Queensland Hunter
Gas Pipeline

Appendix L
Soils management

HEGGIES

REPORT 10-5693mrc01-emp

Revision 3

General Soil Management Assessment
Queensland Hunter Gas Pipeline (QHGP)

PREPARED FOR

Manidis Roberts Pty Ltd
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General Soil Management Assessment
Queensland Hunter Gas Pipeline (QHGP)

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1 SCOPE

Heggies Pty Ltd (Heggies) was commissioned by Mr Paul Keighley of Manidis Roberts Pty Ltd (the Client) to prepare a General Soil Management Assessment Report (the Report) which will be used as a reference material for undertaking the environmental assessment of the Queensland Hunter Gas Pipeline (QHGP) construction project. This commission followed the acceptance of proposal (Document No.: 07002L 2007-12-18 HE#123D19.DOC prepared by the Client on 18 December 2007) by Heggies on 7 January 2008.

The Report has been prepared specifically in response to "Contaminated Land" presented in Pages 50-51 of *Queensland to Hunter Gas Pipeline, Preliminary Environmental Assessment Report November 2007* that was prepared by Manidis Roberts (2007). The objective of the Report is to provide information associated with general soil management issues in New South Wales, with an emphasis on soil contamination, which will need to be considered prior to the commencement of the construction phase of the project. Please be advised that pipeline sections located in Queensland are excluded from the scope of the Report.

The following issues are included in the Report:

- Soil landscapes;
- Expansive soils;
- Soil erosion;
- Rising groundwater and salinity;
- Acid sulphate soils in New South Wales; and
- Contaminated sites.

No other issues have been considered in the Report.

2 LIMITATIONS

The following information will assist in understanding the uncertainties relating to the interpretation of the data obtained during this investigation and the recommendations presented in the report, and help with assessment and interpretation of the report.

The Report is intended to address issues listed in **Section 1**. These issues are expected to be considered prior to the construction project takes further steps.

No environmental sampling and analysis is involved in this assessment.

Heggies is not a professional quantity surveyor (QS) organisation. As such, any areas, volumes and tonnages or any other quantities noted in this report are only indicative estimates. The services of a professional QS organisation should be required if quantities are to be relied upon.

Heggies assumes no responsibility for the quality of data obtained from external sources, or for occurrences outside the scope of works defined in this report.

All work conducted and reports produced by Heggies are prepared for a particular Client's objective and are based on a specific scope, conditions and limitations, as agreed upon between Heggies and the Client. Information and/or report(s) prepared by Heggies may therefore not be suitable for any use other than the intended objective.

Before passing on to a third party any information and/or report(s) prepared by Heggies, the Client is to inform fully the third party of the objective and scope, and all limitations and conditions, including any other relevant information which applies to the information and/or report(s) prepared by Heggies.

It is the responsibility of third parties to investigate fully to their satisfaction if any information and/or report(s) prepared by Heggies is suitable for a specific objective.

Investigations are conducted in a conscientious and professional manner. The nature of the task, however, and the likely disproportion between any damage or loss which might arise from the work and any report prepared as a result and the cost of our services is such that Heggies cannot guarantee that all issues of concern/contamination have been identified.

While Heggies carries out the work to the best of our ability, Heggies totally excludes any loss or damages which may arise from services provided to Manidis Roberts Pty Ltd or any other parties.

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3 STUDY AREA DESCRIPTION

3.1 General Information

A description of pipeline design specifications has been presented by Manidis Roberts (2007) and URS (2008). In brief, Hunter Gas Pipeline Pty Ltd is considering constructing a gas transmission pipeline (∅500 mm diameter and 12.7 mm in thickness) to supply gas from the Wallumbilla area in Queensland to the Newcastle area in New South Wales. This gas pipeline is referred to as the Queensland Hunter Gas Pipeline (QHGP). The transmission gas pressure is expected to be 15.3 MPa. The pipeline will be made of seamless steel pipes of API 5L X65 or X70 grade. The construction right of way will be 30 m.

The pipeline has a total length of 825 km and is divided into 222 km in Queensland and 603 km in New South Wales. The pipeline in the New South Wales section runs between Boonanga Crossing and Kooragang Island (**Figure 1** in **Appendix A**) and is sub-divided into the following sections:

- Boomi, Kilometre Point (KP) 222 – 260 **(Figure 2a** in **Appendix B**);
- Garah, KP 260 - 295 (**Figure 2b** in **Appendix B)**;
- Ashley, KP 295 - 333 (**Figure 2c** in **Appendix B**);
- Moree, KP 333 - 366 (**Figure 2d** in **Appendix B**);
- Bellata, KP 366 - 399 (**Figure 2e** in **Appendix B**);
- Narrabri North, KP 399 - 432 (**Figure 2f** in **Appendix B**);
- Narrabri, KP 432 - 470 (**Figure 2g** in **Appendix B**);
- Boggabri, KP 470 - 505 (**Figure 2h** in **Appendix B**);
- Gunnedah, KP 505 - 544 (**Figure 2i** in **Appendix B**);
- Breeza, KP 544 - 584 (**Figure 2j** in **Appendix B**);
- Quirindi, KP 584 - 622 (**Figure 2k** in **Appendix B**);
- Murrurundi, KP 622 - 665 (**Figure 2l** in **Appendix B**);
- Muswellbrook, KP 665 - 704 (**Figure 2m** in **Appendix B**);
- Singleton North, KP 704 - 734 (**Figure 2n** in **Appendix B**);
- Singleton East, KP 734 - 761 (**Figure 2o** in **Appendix B**);
- Maitland, KP 761 - 791 (**Figure 2p** in **Appendix B**); and
- Newcastle, KP 791 - 819 (**Figure 2q** in **Appendix B**).

A lateral of approximately 10.5 km is understood to extend from the main pipeline to the Maitland area (**Figure 2p** in **Appendix B**).

