APPENDIX 3: ADDITIONAL INFORMATION ON GROUNDWATER RESOURCES

GROUNDWATER RESOURCES

A number of groundwater sources exist in the study area. The NSW Office of Water (2010a) groups aquifer types into four basic categories:

1. Fractured rock aquifers found in rock formations such as granite or basalt. Groundwater in these rocks occurs mainly within the fractures and joints. The North Coast Fractured Rocks and Alstonville Basalts make up the fractured rock aquifers in the study area (shown in pink in Figure A3.1);
2. Coastal sand aquifers, where groundwater is contained in the pore spaces in the unconsolidated sand sediments;
3. Porous rock aquifers found in rock formations such as sandstone or limestone. Groundwater occurs within the pore space in the rock matrix. The Clarence Moreton Basin (shown in green) in Figure A3.1 represents porous rock aquifers in the study area; and
4. Alluvial aquifers, where groundwater is contained in the pore spaces in the unconsolidated floodplain material.

Figure A3.1 shows the location of groundwater sources in the study area. Further discussion of each of the four main aquifer types is provided below.

A1.1 Fractured Rock aquifers

The fractured basalt aquifers are an important resource of fresh groundwater and the majority of groundwater use in the study area is from these aquifers. Permeability is due to jointing and vesicular zones within the basalt and perennial springs from the basalt maintain a large number of creeks (Drury, 1982). Bore yields are variable, ranging from less than 0.5 L/s to greater than 30 L/s. High yields are dependent on intersecting one or more of the water bearing fracture zones.

The basalt groundwater system can be divided into two main components:

- A shallow, unconfined groundwater flow system in the weathered and shallow highly fractured basalt. This system tends to be localised with groundwater flow direction following topography; and
- A deep, semi-confined to confined groundwater flow system in fractured horizons within the basaltic sequence. Groundwater flow is controlled by geology with flow direction following the dip of the geological sequence.

The main basalt aquifers in the study area are:

- The Alstonville Basalt aquifer managed under the *Alstonville Groundwater Sources Water Sharing Plan*, which commenced on 1 July 2004; and
- The North Coast Fractured Rock Basalt aquifer which includes all basalt aquifers outside the boundary of the Alstonville Basalt Water Sharing Plan area and is not managed by a Water Sharing Plan.

Basalt aquifers of the plateau generally contain low salinity groundwater and have low nitrate concentrations. The pH values range from 4.6 to 9.8, and generally increase (becoming more alkaline) with depth. Shallow groundwater is slightly acidic, possibly due to the acidic krasnozem soils, and this causes a natural increase in dissolved metal concentrations, particularly aluminium, zinc, manganese, copper, iron and lead (Parsons Brinckerhoff, 2011). Bore yields range between 7 and 16 L/s for the bores installed in the Alstonville Basalt aquifer.

Rous Water currently operates two bores on the Alstonville Plateau and is licensed to extract 150 ML/a from Convery's Lane bore and 530 ML/a from Lumley Park bore. Ballina Shire Council also hold groundwater

licences for extraction of a combined total of 550 ML/a at Ellis Road and Lindendale Road bores near Alstonville. An assessment by Parsons Brinckerhoff (2011) concluded that none of the Rous Water bores are used to either their licensed volume or their maximum pumping capacity.

