act 1912* (either under Part 2 or Part 5) for Part 3A approvals and approvals would be required for access to surface and ground water during construction if necessary.

Coastal Alluvials Embargo

Across the Project area, it is noted that the Coastal Alluvials Embargo presently applies to the making of applications for new sub surface water licences under Part 5. Embargo orders are made under the *Water Act 1912* and apply until replaced by either:

- another embargo order made under the *Water Act 1912*; or
- a water sharing plan made under the *Water Management Act 2000* for the water source.

Where an embargo order applies, an application for a new water licence under the *Water Act 1912* cannot be lodged unless it fits within one of the exemptions specified in the order or in the *Water Act 1912*.

Dewatering Licence

If the Project is likely to intercept groundwater, a licence under Part 5 of the *Water Act 1912* would be required. Dewatering of any structure footings may be necessary in low lying areas particularly towards Lismore Substation where the water table is generally shallower. If this work is required, the proponent would apply for a water licence for temporary construction dewatering and construction would proceed only when approval is obtained from the NOW.

Water Use Requirements and Permitting

NOW has indicated that the EA should outline all water requirements for the development (i.e. during construction and post construction) and where the water would be sourced from. All water required for the development must be accounted for and appropriately licensed with the Department.

The use of water would be required during the construction of the transmission line and the Tenterfield 330kV Substation for concrete batching, access track construction, dust suppression activities, drilling work for footings and for earth staking installation. Exact water requirements cannot be adequately estimated prior to the detailed design stage. However, from previous projects it is envisaged that sufficient water would be available from town water supplies and artificially constructed dams to service all construction water requirements. During the detailed design stage, consultation with NOW will be ongoing to ensure that any permitting requirements are met. Consultation with NOW is required as it is noted that the Coastal Alluvials Embargo presently applies to the making of applications for new water licences for sub surface water under the *Water Act 1912*.

The Project does not plan to use any bores for water requirements during construction. No groundwater would be extracted for use during construction. No ongoing water supply would be required for the transmission line component. TransGrid anticipates that the minimal ongoing water requirements at Tenterfield 330kV Substation could be supplied by rainwater tanks.

2.4 Fisheries Management Act 1994

Permits under Section 201 (dredging and reclamation) and 219 (fish passage) of the *Fisheries Management Act 1994* are not required for Part 3A approvals in accordance with s75U of the *EP&A Act*. However, all works proposed within riparian areas would be consistent with the Department of Water and Energy's *Controlled Activity Guidelines (2008)* and all watercourse crossings would be constructed in accordance with TransGrid's specifications and undertaken in accordance with relevant guidelines.

2.5 NSW Water Quality and River Flow Objectives and Assessment Guidance

For each catchment in NSW, the State Government has endorsed the community's environmental values for water. These were adopted following extensive consultation with the community in 1998. The objectives are consistent with the agreed national framework for assessing water quality set out in the ANZECC 2000 Guidelines (DECC, 2006).

Water Quality and River Flow Objectives are outlined for the Border Rivers and Richmond River Catchments below but are not available for the Clarence River. The outcomes of an Independent Inquiry into the Clarence River (Healthy Rivers Commission of NSW, 1999) have therefore been considered to ascertain appropriate objectives for the Clarence River catchment.

2.5.1 NSW Water Quality and River Flow Objective categories

Surface water categories across the Border Rivers and Richmond River catchments are broadly defined for the purposes of the NSW Water Quality and River Flow Objectives according to their general characterisation. The following categories have relevance to the Project area and have therefore been considered within this assessment:

- **Controlled rivers with reduced flows.** This category covers two situations:
  - River reaches downstream of the regulated sections, where the water is extracted or diverted. This results in reduced flow throughout the year. Water is delivered from the main stream for stock, domestic use, some irrigation and town water supply several times a year.
  - Sections of rivers immediately below town water supply dams, where water is diverted directly from the dam. In this situation, flows can be substantially reduced throughout the year, though special environmental releases may be possible.

The consideration of the ‘Controlled Rivers with reduced flows’ category is relevant to parts of the Border Rivers catchment based on the geographical placement of the proposed alignment.

- **Waterways affected by urban development.** Waterways within urban areas are often substantially modified and generally carry poor quality stormwater. Local communities are often keen to see these waterways returned to more natural conditions. The consideration of the ‘Waterways affected by urban development’ category is relevant to parts of the Richmond River catchment based on the geographical placement of the proposed alignment.
- **Uncontrolled streams.** This category covers uncontrolled waterways that are not in the other categories. Their flow patterns are largely natural but may have been partially altered. Flows can occur in these streams from local runoff. They are typically ephemeral (flow only during floods and freshes). Frequently, they open into or flow past wetlands and billabongs. The consideration of the ‘Uncontrolled streams’ category is relevant to parts of the Borders Rivers and Richmond River catchments based on the geographical placement of the proposed alignment.

Border Rivers and Richmond River Water Quality Objectives

The protection of aquatic ecosystems, visual amenity, and primary and secondary contact recreation were common listed objectives for the categories assessed in relation to the Project. All categories not including those identified as ‘Waterways affected by urban development’ also included the objectives of protecting water quality for livestock, irrigation, homestead supply, drinking water quality and for aquaculture.

2 Legislative and Planning Context

Border Rivers and Richmond Rivers River Flow Objectives

A common River Flow objective, featured in both the Border Rivers and the Richmond River Flow Objectives, was to "minimise the effect of weirs and other structures". The protection of pools in dry times, natural flows and flow variability, important rises in water levels, management of groundwater for ecosystems and maintenance of wetland and flood inundation were also strongly represented objectives across the categories relevant to the Project.

Clarence River Water Quality and River Flow Objectives

The Clarence community's aspirations for water quality and related river health issues, as expressed to the Inquiry into the Clarence River were as follows:

- protection of aquatic ecosystems, visual amenity, primary and secondary contact recreation, and the human consumption of crustaceans and shellfish should be provided throughout the catchment.
- the river system should be restored, realising that there are land use and river needs.
- revegetation of river banks with native vegetation should be undertaken.
- contamination of the river should be prevented, especially if used as a drinking water source, for recreational use, or for aquaculture.
- the community should be able to maintain current urban and rural activities. (Healthy Rivers Commission 1999 - Independent Inquiry into the Clarence River System).

The assessment has considered the potential of the Project to affect the water quality and river flow objectives for the catchments through which the Project would traverse. See **Section 4.3**.

3

Existing environment

3.1 Regional Setting

3.1.1 Catchments

The Project is located in two Catchment Management Areas (CMAs), the Border Rivers-Gwydir Catchment and The Northern Rivers CMA Region.

The Border Rivers-Gwydir Catchment occupies an area of approximately 50,000km^2. The principal rivers that drain the inland slopes of the eastern highlands are the Dumaresq, Severn and Macintyre Rivers. The Border Rivers-Gwydir Catchment Management Authority services the entire Gwydir Catchment (approx 26,500km^2) and the NSW portion of the Border Rivers Catchment (approx 24,000km^2). Both of these catchments are located within the Murray-Darling Basin. They are bounded by the Queensland border in the north and west, the Great Dividing Range in the east and the Namoi Catchment in the south. The Border Rivers Catchment is characterised by rivers which have highly variable flow and are strongly dependant on local rainfall and runoff. Principal streams are the Macintyre River and Severn River (NSW) in the south-east, the Dumaresq River and Severn River (QLD) in the east, and Macintyre Brook and the Weir River in the north and north-west respectively. The state border follows the Dumaresq River and the Macintyre River below its junction with the Dumaresq River downstream to Mungindi (NSW Department of Water and Energy, 2009).

The Northern Rivers Catchment Management Area is located in the north-eastern corner of NSW extending from the Queensland border, south to the Camden Haven catchment and inland to the eastern slopes of the New England Tablelands. The Region stretches seawards three nautical miles and includes Lord Howe Island, 600 km east of Port Macquarie. It covers 50,000km^2 and includes eight major river catchments, including the Tweed, Brunswick, Richmond, Bellinger, Nambucca, Macleay, Hastings and Clarence rivers. The Northern Rivers Catchment Management Area also encompasses significant coastal lake and estuary systems as well as floodplain and wetland areas (NRCMA, 2009).

There are also three river catchments relevant to the Project within the Border Rivers-Gwydir CMA and the Northern Rivers CMA. The Clarence River Catchment and the Richmond River Catchment fall within the Northern Rivers CMA Region; and the Borders River Catchment falls within the Border Rivers-Gwydir CMA. **Figure 3-1** shows the location of the three major river catchments.

3.1.2 Topography

Topography within the Alignment West region is generally described as a “stepped plateau of hills and plains” with elevations ranging from 600 to 1500m above sea level. Alignment East ranges from the coastal lowlands in the east, across 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).

3.1.3 Climate

Alignment West

Climatic conditions within the western half of the proposed transmission line are primarily temperate to cool temperate, characterised by warm summers with uniform rainfall typically occurring in summer. Where the North Coast bioregion adjoins on the north-east edge of the bioregion the climate tends to be warmer and sub-humid. Patches of montane climate occur at higher elevations, and these are

characterised by mild summers and no dry season. Rainfall within the bioregion varies from an average of 600mm per year in the hotter and drier western portion to 1200mm in the cooler and wetter eastern section (Bureau of Meteorology, 2009).

Alignment East

Climatic conditions within the area between Lismore and Tenterfield change with topography however can generally be described as sub-tropical in the east near the coast, with hot summers, through to sub-humid conditions on the slopes, to a cool temperate climate in the uplands/tablelands in the west with warm summers and no dry season. A montane climate occurs in a small area in the southwest of the bioregion at higher elevations. Temperatures range from winter extremes of minus 5°C to over 40°C in summer. Coastal areas typically experience milder conditions, however some inland areas experience extremes of temperature year round. Rainfall is highest in summer. Rainfall ranges from between 1,350 – 1,650mm per year in coastal areas to around 800mm per year in inland areas. Rainfall is highly variable (Bureau of Meteorology, 2009).

3.2 Surface Water Characterisation

3.2.1 River Catchments

As shown in **Figure 3-1**, the Project traverses three major river basins: the Border Rivers Catchment, the Clarence River Catchment and the Richmond River Catchment.