It is understood that the pipeline will be laid in open trenches at depths between 1,250 mm (general sections) and 2,500 mm (creeks and river crossings) in accordance with Australian Standard AS 2885 Part 1 Design and Construction of Pipelines – Gas and Liquid Petroleum. The horizontal borehole method is being considered at minor to major road crossing points and railway lines. Trenches are expected to be backfilled with suitable materials. The use of a horizontal directional drill (HDD) is understood to be considered where water flow diversion with site specific mitigation measures is needed (Manidis Roberts, 2007). URS (2008) estimated that the volume of spoil per linear meter to be generated after trench excavation would range between 1.4 m^3 and 2.0 m^3 at cover depths from 750 mm and 1,200 mm. This range is expected to increase due to greater trench depths suggested by Manidis Roberts (2007).

3.2 Crossings

3.2.1 Major Sealed Roads, Railroads and Existing Pipelines

Heggies understands that the QHGP crosses roads, railroads and existing pipelines at various locations where probable crossing methods have been suggested by URS (**Table 1**).

3.2.2 Water Bodies

A review of the section plans (**Figures 2a to 2q** in **Appendix B**) indicates that the QHGP crosses a large number of rivers, creeks, swamps and other surface water features. These water features are tabulated in **Table 2 (Appendix C)**.

Some of the water bodies listed are monitored for flood control and management reasons by the NSW Department of Natural Resources. The current scope of works defined in the Report does not address the potential flood and sediment loading impacts of the water features on the pipeline construction. As such, the Report should be read in conjunction with the forthcoming Concept Environmental Assessment that will addresses potential water quality, hydrology and aquatic ecology impacts, as well as hazards and risks associated with the proposed construction.

Table 1 – Major Sealed Road, Railroads and Pipeline Crossings in New South Wales (URS, 2008)

Section	KP	Name	Probable Crossing Method Options
Major Sealed Roads			
Boomi	243	Calloona Boomi Road	Horizontal Bore
Garah	288	Carnarvon Highway	HDD w/ Moree Weemelah Railway & Moree Weemelah Railway?
Ashley	309.5	Carnarvon Highway	Horizontal bore or HDD
Ashley	331.2	Newell Highway	Horizontal bore or HDD w/ Moree Weemelah Railway
Moree	338	Gwydir Highway	HDD with abandoned RR's & Mehi River?
Moree	338.1	Moree Terry Hie Hie Road	HDD with abandoned RR's, Gwydir Highway & Mehi River?
Bellata	388.5	Millie Bellata Road?	Horizontal bore
Narrabri North	427.5	Narrabri Bingara Road	Horizontal bore
Boggabri	470.5	Kamilaroi Highway	Horizontal bore
Boggabri	474.5	Kamilaroi Highway	HDD w/ Namoi River?
Gunnedah	526	Oxley Highway	Horizontal bore
Quirindi	585.5	Kamilaroi Highway	Horizontal bore
Quirindi	591	Quirindi Premer Road	HDD w/ Quirindi Creek?
Muswellbrook	668.5	Scone Road	Horizontal bore
Muswellbrook	682	New England Highway	HDD w/ Kingdon Ponds
Singleton East	750.5	Gresford Road	Horizontal bore, HDD w/ Glendon Brook
Maitland	785	Tocal Road	Horizontal bore, HDD w/ North Coast Railway
Maitland	787 or 789	Clarence Town Road	Horizontal bore
Newcastle	794	Morpeth Road	HDD w/ Hunter River
Newcastle	799.5	Raymond Terrace Road	Horizontal bore
Newcastle	807	Pacific Highway	HDD w/ Hunter River
Newcastle	809	Tomago Road	HDD w/ Hunter River
Railroads			
Garah	289	Moree Weemelah Railway	HDD w/ Gil Gil Creek & Carnarvon Highway?
Ashley	310.5	Moree Weemelah Railway	HDD or horizontal bore
Ashley	326.2	Moree Weemelah Railway	Horizontal bore
Ashley	327.7	Moree Weemelah Railway	Horizontal bore
Ashley	331.5	Moree Weemelah Railway	HDD or bore
Moree	339	Abandoned railroad?	HDD with Gwydir Highway & Mehi River?
Breeza	574	Werris Creek Moree Railway	Horizontal bore
Breeza	578	Binnaway Werris Creek Railway	Horizontal bore
Murrurundi	627	Main North Railway	Horizontal bore, HDD w/ New England Highway
Murrurundi	629	Main North Railway	Horizontal bore, HDD w/ New England Highway
Murrurundi	631	Main North Railway	Horizontal bore, HDD w/ New England Highway
Muswellbrook	681	Main North Railway	Horizontal bore, HDD w/ New England Highway
Maitland	785	North Coast Railway	Horizontal bore, HDD w/ Tocal Road
Gas Pipelines			
Breeza	544.5	Breeza Gas Pipeline (Proposed)	To be specified
Breeza	543.5	Breeza Gas Pipeline (Proposed)	To be specified
Breeza	563	Central Ranges Pipeline	To be specified
Newcastle	814	Killingsworth to Walsh Point Gas Pipeline	To be specified

Abbreviation: HDD, horizontal directional drill

4 SOIL LANDSCAPES

4.1 General

The Report identifies the following broad landscape regions which are expected to be encountered during earthworks:

- Region VI Eastern Highlands (**Figure 3a**); and
- Region VII Murray – Darling Plains (**Figure 3b**).

At the detailed design and project application stage, more information will be available regarding the construction methods and specific pipework areas. This will allow more detailed investigation of the study area to be undertaken, providing information for specific management measures to be appropriately determined.