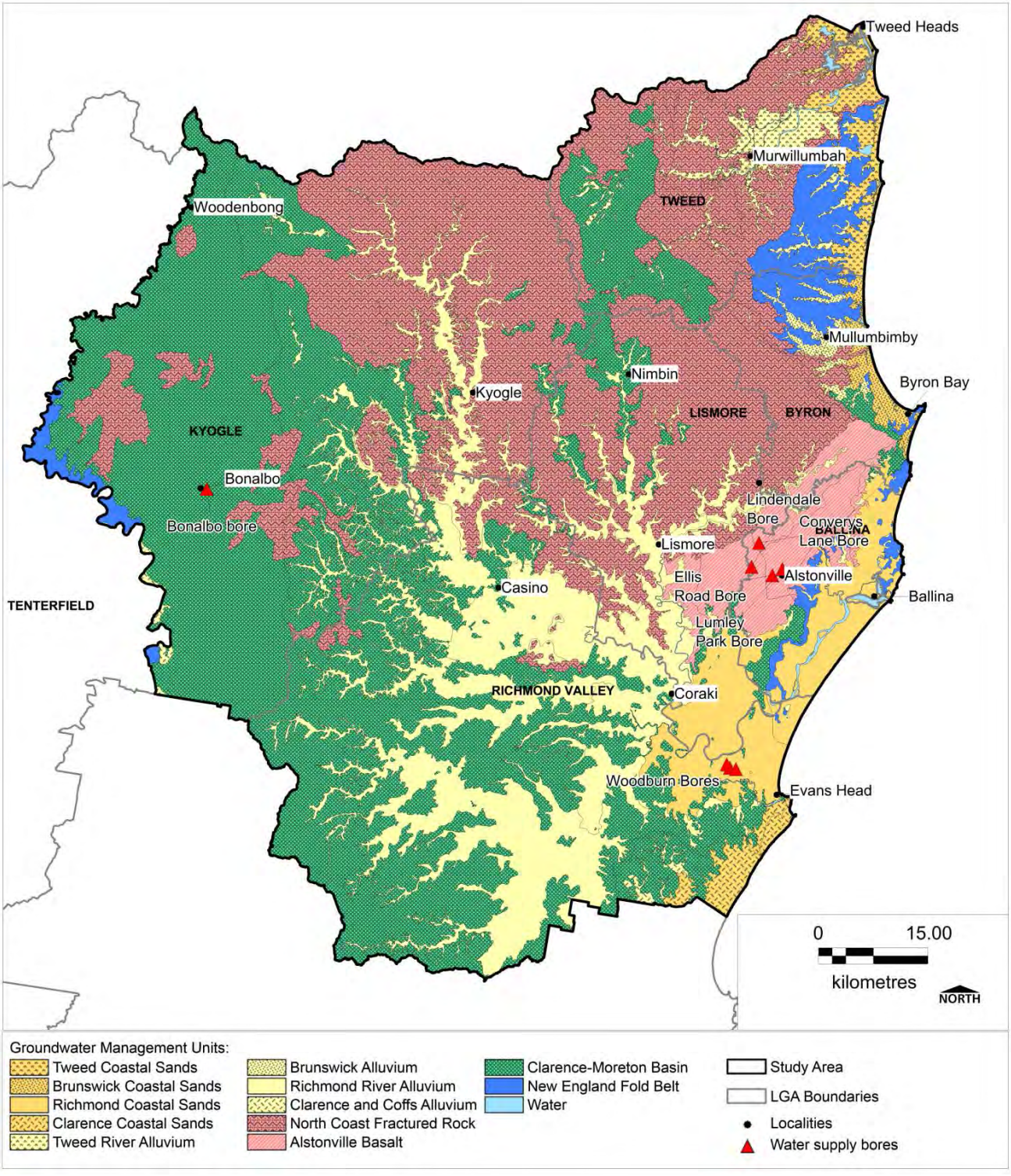

Figure A3.1: Groundwater sources in the study area

Mapping provided by NSW Office of Water, Jan 2013

The New England Fold Belt metasediments are categorised by NSW Office of Water into the Fractured Rocks category. The geology differs from the fractured basalts and consists of ancient rocks that have been deformed over hundreds of millions of years and mainly consist of slates, greywacke and granites. The New England Fold Belt generally lies beneath the fractured basalt layers, except for notable outcrops in the

Tweed region and small outcrops along the coast near Byron Bay, Alstonville and Ballina. This aquifer generally has much lower yields than the fractured basalt (typical yields of 0.1-0.5 L/s), although occasional supplies up to 5 L/s have been recorded around Murwillumbah (McKibbin, 1995). Consistently high yielding bores from the New England Fold Belt metasediments have not been established in NSW (EHA, 2008).