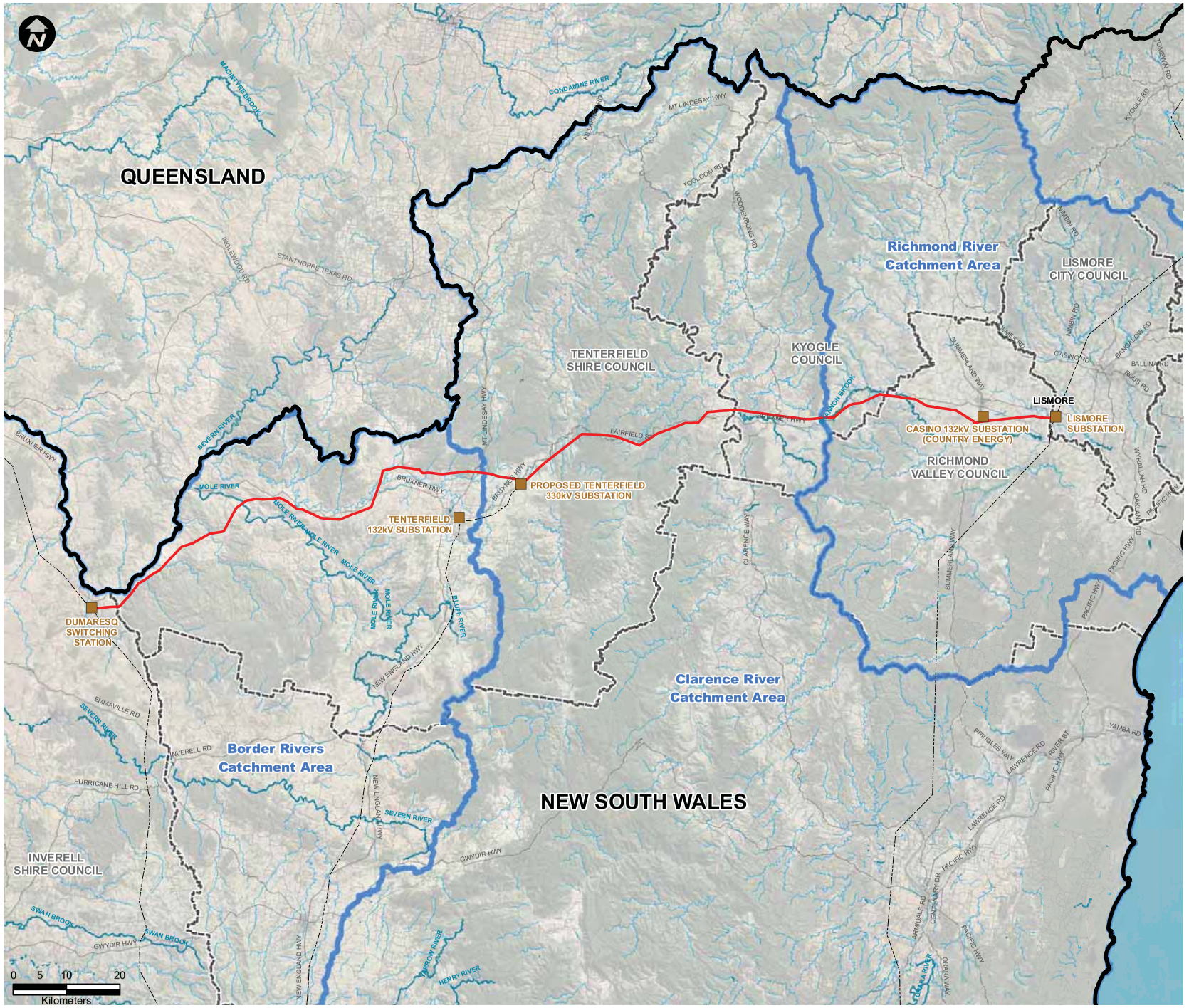
Alignment West lies partially within the Border Rivers Basin. The Border Rivers Basin includes the Macintyre River catchment and is located across two States (NSW and QLD), with 25,580km^2 of the total 49,470km^2 in NSW. The NSW portion includes the Mole, Dumaresq and Severn Rivers. This basin forms part of the headwaters the Barwon River which flows south into the Darling River.

Alignment East lies partially within the Clarence River catchment and the project crosses the Clarence River upstream of Tabulam. The Clarence River catchment stretches from far northern NSW in the foothills of the Great Dividing Range, winds its way south to the City of Grafton and discharges to the Pacific Ocean at Yamba. The Clarence River is the biggest river on the east coast of NSW. Generally the catchment is characterised in its western extremities by tableland areas that fall away to the relatively large, flat coastal floodplain.

Alignment East lies partially within the Richmond River catchment and includes the Wilsons River and the Richmond River, which ultimately discharges to the ocean at Ballina on the NSW north coast. The Richmond River catchment covers 7,022km^2, with a large coastal plain stretching from south of Evans Head and to the north almost as far as Cape Byron. The townships of Lismore, Ballina, Casino and Kyogle are located within this catchment. The Border Ranges National Park and the Richmond Range form the northern and western limits of the catchment, with the Richmond Range continuing to the south.

3.2.2 Surface water classification

There are a number of river systems along the proposed alignment. These include the Dumaresq River (near the Dumaresq Switching Station); the Clarence River (in the vicinity of Tabulam) and the Richmond River and Wilsons River (in the vicinity of Casino and Lismore). There are also many smaller creeks, intermittent or ephemeral drainage lines and a number of rural dams within the alignment.



LEGEND:

- Existing Transmission Lines^
- Proposed 330kV Alignment^
- Substation/Switching Station
- Roads
- Waterways
- Surface Water Catchment Areas
- State Border
- Local Government Area

Symbols and lines used in this figure are indicative and are not intended to reflect actual size of represented features.
Symbols and lines have been enhanced to aid visibility.

Source: Aerial Imagery from © Microsoft Bing Maps 2010
^ Transgrid 2010

Map compiled using MapInfo StreetPro and NPWS Data.

Drawn: AO	Approved: KT	Date: 17/01/2011
Job No.: 43177662	File No.: 43177662.110	

Client: TransGrid

Project: FAR NORTH NSW (DUMARESQ - LISMORE 330kV TRANSMISSION LINE) PROJECT

Title: RIVER CATCHMENT AREAS

Figure: 3-1

URS

Datum: GDA94, Projection: UTM, Grid: MGA Zone 56

3 Existing environment

Table B-1 in **Appendix B** provides an analysis and brief description of surface water features present where the alignment and access tracks cross them. The Project traverses three major river basins and spans over 200km in length from near Bonshaw to Lismore Substation in the east. The **Figure 2** series (preceding the report appendices) presents surface water features along the line in relation to all proposed project elements.

There are a number of different ways to classify stream types. This assessment has considered the classification system of surface water features according to flow characteristics. This approach is outlined in the NSW Fisheries Office of Conservation (2003) guidelines- *Why do fish need to cross the road?* (Fairfull and Witheridge, 2003).

Table 3-1 below is adapted from these guidelines for the purposes of categorising the surface water features across the study area according to flow characteristics and the relative importance of the waterway as potential fish habitat.

Table 3-1 Waterway Classification

Waterway type	Characteristics of Waterway Type	Potential importance as aquatic habitat
Class 1	Major permanently flowing waterway	Major fish habitat
Class 2	Named creeks or waterways: with clearly defined bed and banks; with semi - permanent to permanent; waters in pools or in connected wetland areas. Freshwater aquatic vegetation is present.	Moderate fish habitat
Class 3	Generally unnamed waterways or drainage lines with intermittent flow, or flow only following rain events. Aquatic vegetation which would provide some refuge, breeding or feeding areas may or may not be present.	Unlikely fish habitat

For context, the Strahler system of river classification could also have been used to categorise the surface water features across the Project area. 'First Order Streams' under the Strahler system would broadly correlate to Class 3 waterways. These would include minor streams and drainage features. First order streams connect with minor streams to create larger 'second order' streams and rivers. These would equate with Class 2 Waterways as defined in **Table 3-1** above. Second order streams or rivers would then connect with other second order features to create 'third order' rivers, broadly equivalent to Class 3 Waterways as classified within this assessment and **Table 3-1** above.

A broader surface water classification system than Strahler has been used in this Environmental Assessment to also capture the ecological significance of surface water features across the Project as shown in **Table 3-1** above.

Figures 2-1a-ae classify the waterways across the Project by flow characteristic and potential aquatic habitat provision, as per the above descriptions. A summary of the waterway classes across the alignment is presented in **Table 3-2** below. Further detail is offered in the discussion below.

3 Existing environment

Table 3-2 Waterway Classification Summary

	Alignment West	Alignment East
Class 1 waterways	Cataract River intersected between APs 37-38 and APs 38-39.	Timbarra River (Clarence) intersected between APs 49-50. Shannon Brook intersected between APs 59-60. Richmond River intersected between APs 66-67.
Class 2 waterways	Beardy River intersected between APs 3-4. Mole River intersected between APs 16-17.	None identified.
Class 3 waterways	Project crosses waterways classified as Class 3 at 46 points.	Project crosses waterways classified as Class 3 at 38 points.

None of the surface water features across the Project are downstream reaches of regulated rivers where the water has been extracted or diverted. As such, the Project occurs within river catchment areas which are highly dependent on rainfall for flow variability. Streamflow data of relevance to rivers within the vicinity of the proposed alignment is presented in **Appendix A**.

Alignment West watercourses

The proposed 330kV transmission line, associated 60m easement and identified access tracks would cross the following surface water features along the Alignment West between the Dumaresq Switching Station and the proposed Tenterfield 330kV Substation (listed from west to east in order of where the waterway and Project first intersect):

1. Beardy River;
2. Black Creek;
3. Sandy Creek;
4. Gulf Creek;
5. Shed Creek;
6. Reedy Creek;
7. Rocky Camp Creek;
8. Mole River;
9. Orchard Creek;
10. Ravine Creek;
11. Skillio Hut Creek;
12. Five Mile Creek;
13. Deadman Creek;
14. Eight Mile Creek;
15. Swamp Creek;
16. Ten Mile Creek;
17. SunnySide Creek;
18. Tarban Creek; Tenterfield Creek;
19. Gosling Swamp Creek;
20. Ram Swamp Creek;
21. Halls Creek;
22. Washpool Creek;
23. Chinamans Swamp Creek; and
24. Cataract River.

Alignment West and the associated access tracks would also intersect an estimated 83 unnamed streams, intermittent or ephemeral creeks, or visible drainage lines. These crossings have primarily been identified through analysis of aerial / satellite imagery and topographic mapping.

As shown within **Figures 2-1a-ae and Table B-1** within **Appendix B,** Alignment West intersects 46 Class 3 waterways, two Class 2 waterways, and one Class 1 waterway at two locations.

It is noted that these have primarily been identified through analysis of aerial / satellite imagery and topographic mapping.

3 Existing environment

Table B-1 in **Appendix B** details all surface water features which would be intersected by the easement and access tracks identified to date from Dumaresq Switching Station to Lismore Substation according to AP intervals along the line. Corresponding aerial mapping references are included.

Surface water features between the following APs would likely be traversed only by the alignment rather than by identified access tracks: AP5-8, AP9-10, AP14-15, AP17-26, AP28-31, AP32-33 and AP39-40. **Table B-1** notes that access track construction or upgrade may also be required between AP8-9, AP10-11, AP15-16 and AP16-17.

Plates 3-1 - 3-3 show selective surface water features observed within or in close proximity to Alignment West during field investigations. Photograph locations are shown on **Figure B-1 in Appendix B** and their intended purpose is to offer a view of the local surface water environment.

Plate 3-1 View of Mole River North of Proposed Alignment

3 Existing environment

Plate 3-2 View of Mole River South of Proposed Alignment

Plate 3-3 Tarban Creek

3 Existing environment

Alignment East watercourses

Alignment East and the associated access tracks would cross the following surface water features along the alignment between the proposed Tenterfield 330kV Substation and Lismore Substation (listed from west to east in order of where the waterway and Project first intersect):

1. Clear Creek;
2. Sandy Creek;
3. Sheep Yard Creek;
4. Slaty Creek;
5. Crooked Creek;
6. White Rock Gully;
7. Plumbago Creek;
8. Cataract River;
9. Violet Creek;
10. Teatree Creek;
11. Saleyard Gully
12. Clarence River;
13. Tunglebung Creek;
14. Culmaran Creek;
15. Shannon Brook;
16. Mummulgum Creek;
17. Oaky Creek;
18. Reids Creek;
19. Richmond River; and
25. Walsh's Creek.