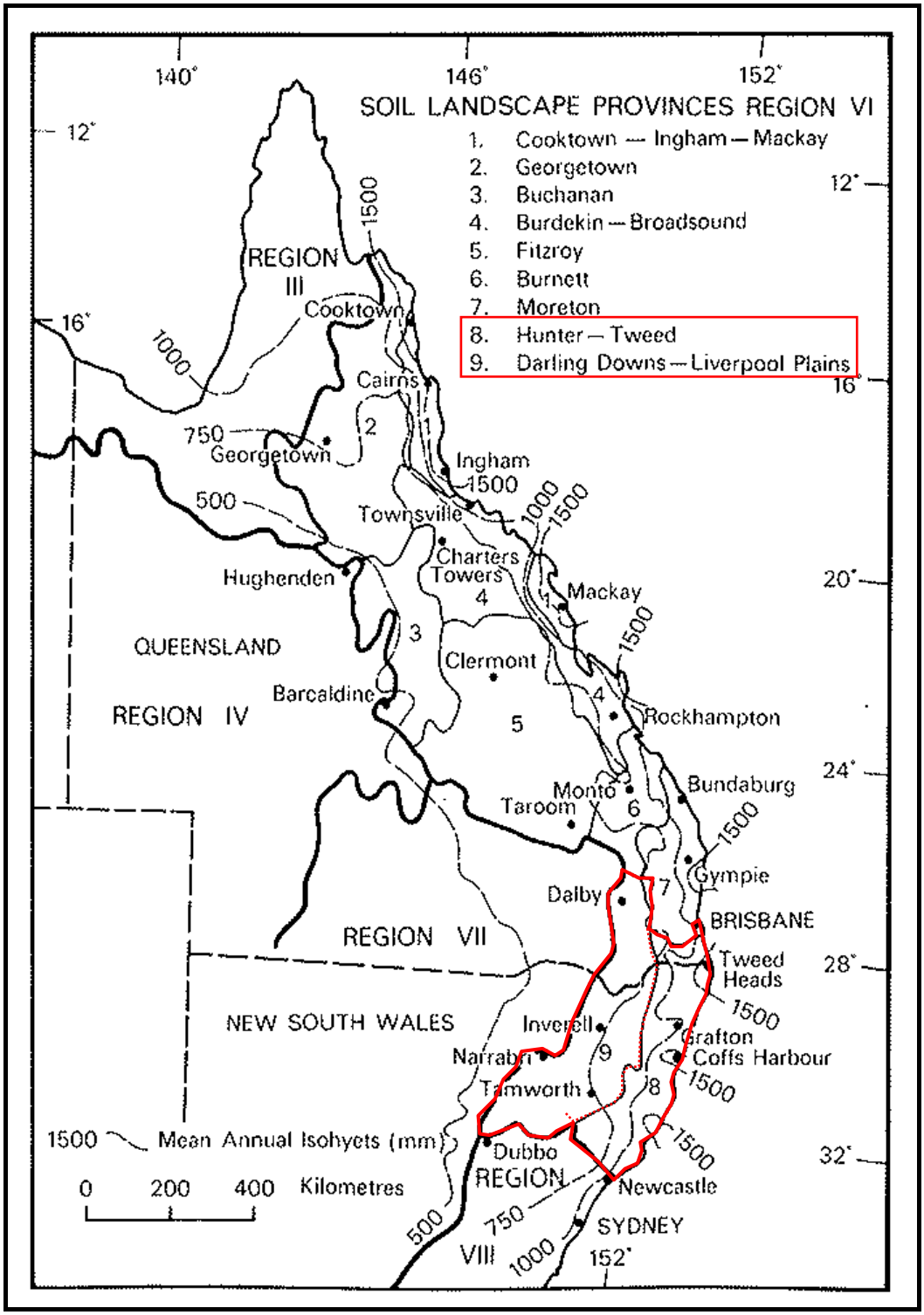

Figure 3a – Soil Landscape Region VI Eastern Highlands (Hubble and Isbell, 1983)