A1.2 Coastal Sand Aquifers

McKibbin (1995) reported that interspersed between rocky headlands, coastal sand masses extend almost the entire seaboard length of the upper north coast of NSW. McKibbin (1995) noted that the coastal sand beds are an important aquifer system because they catch and store a significant proportion of the rain that falls on them and because their permeability is generally high. A key advantage of coastal sands aquifers is their proximity to existing urban centres and water supply infrastructure in coastal areas. McKibbin (1995) noted that with proper bore design, yields of up to 40 L/s can be drawn from some bores, however because of their connection with bodies of saline water, care is necessary to avoid saline intrusion. Depending on the location of the aquifer, discharge from coastal sands may feed local rivers, waterways or coastal swamps. Freshwater lagoons, lakes and freshwater habitat within the sand beds are common and represent windows in the water table.

McKibbin (1995) also noted that whilst groundwater salinity within these sediments is generally low (<500 mg/L TDS), water quality issues exist in some areas associated with the presence of hydrogen sulphide, iron, low pH or excessive colour. DLWC (1998) rated the vast majority of coastal sand units to be of “High” aquifer vulnerability due to their shallow, unconfined and highly permeable characteristics. The water tables were typically less than 5 metres deep, combined with shallow soil depth, low slope and high to very high permeability, which placed them in the high risk category for contamination and variation in yield.

The Coastal Sands groundwater sources which have been previously delineated in the study area are:

- Tweed Coastal Sands – from the Tweed River to Mooball Creek;
- Brunswick Coastal Sands - from Mooball Creek to Tallow Creek; and
- Richmond River Coastal Sands – from Tallow Creek to the Evans River.

The Woodburn Sand aquifer is located within the Richmond River Coastal Sands and is an example of one of the main coastal sand aquifers currently used for water supply in the study area. The estimated potential yield from the Woodburn Sand ranges from 4.5 to 6 L/s. Rous Water currently extracts periodically from this source to augment town water supplies during drought conditions. The water needs to be treated to correct low pH, high iron and dissolved carbon dioxide levels. The aquifer is very transmissive, but has a lower potential yield due to limited available drawdown. Drury (1982) suggests that large groundwater supplies (>25 L/s) could potentially be obtained from the Woodburn Sands using a number of bores.

The NSW Office of Water is currently developing a water sharing plan for the Coastal Sands aquifers on the North Coast which will collate all available information about the water source, and the rules and regulations to govern extraction from this aquifer.

A1.3 Porous Rocks of Clarence Moreton Basin- Kangaroo Creek Sandstone aquifer

The Clarence Moreton Basin covers a vast area from 50km south of Grafton through to Queensland and is made up of a number of sedimentary formations at various depths. The porous sedimentary rock aquifers of the Clarence Moreton Basin have variable groundwater potential with bore yields previously described as generally low with variable salinity (McKibbin, 1995). DLWC (2001) reported average yields of approximately 0.4 L/s with potential for yields up to 1.5 L/s. Sustainable yields have not been estimated for this aquifer to date but DLWC (2001) has classified this source as low risk of over extraction.

A1.4 Alluvial aquifers

Alluvial aquifers consist of unconsolidated sediments which were deposited in relatively recent times by fluvial processes (flowing water) over the hard rock geology of the sedimentary Clarence Moreton Basin and volcanic deposits of Tertiary Basalt. The aquifers are associated with major river systems and can stretch from upper catchment locations far inland to the coast. Alluvial aquifers can have a significant connection to their parent streams, depending on the type of alluvial material. For example, where alluvial aquifers are found in upriver situations and are made from coarse material such as sands and gravels, groundwater and surface waters interact significantly. However, in the lower catchment areas closer to the coast, where alluvial materials tend to be finer, there is generally only moderate connection between groundwater and the river (NSW Office of Water, 2010b).

Major alluvial aquifers in the study area are:

- Richmond River Alluvium managed under the *Water Sharing Plan for the Richmond River Area Unregulated, Regulated and Alluvial Water Sources*; and
- Tweed River Alluvium managed under the *Water Sharing Plan for the Tweed River Area Unregulated, Regulated and Alluvial Water Sources*.

Alluvial aquifers commonly exists at 0-30 m below the ground surface (Drury, 1982). The water tables are generally shallow, often only a few metres from the natural surface level (DLWC, 2001). Because alluvial aquifers are unconfined and the water table is located close to the ground surface (<5 m depth), there is potential for contamination of groundwater supplies. DLWC (1998) assigned a ‘high’ risk rating to this aquifer for this reason.