The easement and access track locations would also intersect an estimated 57 unnamed streams, intermittent or ephemeral creeks, or visible drainage lines. The current 132kV line and access tracks currently traverse these 57 surface water features.

As shown within **Figures 2-1 a-ae** and **Table B-1** within **Appendix B,** Alignment East intersects 38 Class 3 waterways, no identified Class 2 waterways, and three Class 1 waterways.

Surface water features between the following APs would likely be traversed only by the alignment rather than by identified access tracks: AP40-41, AP43-44, AP47-51, AP52-54, AP55-57 and AP59-71.

Table B-1 presents the assessed access track categories identified across the proposed alignment. It is noted that few defined access tracks exist within the Casino to Lismore section, however a number of roads run close to the existing 132kV alignment. Access to this part of the alignment would be from existing roads. The precise route from the road to the proposed structure would depend on specific weather and soil conditions and the use of the land for that particular growing season. Access to the proposed structures would take place in consultation with landowners.

Plates 3-4 – 3-9 show selective surface water features observed in proximity to Alignment East during field investigations. Photograph locations are shown on **Figure B-1 in Appendix B**. Their intended purpose is to offer a general area characterisation.

Table B-1 in **Appendix B** details all surface water features which would be intersected by the easement and identified access track locations from Dumaresq Switching Station to Lismore Substation according to AP intervals along the line. Corresponding topographic and aerial mapping references are included.

3 Existing environment

Plate 3-4 Unnamed drainage line in vicinity of Cataract River

Plate 3-5 Teatree Creek

3 Existing environment

Plate 3-6 Clear Creek

Plate 3-7 Clarence River; view from Bruxner Hwy at Tabulam

3 Existing environment

Plate 3-8 Sheep Yard Creek

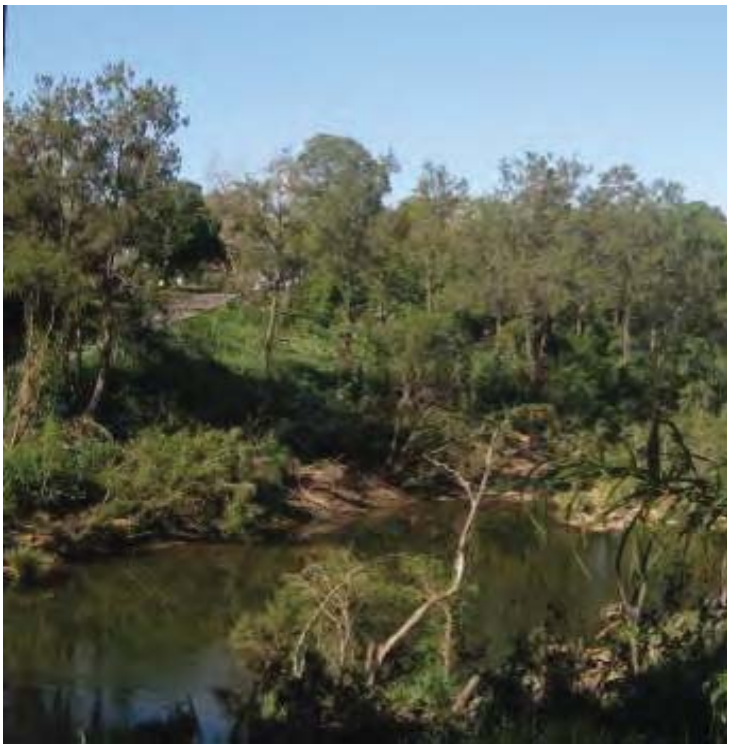


Plate 3-9 Richmond River from Lennox St Casino

3.2.3 River Catchment Quality

Water quality information obtained from the NSW Natural Resources Atlas database between September 2009 and February 2010 is presented as **Figure C-1** in **Appendix C**. At a broad river catchment level, water quality issues affecting the Border Rivers, Clarence and Richmond River Catchments are detailed below.

Table 3-3 River Catchment Level Water Quality Characterisation

River Catchment	Turbidity	Salinity	pH	Nutrients
Border Rivers	Major issue	Not a Significant Issue	Undetermined	Major Issue
Clarence River	Not a Significant Issue	Not a Significant Issue	No Coverage	Undetermined
Richmond River	Undetermined	Undetermined	No Coverage	Significant Issue

Source: Australian Natural Resources Atlas from the National Land and Water Resources Audit 2000

The Assessment of River Condition (ARC) submitted to the National Land and Water Resources Audit Office in 2001 sought to assess the aggregate impacts of resource use on rivers and to identify the priority management challenges for their maintenance or improvement. The aim was to report on waterway condition at a national scale. River basins within the ARC were identified nominally for reporting purposes. The relevant basin reference numbers under ARC assessment are provided below to assist in cross referencing.

The two main components of the ARC were features of the environment (ARCE) and the aquatic biota (ARCB) (Norris *et al*, 2001). The assessment summarised the results of data from over 500 river monitoring sites across numerous river basins. The results obtained for the river basins (416, 204 and 203) of relevance to the Project are discussed below.

Border Rivers

The Border Rivers Basin (416) ARCE was reported as moderately modified and the ARCB was significantly impaired. The basin condition was moderately modified based on the hydrological disturbance index, moderately modified based on the catchment disturbance index, moderately modified based on the habitat index and substantially modified based on the nutrient and suspended load index (Norris *et al*, 2001).

Clarence

The Clarence River Basin (204) ARCE was moderately modified and the ARCB was significantly impaired. The basin condition was non-assessed by the hydrological disturbance index, moderately modified based on the catchment disturbance index, largely unmodified based on the habitat index and substantially modified based on the nutrient and suspended load index (Norris *et al*, 2001).

Richmond

The Richmond River Basin (203) ARCE was moderately modified and the ARCB was significantly impaired. The basin condition was largely unmodified based on the hydrological disturbance index, moderately modified based on the catchment disturbance index, moderately modified based on the habitat index and substantially modified based on the nutrient and suspended load index (Norris *et al*, 2001).

The results of the national assessment as reported in 2001 are summarised in **Table 3-4**.

Table 3-4 Assessment of River Condition (ARC)

River Catchment	ARCE	ARCB
Border Rivers Basin	Moderately Modified	Significantly Impaired
Clarence River	Moderately Modified	Significantly Impaired
Richmond River	Moderately Modified	Significantly Impaired

3.2.4 Flood prone areas

The NSW Natural Resources Atlas Database indicates that there are areas of the proposed alignment which are subject to inundation. **Figure C-2** included in **Appendix C** (Elevation East) (Appendix C to this Appendix) shows that the Project occurs across coastal lowlands in the east, across floodplains through to low foothills and ranges. Areas around Casino are shown to be prone to inundation, and a number of fragmented wetlands are identified across the floodplains also. **Plate 3-10** was taken during an inspection of the existing 132kV Line after a rainfall event near Casino.

Plate 3-10 View of existing 132kV Easement towards Casino

DECCW prepares rural floodplain management plans which are made statutory plans under Part 8 of the *Water Act 1912* (to be replaced by provisions within the *Water Management Act 2000*). It is proposed to develop rural floodplain management plans progressively for each of the State's key inland floodplains.

None of the areas traversed by the Project are currently covered by a rural floodplain management plan.

3.3 Acid Sulfate Soils

The National Strategy for the Management of Coastal Acid Sulfate Soils (1999) provides a definition for Acid Sulfate Soils (ASS) that is repeated in most other ASS management publications:

"Acid Sulfate Soil" is the common name given to naturally occurring soil and sediment containing iron sulfides, principally the mineral iron pyrite, or containing acidic products of the oxidation of sulfides. When sulfides are exposed to air, oxidation takes place and sulfuric acid is ultimately produced when the soil's capacity to neutralize the acidity is exceeded. As long as the sulfide soils remain under the water table, oxidation cannot occur and the soils are quite harmless and can remain so indefinitely."

Although ASS risk is highest in coastal environments, there is potential for other Acid Sulfate Material (ASM) to have widespread distribution in the landscape. If disturbed, all forms of ASM can cause unacceptable environmental impacts, including acidification of waterways, major fish kills, habitat destruction, loss of agricultural productivity, geotechnical instability and corrosion of concrete and steel structures.

Table 3-5 summarises the nature, distribution and potential impacts of ASM.

Table 3-5 Summary Table - ASM

Material	Distribution	Potential impacts
Acid Sulfate Soils (ASS) and Potential Acid Sulfate Soils (PASS)	ASS and PASS are widespread in estuaries and coastal floodplains, backswamps and coastal wetlands. Inland ASS is rarer and may occur in combination with ASR and in soils derived from former marine sediments.	Discharges of very low pH (acidic) waters, biochemical barriers, fish kills, loss of habitat (scalding), loss of agricultural productivity, structural and engineering issues.
Acid Sulfate Rock (ASR)	Potentially in all sedimentary, metamorphic and igneous rock types associated with higher risk metalliferous ores, coal and sulphate/sulfide minerals.	Leachate affects concrete structures, road surfaces and road railings, potential destabilisation of fill. Potential habitat impacts.
Monosulfides and Monosulfidic Black Ooze (MBO)	Drains and waterways in acid sulfate areas, saline areas (coastal, inland and urban).	Rapid deoxygenation and acidification of waters, elevated release of heavy metals. Fish (and other fauna) kills.

As discussed in **Chapter 7 Soils, Geology and Topography (Volume 1 EA)**, the potential for Acid Sulfate Soils within the study area is considered to be low as the far eastern end of study area east is approximately 40km from the coast and is 20m above sea level. Using the Australian Soil Resource Information System (ASRIS) derived soil maps of Acid Sulfate potential, potential occurrences between the Dumaresq Switching Station and the Lismore Substation is low, with patches of extremely low probability around Tabulum, Casino and Sandy Hills. As such, an ASS Management Plan is not deemed necessary. Should any areas of ASS be encountered, excavation and ground disturbing activities should immediately cease and appropriate management measures would be determined.

3.4 Groundwater information

Groundwater availability maps provide a basis for the assessment of the expected and dominant groundwater resources for specified areas. Groundwater mapping is not yet available for the study area.

A review of Groundwater Works Summary data collected at the point of well development from the NSW Natural Resources Atlas indicates that the predominant purpose of registered bores across the study area is to provide water to domestic stock. From groundwater bore records at 22 locations within the study area, it is estimated that depth to groundwater ranges from approximately 6m to 40m below ground level, with the depth to groundwater across alluvial floodplain areas becoming shallower towards the eastern end of the alignment between Casino and Lismore. Selected registered groundwater bore information is presented in **Appendix D**. The basis of selection was to ensure inclusion of a geographically representative sample of information across the 205km Project.

The Sydney Coastal Councils Group *Groundwater Management Handbook* (First Edition September 2006) indicates that *" [A]ny development proposal that involves construction of permanent structures below the water table, other than pile or footing installation, should be supported by a detailed Geotechnical and Hydrogeological Report…"* (SCCG, 2006). Given that the only works likely to intercept groundwater across the Project Area would be pile or footing installations, it is therefore considered that the current Project does not meet the requirements to undertake a Geotechnical and Hydrogeological Report as part of the Environmental Assessment.