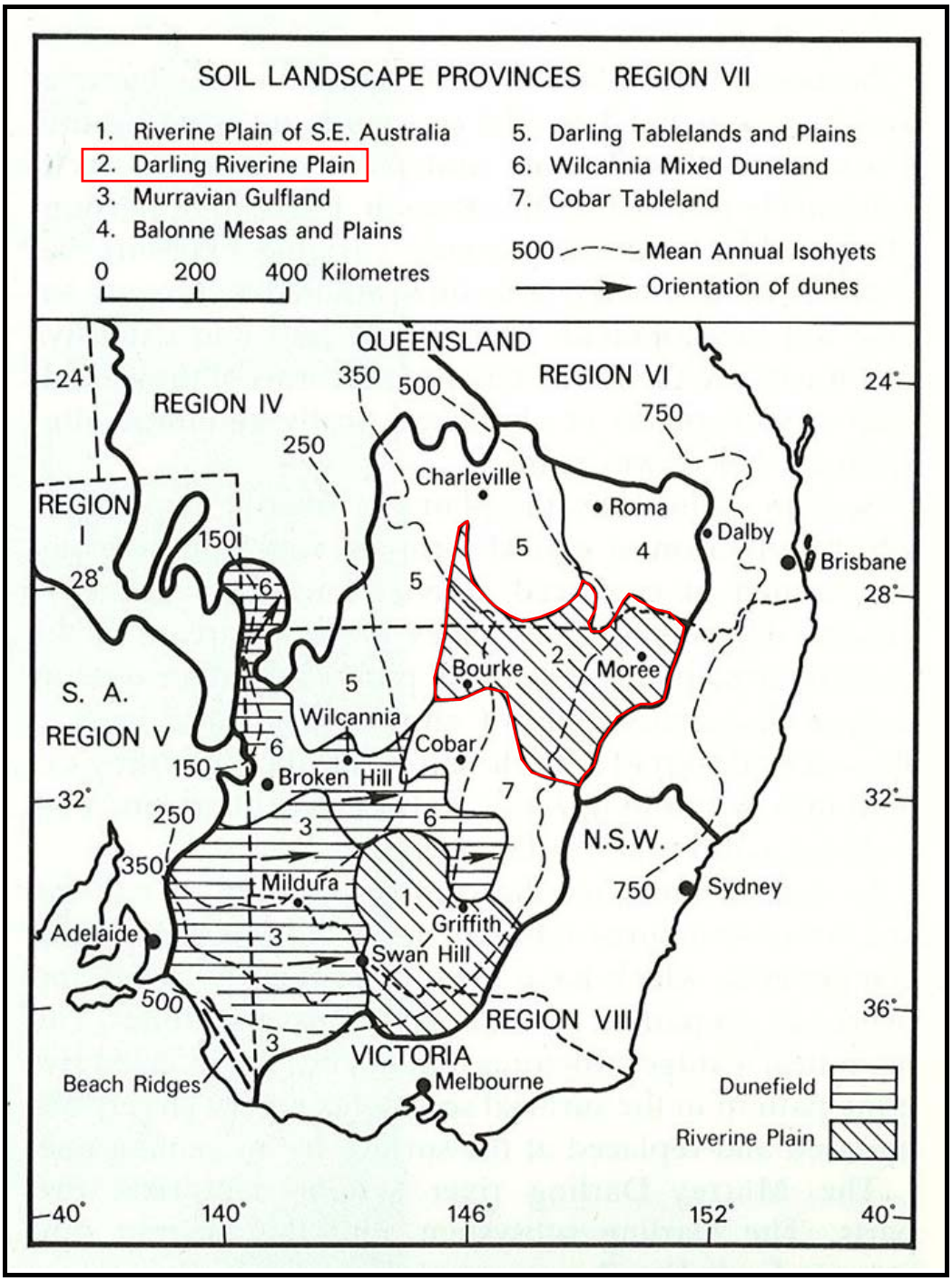

Figure 3b – Soil Landscape Region VI Murray-Darling Basins (Butler et al., 1983)

4.2 Region VI Eastern Highlands

Hubble and Isbell (1983) described this region as *having a dominantly erosional terrain and embraces all of the hilly to mountainous and undulating lands of eastern Australia.* Because of the Great Dividing Range traversing its length, the elevation reaches 1,600 m near coastal areas in the extreme north and south. The land relief is moderate and is influenced by valleys and ranges which are juxtaposed to the coast with crest heights of up to a range between 600 m and 900 m (e.g. the Liverpool Range in the vicinity of Ardglen, Murrurundi Section KP627 to KP629 in **Figure 2l** in **Appendix B**). The region consists of 9 soil landscape provinces, of which 2 landscape provinces are related to the Study Area (**Figure 3a**):

- Hunter – Tweed (Approx KP628 to KP819); and
- Darling Downs – Liverpool Plains (approx. KP 428 to approx. KP628).

A summary of these landscapes is presented in **Table 3**.

4.3 Region VII Murray – Darling Plains

This region consists of all the plain country of the Murray-Darling River System and the enclosed hilly sections (Butler et al, 1983). Large sections are essentially areic (i.e. very low rainfall) with no systematic pattern of streams. Parallel linear dunes constitute much of the region, having a particular local orientation. These dunes are closely spaced and thinly covered with vegetation.

Of 9 landscape provinces forming the region, the Darling Riverine Plain Province (**Figure 3b**) covers a study area between KP 222 to approx. KP 428. This province comprises the alluvial plains of the following rivers:

- Macquarie;
- Namoi (KP442 to KP 443, KP475 to KP476 and KP522 to KP524);
- MacIntyre (KP221 to KP222);
- Balonne;
- Maranoa;
- Warrego; and
- Paroo.

Plains of riverine deposition, inlier hills and liner dunes are typically found in the province. Alluvial deposits and mantles of ancient weathering are often observed. The general pattern of soils in the province is based on coalescent alluvial fans of river ridges and clay flood plains, resulting in grey, brown and red clays being predominant. The concentration of soluble salts increases towards the southwest. Solodized solonetz occurs on the levees in the northern tributaries. Red brown earth also occurs on these levees towards the southeast. Black earths are associated with plains of basaltic alluvium.

Table 3 – Main features of the Hunter – Tweed and Darling – Liverpool Plains landscapes (Hubble and Isbell, 1983)

Landscape Province	Geological and Geomorphological features	Major Soil Features
Hunter-Tweed	Mountainous lands with steep escarpments on Palaeozoic sediments and granite, rolling to hilly basaltic plateaux, lower hilly areas of Mesozoic sediments, and narrow valley plains and coastal lowlands	Lithosols and various podzolic soils are dominant. Basaltic krasnozems and prairie soils are also common in high rainfall areas (e.g. the Hunter region), with some black earths, red-brown earths and solodised solonetz in drier sites. On the wet flood plains of the lower valleys and merging into swampy estuarine and coastal plains, humic gleys including acid sulphate soils are found with minor areas of acid peats and humus podzols. On the coastal dunes podzols, siliceous sands and some acid peats are present in wet depressions.
Darling Downs – Liverpool Plains	Erosional uplands of Palaeozoic metamorphic and granitic rocks. Mesozoic sediments and Tertiary basalts. Generally rounded hilly with some high basaltic tablelands and ranges, lower hilly plateaux and undulating colluvial to alluvial plains. Minor remnants of old land surfaces.	Podzolic, solodised solonetz and solodic soils are widespread on granite, siliceous metamorphic rocks and sediments; black earth, prairie and chocolate soils with minor euchrozems and krasnozems occur on basalt. Non-calcic brown soils, red-brown earths and solodic soils common on less siliceous sediments and in drier areas. Smaller areas of lithosols, gleyed podzolics, yellow and red earths and lateritic podzolics

5 SOIL MANAGEMENT

5.1 General

Earthworks involved in the QHGP project are considered to include:

- Excavation of soils;
- Backfilling and area levelling;
- Off site removal of soils; and
- Importation of fill.

A review of the QHGP Study Area indicates that several soil management issues need to be considered before the above mentioned earthwork elements are undertaken. At least five soil management issues need to be considered:

- Expansive soils;
- Soil erosion;
- Rising groundwater and salinity;
- Acid sulphate soils; and
- Contaminated soils.

5.2 Expansive Soils

Expansive soils that shrink and swell with changes in moisture content are considered to be observed in the QHGP Study Area, particularly in semi-arid and subhumid areas as can be exemplified by black, grey and brown cracking clays in north-western New South Wales. These soils can cause major long-term stability problems. According to Hicks (2007), areas that have the following features are likely to contain expansive soils:

- Soils with surface cracks of 6 mm width or wider, 300 mm deep or deeper, and at least one crack per square metre;
- Soils that develop gilgai microrelief;
- Soils with obvious medium to heavy clay subsoils; and
- Soil depth greater than 50 cm.

The estimate of a potential for surface movement is critical in construction practice. Engineers often use the term "reactive soils" to describe soils which can shrink and swell. According to Standards Association of Australia (1986), reactive soils are classified on the basis of surface movement (**Table 4**). Which category best characterises a particular soil can be assessed using direct field measurement, laboratory testing and climatic information. Several laboratory methods are available to estimate the shrinkage behaviour of soils:

- Atterberg tests;
- Linear shrinkage test;
- Potential volume change meter;
- Coefficient of linear extensibility; and
- Volume expansion test.

Table 4 – Categories of Reactive Soils (Hicks, 2007)

Soil Description	Surface Movement (mm)
Slightly reactive or non-reactive	< 20
Moderately reactive	20 – 40
Highly reactive	40 – 70
Extremely reactive	> 70

5.3 Soil Erosion

Erosion is considered to be a hazard in both landscape regions. Erosion can be divided into water erosion (inter-rill erosion, rill and gully erosion and tunnel erosion) and wind erosion. In general, when vegetation cover is disturbed or removed in areas, this will be followed by gully erosion. This is often seen where solodized solonetz and solodic soils are present. This implies that saline areas are susceptible to erosion.

Murphy (1984) proposed a ranking scheme for assessment of water erodibility of agricultural soils (**Table 5**). This ranking scheme consists of two assessments, field observation and laboratory testing. The following laboratory tests are considered to provide useful information:

- Particle size distribution analysis (sieving and hydrometer);
- Clay mineralogy identification;
- Emerson aggregate test; and
- Organic carbon determination.

Soil properties affecting wind erodibility are considered to be as follows:

- Soil texture;
- Soil moisture; and
- Soil binding agents.

According to Zingg (1951), Chepil (1953) and Semple et al. (1988), there are 8 wind erosibility groups (WEG) (**Table 6**).

Table 5 – Soil Erodibility Classes for Water Erosion (Murphy, 1984)

Erodibility	Topsoil	Subsoil
Low	High organic matter (>3%) (soils have a dark colour and feel greasy when textured) High coarse sand	Cemented layers including silcrete, ortstein and laterite iron, managanese and silicon pans. High coarse sand
	Well structured, non-dispersible clay loams and clays having aggregates that do not slake in water to particles less than 2 mm (Emerson Aggregate Classes 4, 6, 7 and 8) such as Red Ferrosols, some Vertosols, some structured loams, and Chromosols with friable surface soils.	
Moderate	Moderate organic matter (1.5 to 3%) Moderate fine sand and silt, such as some surface soils of Red Chromosols and Red Kandosols Well structured clay loams and clays that slake in water to particles less than 2 mm (Emerson Aggregate Classes 3 to 6), such as strongly self-mulching Vertosols.	Stable, non-dispersible loams and clay loams, such as Red and Yellow Kandosols. Non-dispersible or slightly dispersible clays with particles that slake to finer than 2 mm (Emerson Aggregate Classes 3 to 6), such as some Chromosols.
High	Low (0.9 to 1.5%) to very low (0.9%) organic matter, such as sols with bleached A2 horizons High to very high silt and fine sand (>65%)	Dispersible clays (Emerson Aggregate Classes 1 and 2) such as **Sodosols** Unstable, dispersible clayey sands and sandy clays, such as Yellow and Grey Kandosols formed on sandstone and some granites Unstable materials high in silt and fine sand, **such as unconsolidated sediments and alluvial materials**.

Table 6 – Description of Wind Erodibility Groups (WEG)
(Zingg, 1951; Chepil, 1953; and Semple et al. (1988)

WEG	Soil surface texture class	Wind Erodibility Index (t/ha)
1	Very fine sand, fine sand or coarse sand	659
2	Loamy very fine sand, loamy fine sand, loamy sand, loamy coarse sand or saptic soil materials	300
3	Very fine sandy loam, fine sandy loam, sandy loam or coarse sandy loam	193
4	Clay, silty clay, non-calcareous clay loam or silty clay loam with more than 35% clay content	193
4L	Calcareous loam and silt loam or calcareous clay loam and silty clay loam	193
5	Non-calcareous loam and silt loam with less than 20% clay content or sandy clay loam, sandy clay and hemic organic soils	126
6	Non-calcareous loam and silt loam with more than 20% clay content or non-calcareous clay loam with less than 35% clay content	105
7	Silt, non-calcareous silty clay loam with less than 35% clay content and fibric organic soil material	85
8	Soils not susceptible to wind erosion	0

Information presented in **Tables 5 and 6** is useful to determine adequate erosion measures. The following measures are available (Hicks and Hird, 2007):

- Control of soil dispersion by incorporation of hydrated lime in critical areas, for example, culvert aprons or stormwater channels;
- Use of erosion and sediment control techniques in construction areas, for example, catch drains, perimeter banks or sediment traps;
- Use of adequate topsoil and revegetation techniques on disturbed areas to minimise erosion risks; and
- Mitigation of concentrating runoff in critical areas.

5.4 Rising Groundwater and Salinity

It is generally known that irrigation areas in the Darling Plains region have difficulty managing rising groundwater levels which increase soil salinity by consequent.

Saline soils are identified by electrical conductivity tests on either a 1:5 extract (greater than 1.5 dS/m) or a saturation extract (greater than 4.0 dS/cm) (Murphy et al., 2007). Salinity processes can impact on various infrastructures in three ways (Charman and Wooldridge, 2007):

- Waterlogging;
- Impacts on metal products used in infrastructure (i.e. corrosion) and on concrete materials if high sulfate levels are present; and
- The growth of salt crystals in porous media (bricks and pavers).

Salinity impacts have previously been seen in underground infrastructures including gas pipelines.

Soil drainage is essential to control surface water and groundwater, and further slope stability and potential expansive soils. Installation of cutoff or interceptor drains is useful to protect critical areas. Subsurface drains should be protected with filter fabrics and/or sand/gravel envelops. It is noted however that on the riverine plains, it is often difficult to locate an adequate drainage outfall without triggering additional drainage difficulties in other places.

Salinity should be managed on a catchment basis. The first step in managing salinity involves the recognition of potentially saline sites which may be located adjacent to the Study Area. This needs to be considered prior to the commencement of earthworks. In addition, ongoing management (e.g. surface water control and management, sowing of salt-tolerant plant species and careful grazing management) may be required to monitor and control the impacts of salinity.

A range of methods are considered to be used for recognising salinity which may exist in the Study Area:

- Field observation;
- Laboratory measurements;
- Field measurements;
- Electromagnetic induction measures; and
- Other remote sensing methods.