3.4.1 Groundwater dependant ecosystems

No groundwater dependent ecosystems were identified in proximity to the Project. The closest groundwater dependent ecosystem is located approximately 10km to the east of Lismore Substation. **Figure C-3** illustrates the proximity of groundwater dependent ecosystems to the Project.

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Impact Assessment

The Impact Assessment considers the potential impacts upon surface water and groundwater within the vicinity of the Project arising from:

- potential construction impacts to surface water hydrology as well as changes to water quality arising from:
  - the establishment of access tracks;
  - watercourse crossings; and
  - the use of water during the construction phase.
- potential groundwater impacts arising from boring or excavation works for the installation of access tracks and support structures in locations where shallow aquifers exist. Potential groundwater impacts include:
  - potential changes to hydrological conditions through dewatering activities (if carried out inappropriately);
  - water quality decline / contamination if there is a fuel or chemical leak/spill near dewatering work sites (i.e. if sufficient buffer zones are not maintained between dewatering work sites and areas where vehicles are refuelled or where other chemicals are stored); and
  - a reduction in groundwater level and reduced flow to groundwater dependent ecosystems (if dewatering activities are carried out inappropriately).

4.1 Surface Water – Potential Construction Impacts

The main environmental impacts with regard to surface waters are likely to occur where the proposed easement and identified Access Track locations cross watercourses and gullies at the locations detailed in **Section 3.2.1**. Waterway crossings such as roads, causeways, and culverts have the potential to disrupt the hydrologic, hydraulic, and geomorphic functions of a watercourse affecting flows, bed and bank stability as well as the ecological values and functions of the riparian corridor (NSW DWE, 2008). Habitats can be damaged during the construction of waterway crossings by the removal of riparian and in-stream vegetation as well as disturbance to the bed and bank of the waterway. Other impacts can include the creation of long-term barriers to fish movement, bed and bank erosion and continuing pollution from erosion and sedimentation.

The Project would intersect 41 named watercourses and an estimated 140 unnamed smaller creeks or potential drainage lines - 17 of these named watercourses and over 57 unnamed drainage lines and creeks are intersected by the existing 132kV line. Areas likely to be traversed by the alignment and/or access tracks have been differentiated in **Table B-1**, although the limitations of this assessment to date are noted, and further field assessment and approvals would need to precede any construction works. Potential soil erosion impacts from dismantling, Access Track construction and transmission line and substation construction activities have also been considered along with potential water quality impacts.

4.1.1 Establishment of Access Tracks

Due to the minimal ground disturbance involved with the establishment of Category 1 access tracks, these would not be expected to impact significantly on surface water features.

TransGrid has identified the likely requirement for approximately 153km of Category 2 Access Track, which would involve varying degrees of ground excavation works and cut and fill construction

techniques. **Plate 4-1** shows the typical construction of a permanent Category 2 Access Track inclusive of mitigation measures to prevent erosion impacts.

Approximately 9km of Access Track construction would be required across waterlogged and swampy terrain. The works for Category 3 Access Tracks would potentially include the excavation of poorly drained soil material, dewatering or other drainage works, the installation of geotextile material at the base of the excavation, and backfill with stable construction material for a solid surface on which to construct the track.

Plate 4-1 Category 2 Access Track Construction

Earth works could potentially impact upon surface water quality and stream flow through increased sedimentation of local waterways. Higher rates of sediment within runoff entering local tributaries could cause increases to the turbidity of surface water features. Chemical contaminants could also potentially runoff into local waterways from Access Track construction sites. Similarly, disturbance to the watertable from dewatering activities could potentially include changes to groundwater hydrology.

Mitigation measures to minimise these potential impacts are discussed in **Section 5.1.1**.

4.1.2 Watercourse crossings

The route selection for the proposed alignment and Access Track locations sought to minimise the number of watercourse crossings required. However, the construction of access tracks across waterways or drainage lines would inevitably be required at a number of locations to facilitate access

4 Impact Assessment

of plant, machinery and equipment to each proposed structure site, and to ensure adequate access for operational maintenance.

A number of existing creek crossings in the vicinity of the development would require repair or upgrading since they are commonly maintained only to allow 4WD passenger vehicular access. In their current condition, they would not accommodate the larger equipment necessary for the proposed construction work. **Plates 4-2 – 4-4** below illustrate a sample of watercourse crossings observed in proximity to the proposed alignment during field investigations. These are included to offer a general characterisation of existing watercourse crossings in the study area. Refer to **Figure B-1** in **Appendix B** for photograph locations.

Plate 4-2 **Existing watercourse crossing over a small tributary to the Cataract River**

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Plate 4-3 Watercourse crossing Tarban Creek (Study Area West)

Plate 4-4 River crossing over Mole River, north of proposed Alignment (Study Area West)

TransGrid field teams have identified areas requiring the installation of new creek crossings, as well as existing creek crossings where upgrades would be required. The locations of creek crossing requirements identified to date are illustrated in **Figures 2a-ae** and are detailed in **Table B-1 (Appendix B- Surface Water Characterisation)**.

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The following table summarises the number of existing creek crossing upgrades and new crossings required within the easement and surrounds for the alignment. This is a preliminary assessment based on field inspections undertaken to date for the Access Track locations identified by TransGrid in consultation with landholders where possible. Further field inspections and landholder consultation regarding both Access Tracks and creek crossing construction and upgrades would be carried out during the detailed design phase of the Project. Only crossing upgrades are proposed at this stage for Alignment East as access to this part of the alignment would be from these existing roads. The precise route from the road to the proposed structures would depend on specific weather and soil conditions and the use of the land for that particular growing season. Access to the proposed structures would take place in consultation with landowners.

Table 4-1 Alignment watercourse crossing requirements (preliminary)

	Watercourse crossings to be upgraded		Watercourse crossings to be installed	
	On Easement	Off Easement	On Easement	Off Easement
Alignment West	6	11	14	11
Alignment East	7	4	0	0

Source: Based on Aerial and Topographic mapping issue dates 21/02/2011

The published guidelines available from the NSW Department of Primary Industries and NSW Fisheries would inform the design of creek crossings. These would be site specific designs and potential crossing types would range from the installation of culverts and bridges, to fords or wet crossings or causeway types.

Table 4-2 is adopted from Fairfull, S. and Witheridge, G. (2003) *Why do fish need to cross the road?* The table provides guidance about which watercourse crossing types are likely to be suitable across different classes of waterways. Different crossing types have associated benefits and disadvantages in different settings.

Table 4-2 Minimum recommended watercourse crossing types for different categories of waterway

Waterway type	Characteristics of Waterway Type	Minimum Recommended Crossing Type
Class 1	Major permanently flowing waterway; major fish habitat	Bridge, arch structure or tunnel.
Class 2	Named creeks or waterways with clearly defined bed and banks; Freshwater aquatic vegetation is present and these waterways provide for moderate fish habitat	Bridge, arch structure, culvert or ford.
Class 3	Generally unnamed waterways or drainage lines with intermittent flow, or flow only following rain events. Aquatic vegetation which would provide some refuge, breeding or feeding areas may or may not be present. These watercourses are unlikely to provide fish habitat.	Culvert or ford.

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To date, the only watercourse crossings that have been identified by TransGrid as in need of upgrade or installation are across waterways which have intermittent flow (Class 3). It is important to note that the classification of waterways across the Project Area has been based on desktop analysis given the size and scale of the Project and the obvious difficulties of completing field verification at every location prior to the detailed design stage. Further site inspection would be carried out to assess alignment watercourse crossing requirements as the Project develops and landholder consultation continues. Specific details of watercourse crossings identified along the alignment are set out in **Table B-1.**

As per **Table 4-2**, it is recommended that culverts or ford type watercourse crossings are used, as a minimum, to traverse Class 3 waterway types where this is necessary. Ford or causeway types commonly installed are near-level waterway crossings, constructed at or slightly above the natural bed level of the watercourse. They are designed in a manner that promotes the formation of thin sheet flow passing over the road surface. In some cases a low-flow pipe may be placed under the causeway to keep the crossing dry during periods of low flow. Causeways have the benefit of not requiring significant disturbance of the banks and bed. These types of crossings cannot be used in instances where the stream has a deep cross-section requiring considerable excavation to provide approaches to the crossing. They also present disadvantages in facilitating fish passage. Fish friendly culvert structures would be considered at these locations, although TransGrid would ensure that culverts would not be installed at locations where debris blockages are likely. The design of appropriate crossings would be informed during the detailed design stage by further site assessment.

4.1.3 Changes to Surface Water Hydrology

Given the discrete nature of the substation and structure work sites and the distance between work sites, the potential for works to significantly affect either the rate or volume of water entering natural drainage systems of catchment areas across the project is considered minimal. Localised drainage diversions and minor, temporary changes to runoff volumes and flow rates which may be impacted by construction of new access tracks would not be expected to result in significant changes at the regional scale because:

- only a small proportion of the study area would be disturbed at any time;
- surface water diverted around an active work site area would be redirected back into the natural drainage line downstream; and
- access tracks would be designed and constructed in accordance with relevant guidelines to ensure adequate drainage provisions to prevent significant changes to local drainage patterns.

It is unlikely that the Project would be significantly impacted by flooding events, given the discrete and well spaced location of structures across an expanse in excess of 205km. Tower structures would be installed with appropriate footings to ensure stability, and the tower structures themselves do not represent a significant barrier which would serve to concentrate surface water flow. As is the case with all of TransGrid's assets, appropriate emergency response procedures exist. The integrity of the structures would be assessed and repair works commissioned in the event of damage from a storm or flooding event.

4.1.4 Changes to Surface Water Quality

Changes to surface water quality could eventuate from chemical contamination carried in surface water run off, or through sedimentation from ground disturbance.

Runoff from work sites and structure locations as well as areas cleared of vegetation for access tracks and easement areas may contain high levels of sediments which could enter the natural drainage system. The soils at disturbed sites are likely to have a high percentage of fines, and may or may not be dispersible as discussed in **Chapter 7 Soils, Geology and Topography (Volume 1 EA)**. Given the undulating topography across much of the proposed alignment, construction activities are likely to present an erosion hazard, and mitigation measures including the preparation of an Erosion and Sediment Control Plan would be implemented as part of the CEMP. Potential impacts to water quality derive from the crossing of surface water features, sediment movement from ground disturbance at structure sites and as a consequence of driving vehicles over unsealed or unprepared surfaces. A reduction in streamwater quality can occur as a result of runoff, the spread of invasive weed species and erosion.

Planning of the Project has considered the location of waterways and the potential impact of runoff. In line with the NSW Office of Water's Controlled Activities Guidelines, the design has ensured that the majority of Angle Positions would be located greater than 40m from any surface water feature. The location of intermediate supporting structures as assessed in this report are indicative. The design process for finalising intermediate structure locations would take into account the preference to avoid areas within 40m of surface water features. This objective is necessarily balanced alongside other objectives to minimise impacts to vegetation and heritage sites. Appropriate erosion and sedimentation measures would need to be applied to any such area where impacts in proximity to watercourse are unavoidable (e.g. installation of sediment controls such as sediment fences). In addition, riparian vegetation would need to be maintained wherever feasible in order to limit the disturbance to the bank and riparian environment.