5.5 Acid Sulphate Soils

Acid sulphate soils have formed in relatively low lying and coastal areas (e.g. mangrove swamps, salt marshes, and tidal lakes and estuaries) where sulfur rich materials (e.g. pyrite) have accumulated. When these materials are exposed to oxygen during excavation and drainage, these materials will generate sulfuric acid that subsequently lower the pH value of soils, allowing metals such as aluminium and iron to be released to the environment**.** It is known that when acid sulphate soils are being drained, the potential for acid sulphate soils affects infrastructures made of concrete, iron and steel involving drainage pipes and building foundations. It is also known that acid sulphate soils have very poor engineering properties.

The presence of acid sulphate soils has been identified in the Hunter – Tweed Landscape Province. A review of the following acid sulphate soil risk maps indicates that the QHGP Study Area for Maitland and Newcastle (**Figures 2p and 2q**) is affected by acid sulphate soils:

- Maitland (**Figure 4a in Appendix D**);
- Greta (**Figure 4b in Appendix D**);
- Beresfield (**Figure 4c in Appendix D**);
- Williamtown (**Figure 4d in Appendix D**); and
- Newcastle (**Figure 4e in Appendix D**).

Table 7 in Appendix E presents sections of study areas which are expected to be affected by acid sulphate soils. The probability of the occurrence of acid sulphate soils within the soil profile at these sections have been assessed using descriptions presented by the NSW Department of Natural Resouces (**Table 8**).

Table 8 – The Probability of the Occurrence of Acid Sulphate Soils
(Excerpted from Acid Sulphate Risk Maps by NSW Department of Natural Resources)

Probability	Description	Landforms
High	Moderate and severe environmental risks are anticipated if acid sulphate sols in landforms listed are disturbed by activities including shallow and deep excavation, clearing, dredging.	Bottom sediments of lakes, lagoons, tidal creeks, rivers and estuaries. Estuarine swamps, intertidal flats and supratidal flats. Low alluvial plains, estuarine sandplains, backswamps. Alluvial plains, alluvial swamps, alluvial levees and sandplains. Elevated levees and alluvial swamps in estuarine reaches of catchments.
Low	Within a soil depth range between the ground surface and 3 m The majority of these landforms are not suspected to contain acid sulphate soil materials. Therefore, land management is generally not affected by acid sulphate soils	Elevated alluvial plains and levees dominated by fluvial sediments. Plains and dunes dominated by aeolian sands. Pleistoene plains, Locustrine and alluvial bottom sediments.
Not Known	Acid sulphate soils are not known or expected to occur in landforms listed. Land management activities are not likely to be affected by acid sulphate soil materials	Bedrock slopes, elevated Palaeocene and Holocene dunes and elevated alluvial plains
Disturbed Terrain	Disturbed terrain may include filled areas which often occur during reclamation of low lying swaps for urban development. Other disturbed terrain includes areas which have been mined or dredged, or have undergone heavy ground disturbance through general urban development or construction of dams or levees. Soil investigations are required to assess these areas for acid sulphate potential.	

The presence of acid sulphate soils is highly probable after the QHGP passes the following KPs:

- **KP786 in Study Area 1A;**
- **KP 785 in Study Area 1B; and**
- **KP 785.7 in Study Area 1C.**

One of feasible options in managing acid sulphate soils is to retain as much as possible of existing acidity in situ (i.e. avoid developing affected areas or minimise the disturbance of acid sulphate soils). URS (2008) is understood to have proposed a method that is designed to minimise this soil disturbance. The method proposed by URS involves the on-site assembly and welding of pipes along the Right of Way (ROW), which is followed by pipe placement in the ground. A period of time taken from trench opening to backfilling is estimated to be less than 12 hours in order to lessen the exposure time of actual or potential acid sulphate soils to the atmosphere and limit associated chemical reactions. Lime will be stored on-site and may be used to neutralise sulphuric acid if there are needs for lime application. Excavation activities in the affected areas will be undertaken at a shorter distance than in other areas. This is expected to enable acid sulphate soils to be managed in a systematic manner. In ecologically sensitive and/or geotechnically unstable areas, the horizontally directional drilling may be used as an alternative installation option.

As the construction processes are further refined at the detained design stage, appropriate management measures would be selected for particular locations. A detailed acid sulphate soil management plan will also be prepared as part of the forthcoming Construction Environmental Management Plan and will discuss the particulars of the management measures.

5.6 Contaminated Sites

5.6.1 General

Due to intensive land use which applies to many areas in New South Wales, the occurrence of soil and water contamination may exist in the QHGP Study Area, including contamination with anthropogenic chemicals (fuels, oils, pesticides, herbicides, asbestos, metal compounds and waste products) which may be organic or inorganic in form, or the accumulation of excessive natural products (e.g. heavy metals contained in fertilisers) resulting from human mismanagement.

Depending on the nature and concentration of contaminants, soil and groundwater contamination has health and environmental impacts and can affect the QHGP project. This warrants the contamination to be included as one of site management issues in the Report.

5.6.2 Registered Contaminated Site

Contaminated sites registered under Section 58 of the Contaminated Land Management (CLM) Act 1997 have been reviewed. A total of 284 sites were registered on 20 December 2007 when the record was accessed. Twenty four sites are observed to be located close to or near the QHGP Study Area (**Table 9**). The location (number) of each site is as a blue circle in **Figures 2d, 2g, 2m, 2p** and **2q** (**Appendix B**). Amongst these sites, 3 sites (Site Nos.: 8, 9 and 24 located in **Figure 2q** for the Newcastle section) are located immediately adjacent to the Study Area. The extent of contamination identified at these three sites and the potential impacts on the QHGP project would be assessed at the detailed design stage.

Additional contaminated sites that are not recorded under the Act may be identified in other information sources such as Section 149 Planning Certificates and property files. These sources may be provided by local government authorities. For this reason, it is essential to liaise with relevant stakeholders (e.g. local government authorities, town planners and property owners) in order to identify as many potentially or actually contaminated sites as possible and to evaluate needs for additional information gathering on a section basis (e.g. geological and hydrogeological survey, soil map review, reconnaissance works including soil sampling). Heggies understands that preliminary discussions on contaminated sites have been undertaken by the Regional Land Management Corporation (RLMC) with relevant local government authorities. The outcomes of these discussions in relation to actual or potential contaminated sites within each region would be discussed at the detailed design stage.