During construction works, there is the potential for spills and gross pollutants to be mobilised by runoff and to enter the natural drainage system in the absence of appropriate mitigation measures. Additional impacts could potentially arise due to the proposed construction of the Tenterfield 330kV Substation. Within the proposed substation compound, all major oil filled pieces of equipment would be installed within an area serviced by primary containment. Further discussion is presented in **Section 5- Mitigation Measures.**

The secondary oil containment dam would be designed to capture discharge from the primary oil containment tank and the drainage area of 10m beyond this as an additional precautionary design measure.

4.1.5 Surface Water Use in Construction

The use of water would be required during the construction of the transmission line and the Tenterfield 330kV Substation for concrete batching, access track construction, dust suppression activities, drilling work for footings and for earth staking installation. Exact water requirements would be determined at the detailed design stage, however it is estimated from previous projects that approximately 4 to 4.5 mega litres of water would be required for the entire Project. It is expected that sufficient water would be available from town water supplies and artificially constructed dams to service all construction water requirements. During the construction phase, consultation with NSW Office of Water would be undertaken to ensure that permitting requirements are met. No ongoing water supply would be required for the operational phase of the transmission line.

4.2 Groundwater - Potential Impacts

The Project is considered unlikely to impact upon groundwater. No groundwater would be extracted for use during construction. The hydrogeological properties and groundwater flow patterns inclusive of seasonal variations has not been assessed as part of this current assessment due to the shortage of existing information relating to near-surface groundwater in the study area as well as the low potential for construction to intercept groundwater. As discussed with relevance to the *Ground Water Management Handbook* (SCCG 2006) in **Section 3.4**, groundwater interception for the project would be restricted to pile and footing installations, and the guidance states that a detailed Geotechnical and Hydrogeological Report would therefore not be required.

The primary potential impact to groundwater arises through the boring and excavation works for the installation of support structures and access tracks in locations where shallow aquifers exist. These activities could lead to:

- potential changes to hydrological conditions due to dewatering activities; and
- water quality decline / contamination.

4.2.1 Boring and Excavation Works

Potential interception of the water table could occur as a result of excavation works for various components of the Project. Excavation for the purposes of building the Tenterfield 330kV Substation, as well as the erection of supporting structures would generally require boring foundations to a depth of around 5m. It is anticipated that the groundwater level across most areas is unlikely to be within 5m of the ground surface and therefore it would be unlikely that ground disturbing excavation would directly impact on groundwater across the majority of the Project.

4.2.2 Changes to Groundwater Hydrology

As discussed in **Section 3.4,** the depth to groundwater across alluvial floodplain areas is likely to be shallower towards the eastern end of the alignment between Casino and Lismore. The ground surface in low-lying floodplain areas across Alignment East may intersect the water table and become inundated after significant rainfall. Shallower water tables may be intersected by construction boring or excavation, in which case, there may be a requirement for dewatering of access track excavations or structure footings to manage groundwater inflow into excavations during the construction phase. Dewatering is the process of removing groundwater to lower the water table below the lowest level of excavation. This allows construction to proceed in safety by limiting the potential for excavation instability (either through wall collapse or floor heave) and preventing waterlogged ground conditions.

Dewatering, if not carried out appropriately for the local conditions, has the potential to result in adverse environmental impacts including the following:

- temporary or long term disruption to the water table beneath the site or adjacent properties;
- potential ground settlement as a consequence of drawdown;
- disruption to groundwater dependent ecosystems;
- saltwater intrusion or inflow of contaminated groundwater resulting from excessive or prolonged pumping; and
- discharge of contaminated water into the public drainage systems and waterways (SCCG, 2006).

The construction of the Project would not be expected to cause a significant disruption to the water table given the small extent and discrete nature of potential access tracks and structure footing excavations which would be required. The distances between the proposed structures would be between 200 - 500m, with access track construction proceeding in accordance with the four stages outlined in the Project Schedule (refer to **Section 4.4 Chapter 4, Volume 1 EA**). A significant cumulative impact on the underlying groundwater would not be expected as a result of the described works being carried out at discrete sites with significant separation along the 205km alignment.

The location of Project is not within close proximity to any groundwater dependent ecosystems (**Appendix C, Figure C-3**), and would not traverse urban built up areas.

4.2.3 Changes to Groundwater Quality

Where structure footings intersect or occur in close proximity to groundwater levels, the groundwater would be more vulnerable to impacts from contamination associated with construction works. This could potentially entail contamination from chemicals (from the use of herbicides during vegetation clearance for example), or fuel / oil spills from machinery or plant.

The low potential for land contamination is discussed in **Chapter 7 Soils, Geology and Topography (Volume 1 EA)**, and contaminated groundwater in the vicinity of the Project would be unlikely due to the undeveloped nature of the region. The discharge of contaminated water into the public drainage systems and waterways would therefore be an unlikely impact of any dewatering works which may be required across the eastern portion of the study area where the groundwater levels are known to be shallow. Given the small volume of groundwater likely to require dewatering during the construction of supporting structure footings, it is likely that groundwater extracted through dewatering would be disposed of through overland infiltration. Discharge would be released over vegetated areas to prevent the runoff of sediment which may be present in the groundwater. Should any dewatering be required during construction, a temporary construction dewatering licence would be obtained from the NSW Office of Water prior to works commencing.

It should be noted that the design of project components and the proposed construction methods preclude the need for permanent dewatering. In addition, methods and materials used for construction would not cause pollution of groundwater. Mitigation measures including the restriction of refuelling activities to areas beyond 40m from a watercourse would also prevent the contamination of groundwater, given that surface water features are important recharge areas.

4.3 Assessment Against Water Quality and River Flow Objectives

The impact of the Project on the current condition of the Border Rivers, Clarence River and Richmond River basins is considered below. The assessment has considered the potential of the Project to affect the water quality and river flow objectives for these catchments.

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Table 4-3 Assessment of Project Compatibility with Water Quality and River Flow Objectives

Objectives	Relevant CMAs	Potential impact	Conclusion / Management measures
Water Quality Objectives			
Protection of Aquatic ecosystems	Border Rivers, Richmond Rivers, Clarence River+	Project would include the construction of access tracks and include installation and upgrade of watercourse crossings. Watercourse crossing locations identified to date include Class 3 watercourses which tend to provide low degree of aquatic habitat.	Project would potentially adversely impact upon this objective at discrete and disparate locations along the 205km alignment. However provided the mitigation measures discussed in **Section 5.1.1** are implemented, adverse impacts should be minimal.
Protection of Visual amenity	Border Rivers, Richmond Rivers, Clarence River+	Potential sediment impacts and run off from construction site areas may impact the visual amenity of waterways.	Providing mitigation measures discussed in Section 5.1.1 are implemented, adverse impacts should be minimal.
Secondary contact recreation	Border Rivers, Richmond Rivers, Clarence River+	Potential water quality impacts from erosion and run off from construction site areas may impact upon this objective.	Providing mitigation measures discussed in Section 5.1.1 and 5.2 are implemented, adverse impacts should be minimal.
Primary contact recreation	Border Rivers, Richmond Rivers, Clarence River+		
Livestock water supply	Border Rivers, Richmond Rivers, Clarence River+	This objective is generally attainable if aquatic ecosystems are protected.	Project would potentially adversely impact upon this objective at discrete and disparate locations along the 205km alignment. However provided the mitigation measures discussed in **Section 5.1.1** are implemented, adverse impacts should be minimal.
Irrigation water supply	Border Rivers, Richmond Rivers, Clarence River+	The Project would not impact upon water supply arrangements across the Project area.	N/A
Homestead water supply	Border Rivers, Richmond Rivers, Clarence River+		
Drinking water at point of supply-Disinfection only	Border Rivers, Richmond Rivers, Clarence River+	The Project would not impact upon any potential drinking water supplies	N/A
Drinking water at point of supply-Clarification and disinfection	Border Rivers, Richmond Rivers, Clarence River+		
Drinking water at point of supply-Groundwater	Border Rivers, Richmond Rivers, Clarence River+		

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Objectives	Relevant CMAs	Potential impact	Conclusion / Management measures
Aquatic foods (cooked)	Border Rivers, Richmond Rivers, Clarence River+	Predominant project impact would be at locations where watercourse crossings are required, and those identified to date are for Class 3 waterways which are generally drainage lines with intermittent flow, or which flow only following rain events. Aquaculture activities would not be suitable in these waterways.	N/A
River Flow Objectives			
Protect pools in dry times	Border Rivers, Richmond Rivers, Clarence River+	The Project does not involve water extraction from streams or wetlands in periods of low or no flow. Watercourse crossings may potentially impact on the hydrology of surface water flows.	It is unlikely that the Project would adversely impact these objectives, given that watercourse crossings proposed for access to the alignment (where these cannot be avoided) would be subject to site assessment and would be designed in accordance with department of Primary Industries *Policy and Guidelines for Fish Friendly Waterway Crossings* (2004) and *Why Do Fish Need to Cross the Road?* (NSW Fisheries, 2003). Providing that the recommended mitigation measures for the Project are strictly adhered to, the potential to cause significant pollution of waters during the construction or operation phase would be minimal.
Protect natural low flows	Border Rivers, Richmond Rivers, Clarence River+		
Protect important rises in water levels	Border Rivers, Richmond Rivers, Clarence River+		
Maintain wetland and floodplain inundation	Border Rivers, Richmond Rivers, Clarence River+		
Mimic natural drying in temporary waterways	Border Rivers, Richmond Rivers, Clarence River+		
Maintain natural flow variability	Border Rivers, Richmond Rivers, Clarence River+		
Maintain natural rate of change in water levels	Border Rivers, Richmond Rivers, Clarence River+		
Manage groundwater for ecosystems	Border Rivers, Richmond Rivers, Clarence River+	The Project is unlikely to impact upon any groundwater dependent ecosystems given that none exist in close proximity to the alignment.	N/A
Minimise effects of weirs and other structures	Border Rivers, Richmond Rivers, Clarence River+	The Project would not involve the construction of any permanent dams or the installation of weirs. Watercourse crossings would be required at selected locations. Watercourse crossings may potentially impact on the hydrology of surface water flows.	It is unlikely that the Project would adversely impact upon these objectives given that watercourse crossings proposed for access to the alignment (where these cannot be avoided) would be subject to site assessment and would be designed in accordance with department of Primary Industries *Policy and Guidelines for Fish Friendly Waterway Crossings* (2004) and *Why Do Fish Need to Cross the Road?* (NSW Fisheries, 2003) (refer to Section 5.1.1).
Minimise effects of dams on water quality	Border Rivers		

+ It is noted that the water quality and river flow objectives for the Clarence River System are based on outcomes from the Healthy Rivers Commission 1999 - Independent Inquiry into the Clarence River System which include:

- *Protection of aquatic ecosystems, visual amenity, primary and secondary contact recreation, and the human consumption of crustaceans and shellfish should be provided throughout the catchment.*
- *The river system should be restored, realising that there are land use and river needs.*

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- *Revegetation of river banks with native vegetation should be undertaken.*
- *Contamination of the river should be prevented, especially if used as a drinking water source, for recreational use, or for aquaculture.*
- *The community should be able to maintain current urban and rural activities. (Healthy Rivers Commission 1999 - Independent Inquiry into the Clarence River System).*

The impact of the Project construction on the above stated water quality objectives would be minimal given the mitigation measures outlined in **Section 5**, and given that supporting structures, work site areas and access tracks have been preferentially positioned further than 40m from water features wherever possible. As described in the Project Description (**Chapter 4, Volume I of the EA**), the number of vehicle movements associated with the Project at any one location would be low. It would be unlikely that the Project would negatively impact upon livestock water use or the recreational use of creeks. Water for construction activities would not be sourced from natural water sources, and the impacts of construction would be mitigated to prevent surface run-off of sediment and nutrients into local waterways, these mitigation measures are outlined in **Chapter 19.** It is unlikely that the Project would negatively impact upon the goal of maintaining aquatic ecosystem health, given that vegetation would be maintained along the riparian zones of waterways where this would not impact upon safety clearance requirements.

Access to the alignment would require a number of water crossings to be either constructed or upgraded as discussed in **Section 4.1.2**. The design and construction of all tracks across waterways would be in accordance with the NSW Department of Primary Industries policy and guidelines and TransGrid specifications (NSW DPI (2003); NSW DWE (2008)). All proposed works would be undertaken in a manner to minimise the potential for soil erosion, sedimentation and water quality decline across the proposed alignment.

The Project would enable the appropriate upgrade of a number of existing watercourse crossings. At present, eight such locations have been identified within and in close proximity to Alignment West. A preliminary characterisation of existing watercourse crossings in the vicinity of the Project concluded that a number of crossings were outdated and in need of upgrade in accordance with current best practice.

Upgrades carried out as the result of the Project would likely improve the natural flow and variability of watercourses within the alignment, given that outdated and ineffective structures would be removed and replaced with instream structures informed by the NSW Office of Water (2010) and NSW Department of Primary Industries guidelines for watercourse crossings (2003).

5

Mitigation Measures

This assessment has identified the potential impacts of the Project on surface water and groundwater features across the study area. Mitigation measures are set out in this section to identify effective and appropriate management strategies to reduce or avoid the potential impacts of construction activities and ongoing operation of the Project.

5.1 Dismantling and Construction Phase

5.1.1 Surface Water Quality

Prevention of Soil Erosion and Sedimentation Impacts

The location of the proposed Tenterfield 330kV Substation, supporting structures and access tracks have aimed to avoid heavily vegetated and riparian areas in order to reduce as far as practical the area subject to soil disturbance. New supporting structures would be constructed at the locations of existing structures across Alignment East wherever possible to limit the areas of disturbance. All areas disturbed during works would be revegetated or otherwise stabilised as soon as practicable following construction activities successively along the line.

At a minimum, the measures outlined in the *Managing Urban Stormwater –Soils and Construction Volume 1 and 2* (NSW Department of Housing, 2004) (commonly referred to as the Blue Book) would be implemented for all construction works. An Erosion and Sediment Control Plan would be developed and implemented for each work site. Construction would be planned to minimise the time that disturbed land is exposed, and areas which are disturbed would be managed with appropriate erosion and sedimentation control devices installed and maintained in line with the Blue Book. These devices would remain in place until the surface is stabilised. Weather predictions for the area would be consulted prior to the commencement of clearing works and clearing would not be undertaken when large rainfall periods are predicted.

The three key ways that erosion and sediment control would be undertaken for the project would be:

1. construction of diversion banks and channels above the site to intercept and divert clean water away from disturbed ground;
2. construction of cross banks and drains in disturbed areas including unsealed access tracks, together with filters and other equipment as necessary to prevent dirty water and sediment escaping the work site; and
3. treatment of any dirty water captured prior to release.

Where necessary, practices would also include:

- clear demarcation of clearing limits and site boundaries including restricted access to sensitive areas and non-essential areas;
- limiting the removal of ground covering vegetation to that required for the construction and operation of the line;
- appropriate physical stabilisation techniques including geotextiles and replanting;
- regular maintenance of erosion and sediment controls especially after rain and when more than 30% full;
- maintenance of drains and culverts to minimise the impacts of erosion of unsealed tracks; and
- mulching or revegetation of cleared areas as soon as possible to permanently stabilise the soil.

5 Mitigation Measures

Access Track Design and Construction

Principles which would be followed as part of the design and construction of the access tracks include:

- any new access tracks would follow the contour of the land as far as possible, minimising earthworks and drainage requirements;
- stormwater would be controlled by construction of table drains with mitre drains as required, and cross drains to control concentration of runoff;
- temporary erosion and sediment control measures would be installed prior to access track construction/upgrade until site stabilisation in accordance with the Blue Book (Volume 2); and
- erosion control measures would be monitored and maintained during the construction works to ensure that their effectiveness is maintained.

The construction of access tracks and associated environmental management would be included in the Construction Environmental Management Plan (CEMP).

Watercourse Crossing Design and Construction

Where possible, new crossings for the project would be designed and constructed in accordance with Department of Primary Industries *Policy and Guidelines for Fish Friendly Waterway Crossings* (2004) and *Why Do Fish Need to Cross the Road?* (NSW Fisheries, 2003, if this proved to be unachievable, NSW Industry and Investment would be consulted during design and prior to construction of crossings. Where clearing is required, this would be undertaken in accordance with TransGrid's policy for clearing for transmission lines: GD AS G3 015.

Prevention of chemical contamination

Where possible refuelling would be carried out at least 20m from a watercourse on a flat area or preferably within a bunded area of the site compound. Handling measures including the use of drip trays would be in use for refuelling in the field. If refuelling is required in proximity to a watercourse, this would be carried out within a lined and bunded area.

Primary and secondary containment bunding would be incorporated into the Tenterfield 330kV Substation design and would be in place prior to the installation for any oil filled equipment. The primary containment system would consist of a bunded area around the equipment draining to a primary oil containment tank. In accordance with TransGrid Policy GD AS G2 101 Oil Containment in Substations, this would include:

- bunding to be provided to Australian Standard 1940 (2004);
- bund capacity would exceed 100% of the largest oil volume of any tank within the bund;
- each bund would drain via a flame trap to a primary oil containment tank;
- bund drainage would be designed to drain the largest oil volume plus 100mm of water within 20 minutes;
- the bunds housing main transformers would have two full capacity grated drains with flame traps; and
- the primary containment system drainage design would manage an inflow of the largest oil volume plus firewater inflow, and a concurrent 1 in 10 year rain storm event.

The secondary oil containment dam would be designed to capture discharge from the primary oil containment tank and the drainage area of 10m beyond this as an additional precautionary design measure.

Where a spill occurs, TransGrid emergency procedures would be followed and the spill would be cleaned up immediately.

5.1.2 Groundwater Quality

Dewatering works if required would be appropriately licensed and carried out by suitably trained personnel.

5.2 Operational Phase

Prevention of Soil Erosion and Sedimentation Impacts

Potential surface and groundwater impacts arising during the operational phase of the project would be limited. Once previously disturbed areas are stabilised and rehabilitation has occurred in areas where permanent vegetation clearance is not required for periodic line inspection, the operational phase would primarily involve the maintenance of required access tracks and easement clearance.

The adherence to appropriate mitigation measures would ensure no significant soil erosion and sedimentation impacts would occur as a result of the Project.

Watercourse Crossing Maintenance

The condition of all upgraded and newly constructed watercourse crossings would be inspected by TransGrid as part of maintenance inspections along the line. Repairs would be carried out to ensure all causeway or culvert installations remain in good working order. Significant adverse impacts from watercourse crossings would not be expected.

Prevention of chemical contamination

The Tenterfield 330kV Substation would be designed to operate without continuous on-site personnel. Primary and secondary containment bunding would be incorporated into the substation design to ensure that any potential spills from oil filled equipment would be adequately contained.

During normal operation, a mobile operator and various design and maintenance staff may visit the substation to perform routine tasks and inspections as part of a regular maintenance program. The maintenance program would ensure that potential impacts are appropriately managed throughout the life of this project component. Potential small spills during maintenance work from equipment with minor quantities of oil (less then 100L), would be captured by unbunded areas composed of crushed blue metal rock surfaces. If a spill was to occur, clean-up activities would occur immediately in accordance with existing TransGrid policies for substation operation, namely *GD AS G2 101 Substation Oil Containment Principles* and *GM EN G2 001 Oil Management in Substations*.

5.3 Mitigation Measures Summary

Table 5-1 summarises the mitigation measures proposed to manage the surface and groundwater impacts of the construction and operation phase of the Project. Provided the mitigation measures listed below are adhered to, the Project would be in broad agreement with the water quality and river flow objectives for the major river basins through which the alignment passes.

5 Mitigation Measures

Table 5-1 Summary of Mitigation Measures – Surface Water and Hydrology

Mitigation Measures	Implementation of mitigation measures		
	Design	Construction	Operation
Supporting structures and associated access tracks would be preferentially located further than 40m from any surface water feature.	✓		
Erosion control measures would be implemented at each supporting structure work sites, at the substation construction site, and at the locations of all Access tracks to be upgraded or constructed.		✓	
Temporary drainage and sediment controls would be installed around the proposed Tenterfield 330kV Substation to collect surface water flows from areas likely to be disturbed during construction. Disturbed areas would be stabilised and or revegetated prior to the removal of these measures.	✓	✓	
Where practicable, tankers transporting fuel/herbicide would be parked on level ground and a minimum of 40m away from prescribed streams or water bodies.		✓	✓
All access roads would be appropriately constructed and maintained during the construction phase and ongoing operation of the Project. All works would be undertaken in accordance with Managing Urban Stormwater: Soils and Construction Volume 1 (Landcom, 2004) and Volume 2 (DECC, 2008) (The Blue Book Volumes 1 and 2) and DLWC 2004 Guidelines.	✓	✓	✓
Establishment of new watercourse crossings would be avoided wherever practicable through consideration of alternative routes. Preference would be given to the upgrade of existing roads and tracks over establishment of new tracks.	✓	✓	
Watercourse crossings would be designed in accordance with department of Primary Industries Policy and Guidelines for Fish Friendly Waterway Crossings (2004) and Why Do Fish Need to Cross the Road? (NSW Fisheries, 2003)	✓	✓	
Watercourse crossings would be constructed in accordance with TransGrid specifications and undertaken in accordance with the NSW Department of Primary Industries Policy and Guidelines for Fish Friendly Waterway Crossings (2004) and Why Do Fish Need to Cross the Road? (NSW Fisheries, 2003) as well as Controlled Activity Guidelines under the Water Management Act 2000.	✓	✓	
Watercourse crossing culvert size would be matched to the natural stream width to minimise high speed flows which can occur when water is forced through a narrow opening. Low flow culverts would be designed to ensure deep water is provided for larger fish during low flow periods.		✓	
Any required dewatering activities would be carried out in strict compliance with NSW Office of Water licensing conditions.		✓	

5 Mitigation Measures

Mitigation Measures	Implementation of mitigation measures		
	Design	Construction	Operation
Oil containment design within the proposed Tenterfield 330kV Substation would ensure all major oil filled equipment would be located within primary and secondary containment systems. The primary containment system would comply with the following requirements: — bunding to Australian Standard 1940 (2004); — bund capacity would exceed 130% of the largest oil volume of any tank within the bund plus 100mm of freeboard; — each bund would drain to a substation oil containment system; and — TransGrid document GD AS G2 101 Oil Containment in Substations.	✓		
Where possible, no refuelling shall occur within 40m of a prescribed stream or water body.		✓	✓
In the event of prolonged wet conditions creating vulnerability for water quality impacts, TransGrid would direct the contractor to cease work at any location where it is considered that there is a significant risk to water quality until conditions improve.		✓	

6

Conclusion

The proposed Project would be unlikely to alter or impede natural drainage patterns.