Table 9 – CLM Act Registered Contaminated Sites

No.	Suburb	Address	Site Name	Section Plan	KP Start	KP End
1	East Maitland	Corner Melbourne and Brisbane Street	East Maitland Gas Works	Maitland	N/A	N/A
2	Hamilton	116 Tudor Street	Hamilton - former service station	Newcastle	N/A	N/A
3	Hamilton North	Corner Clyde and Chatham Street	AGL Hamilton North	Newcastle	N/A	N/A
4	Hamilton North	56 Clyde Street	Former Black and Decker Site	Newcastle	N/A	N/A
5	Hamilton North	54 Clyde Street	Former ELMA Factory	Newcastle	N/A	N/A
6	Hexham	Lot 28 Sparke Street	Engineering Fabrication Plant	Newcastle	N/A	N/A
7	Hexham	64 Old Maitland Road	Trojay Pty Ltd	Newcastle	N/A	N/A
8	**Kooragang**	**Cormorant Road Lot 1 DP 581473 Lot 2 DP 581473 Lot 11 DP 841542 Lot 12 DP 841542**	**BHP Kooragang Occupier: BHP Rod and Bar Division Owner: BHP**	**Newcastle**	**814**	**819**
9	**Kooragang**	**15 Greenleaf Road Lot 3 DP 234288**	**Orica - Kooragang Island. Owner/Occupier Orica Australia Pty Ltd**	**Newcastle**	**818**	**819**
10	Kurri Kurri	279-281 Lang Street	Caltex Service Station, Kurri Kurri	Maitland	N/A	N/A
11	Maitland	Charles Street	Maitland Gas Works	Maitland	N/A	N/A
12	Mayfield	Industrial Drive	BHP Closure Site	Newcastle	N/A	N/A
13	Mayfield	Industrial Drive	BHP Supply Area	Newcastle	N/A	N/A
14	Mayfield	Woodstock Street	Koppers Coal Tar Products Mayfield	Newcastle	N/A	N/A
15	Mayfield	Industrial Drive	OneSteel Site	Newcastle	N/A	N/A
16	Mayfield	Industrial Drive	Steel River Industrial Estate	Newcastle	N/A	N/A
17	Moree	Gosport Street	Former Mobil Depot	Moree	N/A	N/A
18	Narrabri	West Port Road	Soapstock Disposal Site	Narrabri	N/A	N/A
19	Newcastle	50 Honeysuckle Drive	Honeysuckle Development	Newcastle	N/A	N/A
20	Sandgate	Off Maitland Road	Storage Handling Facility	Newcastle	N/A	N/A
21	Scone	Guernsey Street	BP Depot, Scone	Muswellbrook	N/A	N/A
22	Shortland	1, 2, 28 Astra Street	Astra Street Landfill	Newcastle	N/A	N/A
23	Tarro	Woodland Close	Green Acres Farm	Newcastle	N/A	N/A
24	**Tomago**	**School Drive Lot 1411 DP 582135**	**Genkem Pty Ltd Occupier/Owner: Genkem Pty Ltd**	**Newcastle**	**809**	**809.7**

The site and notice details of each of the three sites shown in bold are presented in **Appendix F**. It is understood that the following contaminants are believed to be present at these sites:

- No. 8, BHP Kooragang, asbestos in "Asbestos Disposal Area" in Drawing No.181997 dated 27 August 1993 and signed by Mr D F Wood, Registered Surveyor. The AMG coordinates of this area are E568686.96 N 6363142.76 to E568707.63, N6363255.64 to E569060.93, N6363190.93 to E569040.26, N6363078.05;

- No. 9, Orica Australia Pty Ltd, contamination (and particularly groundwater contamination) with arsenic, total ammonia and nitrate at the site and in the surrounding area. The contaminants identified have the potential to impact on human health and the environment. No detailed information is given in relation to the exact extent of the identified contamination; and

- No. 24, Genkem Pty Ltd, lead and chromium in soils and groundwater at the site and in the surrounding area. No detailed information is given in relation to the exact extent of the identified contamination.

It is essential for the Client to address the following:

- The perusal of the notices presented in **Appendix F**. These notices contain important legal conditions; and

- Liaison with the site owners/occupiers in order to clarify the extent of areas which have been impacted/or may be impacted by identified contaminants.

5.6.3 Site Management

Construction works and particularly earthworks which can increase health and environmental risks associated with soil contamination need to be undertaken in accordance with:

- On-site contaminated soil management plan;

- Environmental management plan;

- Site specific health and safety plan; and

- Safe work method statement.

Management plans for on-site activities need be prepared by a construction contractor with assistance from environmental and occupational hygiene consultants, in accordance with relevant state and federal legislation.

On-Site Contaminated Soil Management Plan

A potential concept of on-site contaminated soil management is presented in **Figure 5**. This concept presents a broad overview of an approach which can be taken to address potential/actual soil contamination issues which may need to be managed during earthworks.

A contaminated soil assessment may be required if the following indications of soil contamination are identified:

- Unusual soil discoloration;

- Unusual stains;

- Unusual odours;

- The presence of construction rubble;

- Fibre cement sheetings and fragments suspected of containing asbestos; and

- The presence of an oily sheen of water bodies in and near excavation areas.

If the presence of soil contamination is suspected in earthwork areas, this needs to be notified of to a technical superintendent in charge and discussed with the consultants. If the off-site removal of contaminated soils is required, the soils of concern should be excavated and then stockpiled in a designated area in a safe and appropriate manner until they are classified for disposal purposes, under the direction of the consultants.

Activities associated with contaminated soil management should be recorded by the consultant in discussion with the superintendent. The following documents are generally recorded as a minimum:

- Daily activity logs;
- The contamination status of excavated and imported materials;
- Documents related to the disposal of contaminated soils including receipts from a licenced waste management facility which has received these soils and associated materials; and
- The contamination status of soils remaining in situ.