It is considered that there is limited potential for the proposed Project to cause significant pollution of waters through sedimentation of streams and watercourses due to the following factors:

- route selection and project design has endeavoured to minimise the number of supporting structure locations and Access tracks in close proximity to surface water features;
- creek and gully crossings would be designed to minimise disturbance by construction vehicles;
- the number of vehicle movements associated with the project at any one location would be low;
- the contractor would implement erosion and sediment controls as indicated in **Table 5-1** and the outline CEMP provided in **Chapter 19 Draft Statement of Commitments (Volume 1 EA)**; and
- in the event of prolonged wet conditions creating vulnerability for water quality impacts, TransGrid would direct the contractor to cease work at any location where it is considered that there is a significant risk to water quality until conditions improve.

Any potential impacts to groundwater hydrology would be expected to be short in duration and would be highly limited in extent due to the discrete nature of structure footing requirements, the significant spacing between each structure, as well as the overall limited depth of the anticipated intrusion for all construction works including the access tracks and substation construction. No impacts to groundwater quality are anticipated for the proposed Project.

Glossary

Acid Sulfate Soil	The common name given to naturally occurring soil and sediment containing iron sulfides, principally the mineral iron pyrite, or containing acidic products of the oxidation of sulfides. When sulfides are exposed to air, oxidation takes place and sulfuric acid is ultimately produced when the soil's capacity to neutralize the acidity is exceeded. As long as the sulfide soils remain under the water table, oxidation cannot occur and the soils are quite harmless and can remain so indefinitely.
Aquifers	An underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, silt, or clay). The surface of saturated material in an aquifer is known as the water table.
Causeway	A road that is raised above water or marshland or sand.
Culvert	A culvert is a conduit used to enclose a flowing body of water. It may be used to allow water to pass underneath a road, railway, or embankment for example.
Dewatering	Dewatering is the process of removing groundwater from an aquifer to lower the water table below the lowest level of excavation. This allows construction to proceed in safety by limiting the potential for excavation instability (either through wall collapse or floor heave) and preventing waterlogged ground conditions.
Dispersible soils	Soils that are structurally unstable and disperse in water into basic particles i.e. sand, silt and clay.
Ephemeral	Streams that flow only during and immediately after precipitation are termed ephemeral.
First order streams	A stream of the first order is a stream which does not have any other stream feeding into it. When two first-order streams come together, they form a second-order stream. When two second-order streams come together, they form a third-order stream.
Groundwater dependent ecosystems	Ecosystems that use groundwater as part of survival, and can potentially include wetlands, vegetation, mound springs, river base flows, cave ecosystems, playa lakes and saline discharges, springs, mangroves, river pools, billabongs and hanging swamps. The groundwater dependence of ecosystems will range from complete reliance to those that partially rely on groundwater, such as during droughts. The degree and nature of dependency will influence the extent to which ecosystems are affected by changes to the groundwater system, both in quality and quantity.
Hydrogeology	The branch of geology dealing with the waters below the earth's surface and with the geological aspects of surface waters
Inundation	Flooding, by the rise and spread of water, of a land surface that is not normally submerged.

7 Glossary

Leachate	Leachate is the liquid that drains or 'leaches' from a specific material; It can usually contain both dissolved and suspended material.
Riparian zone	A riparian zone or riparian area is the interface between land and a stream. Plant communities along the river margins are called riparian vegetation
Saltwater intrusion	When fresh water is withdrawn at a faster rate than it can be replenished, a draw down of the water table occurs with a resulting decrease in the overall hydrostatic pressure. When this happens near an ocean coastal area, salt water from the ocean intrudes into the fresh water aquifer as shown in the diagram. The result is that fresh water supplies become contaminated with salt water.
Soil fines	Refer to uncompacted and loose soil particles

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9

Limitations

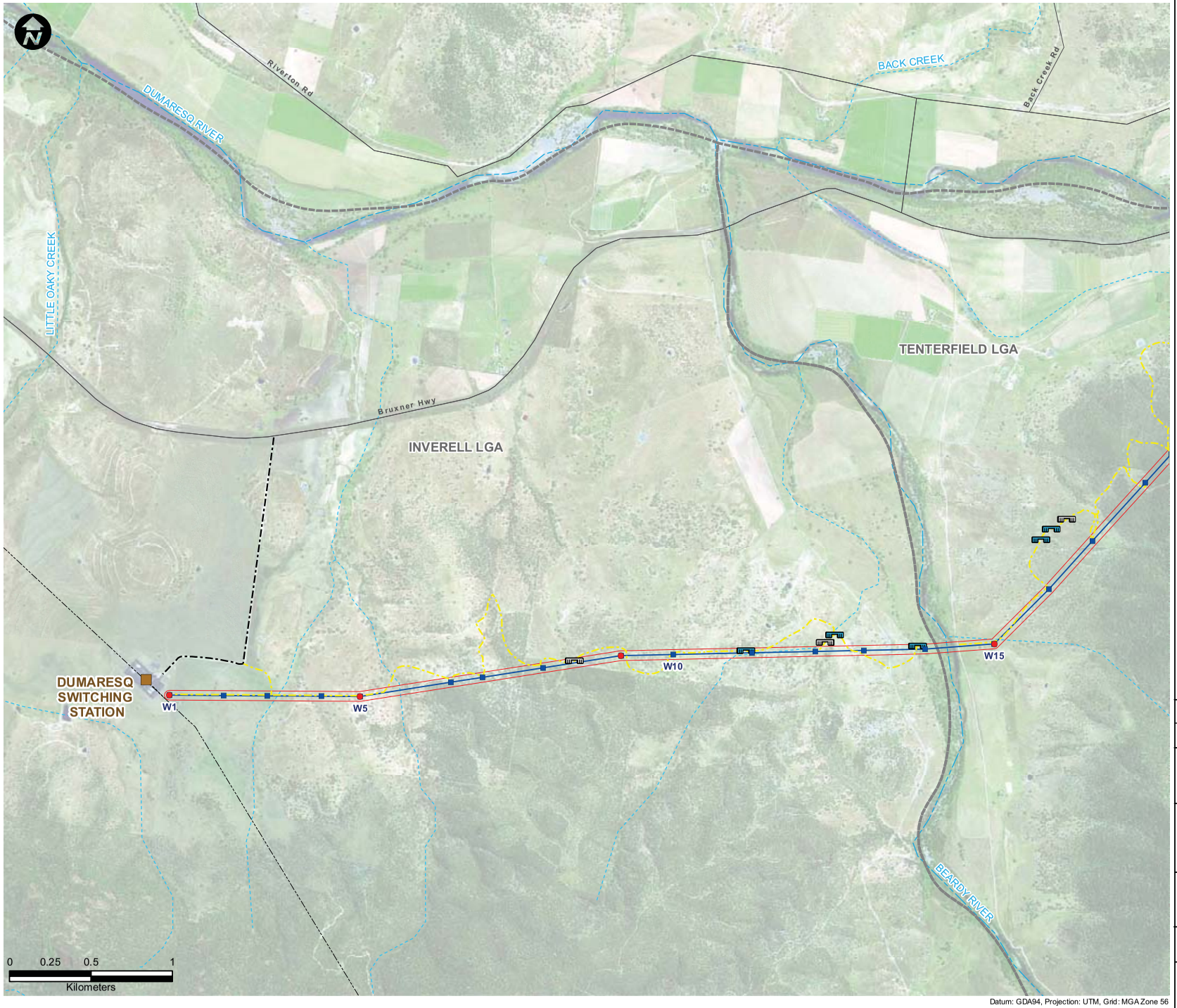
URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of TransGrid and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal Q107/08 dated 10 November 2008.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between September 2009 and February 2010 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

Figure 2 Series



Datum: GDA94, Projection: UTM, Grid: MGA Zone 56

LEGEND:

- Existing 96L 132kV Structure Locations^
- Existing Transmission Lines^
- Proposed 330kV Angle Positions (Indicative)^
- Proposed 330kV Structure Locations (Indicative)^
- Proposed 330kV Centreline^
- Proposed 330kV Easement^
- Substation/Switching Station
- Roads

Waterways*:

- Class 1: Permanent Flow
- Class 2: Permanent / Intermittent Flow
- Class 3: Intermittent Flow

Access Tracks:

- Category 1*
- Category 2**
- Category 3***
- Creek Crossing (New)
- Creek Crossing (Upgrade Required)
- Local Government Area

***Category 1** : Minimal work required. This would include removal of surface obstacles and/or minor upgrades to existing tracks (i.e. resurfacing, widening etc). Some imported sand and gravel may be required.
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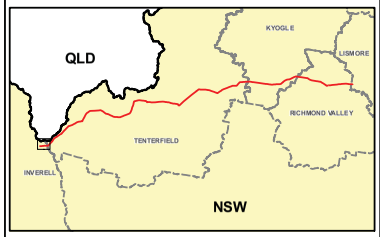

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* Fairfull and Witheridge, 2003
Commonwealth of Australia (Geoscience Australia) 2010

Drawn: AO/SB	Approved: WM/TH	Date: 21/02/2011
Job No.: 43177662	File No.: 43177662.140.mxd	

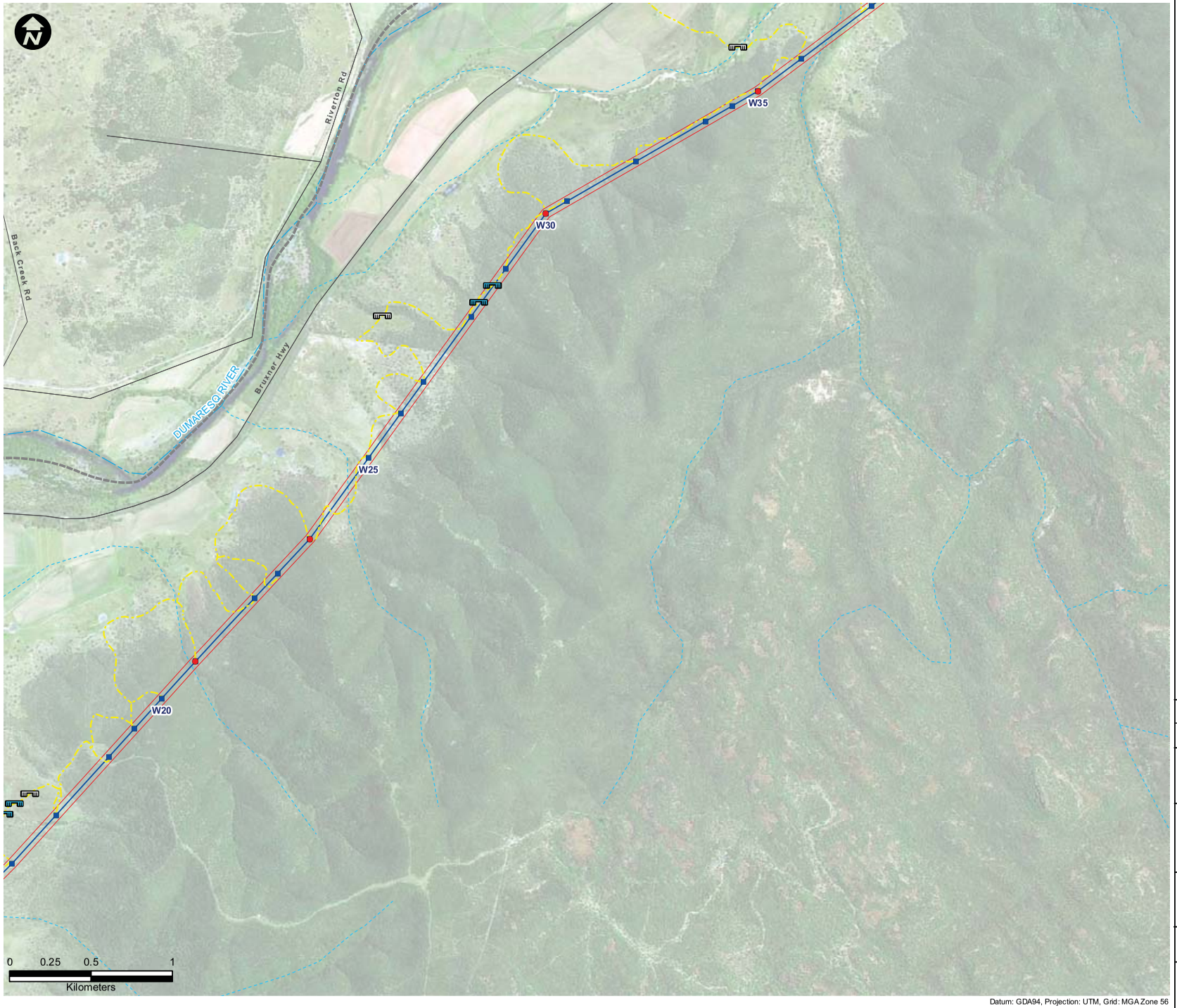
Client: TransGrid

Project: FAR NORTH NSW (DUMARESQ - LISMORE 330kV TRANSMISSION LINE) PROJECT

Title: 330kV TRANSMISSION LINE ALIGNMENT AND ACCESS TRACKS AERIAL

Figure: 2-1a

URS



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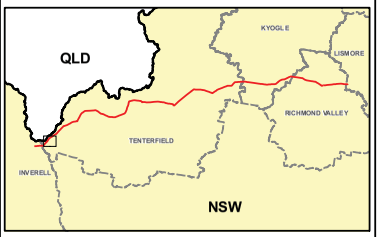

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Title: 330kV TRANSMISSION LINE ALIGNMENT AND ACCESS TRACKS AERIAL

Figure: 2-1b

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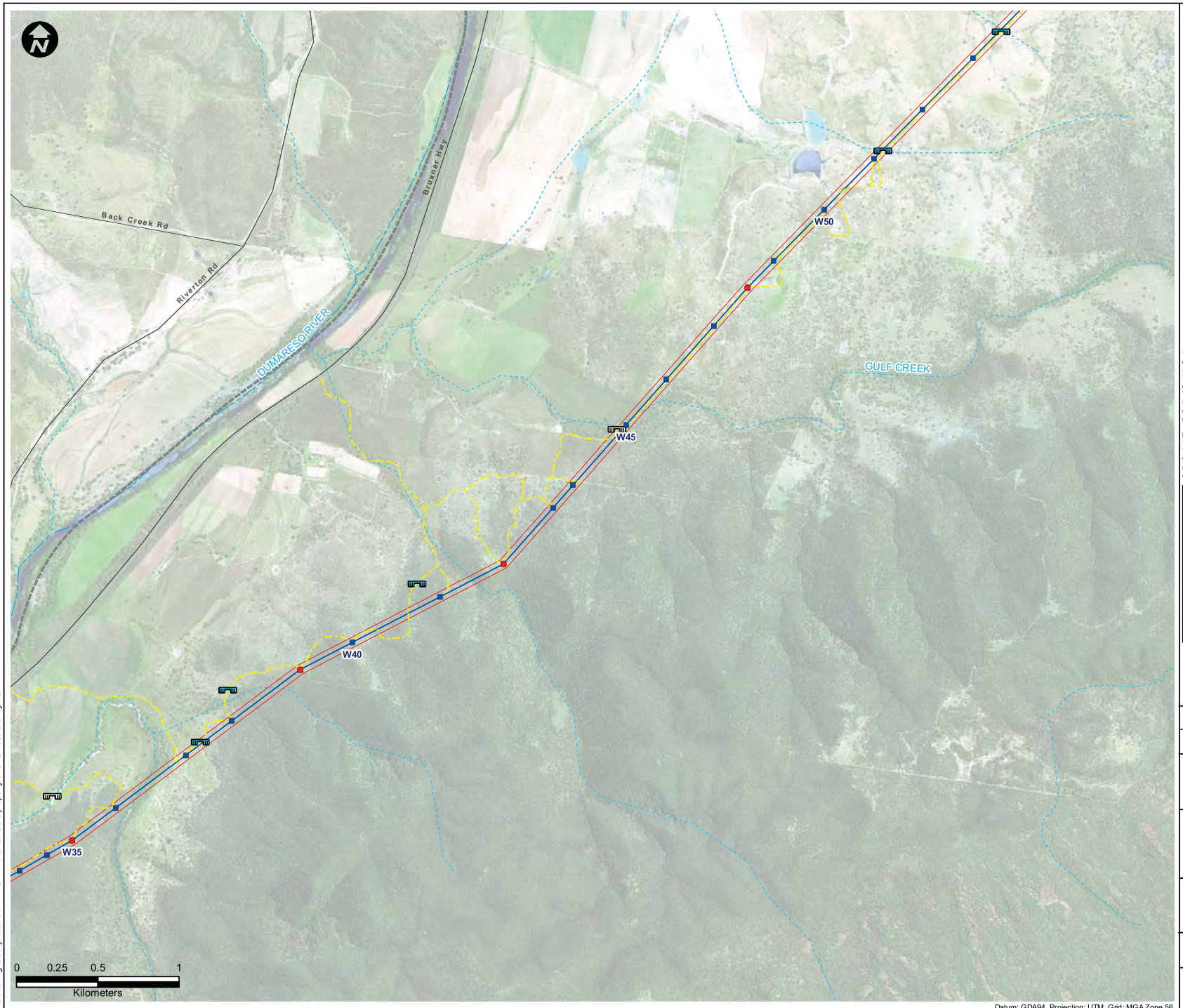

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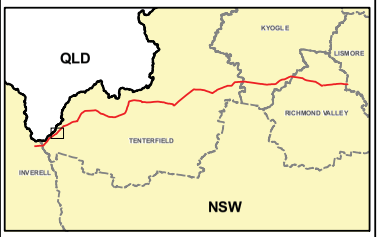

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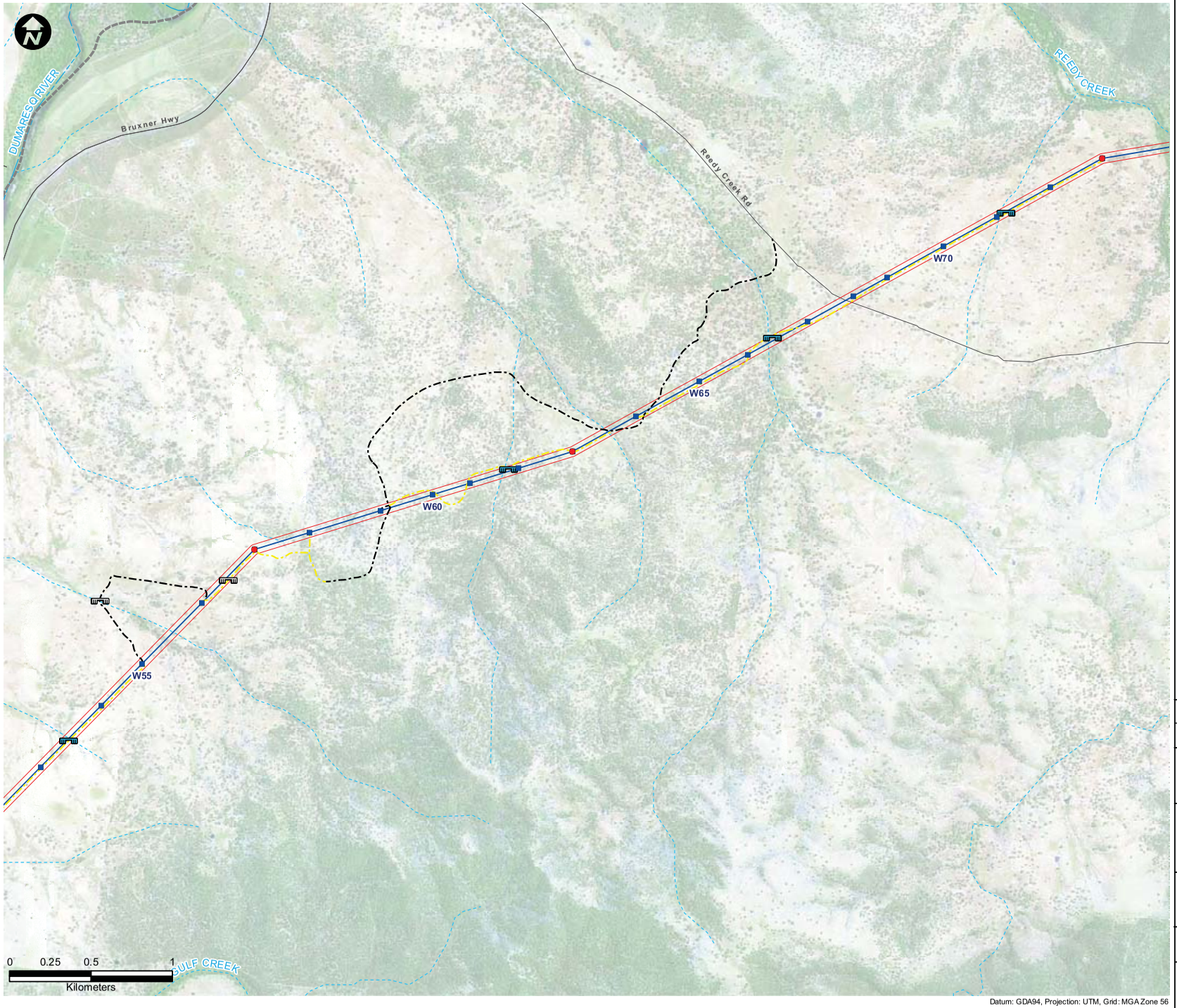
Project: FAR NORTH NSW (DUMARESQ - LISMORE 330kV TRANSMISSION LINE) PROJECT

Title: 330kV TRANSMISSION LINE ALIGNMENT AND ACCESS TRACKS AERIAL

Figure: 2-1c

URS



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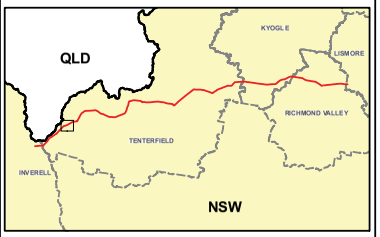

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Project: FAR NORTH NSW (DUMARESQ - LISMORE 330kV TRANSMISSION LINE) PROJECT

Title: 330kV TRANSMISSION LINE ALIGNMENT AND ACCESS TRACKS AERIAL

Figure: 2-1d

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