Environmental, Health and Safety Plans

Environmental, health and safety plans need to be prepared by a contractor responsible for earthwork activities. The following subjects are generally addressed in these plans:

- Work area history and the nature of work activities;
- Site requirements;
- Legal requirements;
- Anticipated health, safety and environmental hazards;
- Potential risks of exposure to identified hazards;
- Control measures to be used to eliminate or control identified hazards;
- Emergency response;
- Consultation, communication and document recording; and
- Health and environmental monitoring.

5.6.4 Mitigation Options

A range of mitigation options are available to manage or remediate sites at which soils and groundwater have been contaminated with contaminants, and can be divided into the following categories (Nathanail and Bardos, 2004):

- Excavation;
- Containment (e.g. liners, capping, vertical barriers and hydraulic measures); and
- Treatment (*in-situ* or *ex-situ*).

Each option has advantages and disadvantages. The following factors should be taken into consideration to select an appropriate mitigation option (e.g. Soesilo and Wilson, 1997):

- Site conditions; (e.g. fill, natural soils, clay content and mineralogy);
- Groundwater (e.g. depth, direction, flow rate);
- The nature of contaminants (e.g. the physico-chemical and transport properties and the susceptibility to biodegradation);
- The extent of contamination;
- Liaison with stakeholders;
- Financial resources,
- Timeframe;
- Technical suitability and feasibility;
- On-going management;
- Operational risks including human health and ecological;
- Clean-up level; and
- Regulatory frameworks and compliance.

The specific mitigation methods used to address contaminated soil issues would be developed at the detailed design stage as more information becomes available.

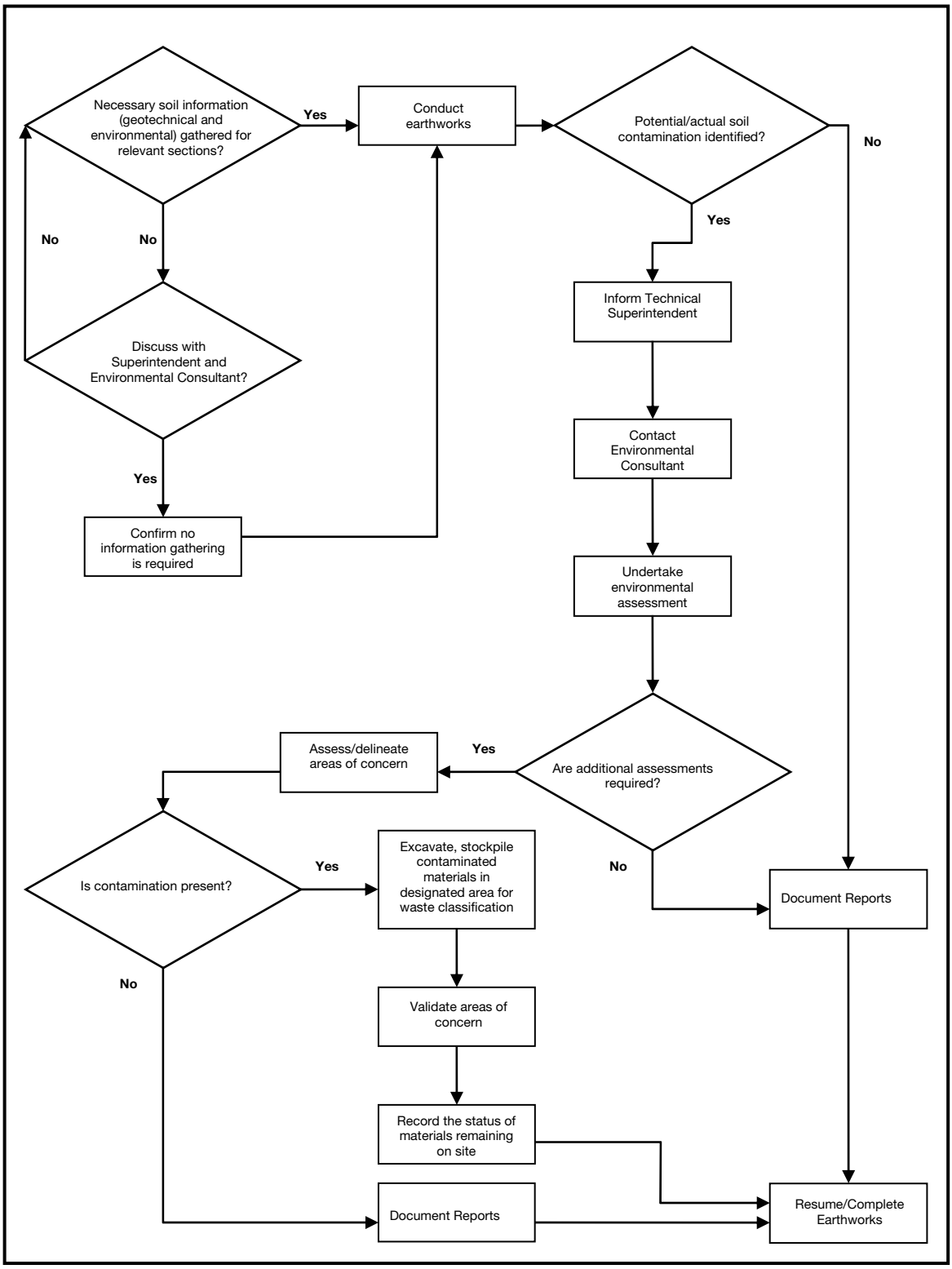

Figure 5 – On-Site Contaminated Soil Management Plan Concept

6 CONCLUSIONS

The Report reviewed the following soil management issues:

- Soil landscapes;
- Expansive soils;
- Soil erosion;
- Rising groundwater and salinity;
- Acid sulphate soils; and
- Contaminated sites.

Suggestions and recommendations have been made for each of the above issues.

7 FURTHER INFORMATION

Should there be any queries regarding this report, please contact the undersigned by phone on 02-9427-8100.

Yours sincerely,

Takashi Itakura PhD (*Sydney*) MIEAust CPEng CPSS (Grade 3)
Principal, Land Contamination

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Appendix A
Figure 1 – A General View of QHGP Study Area

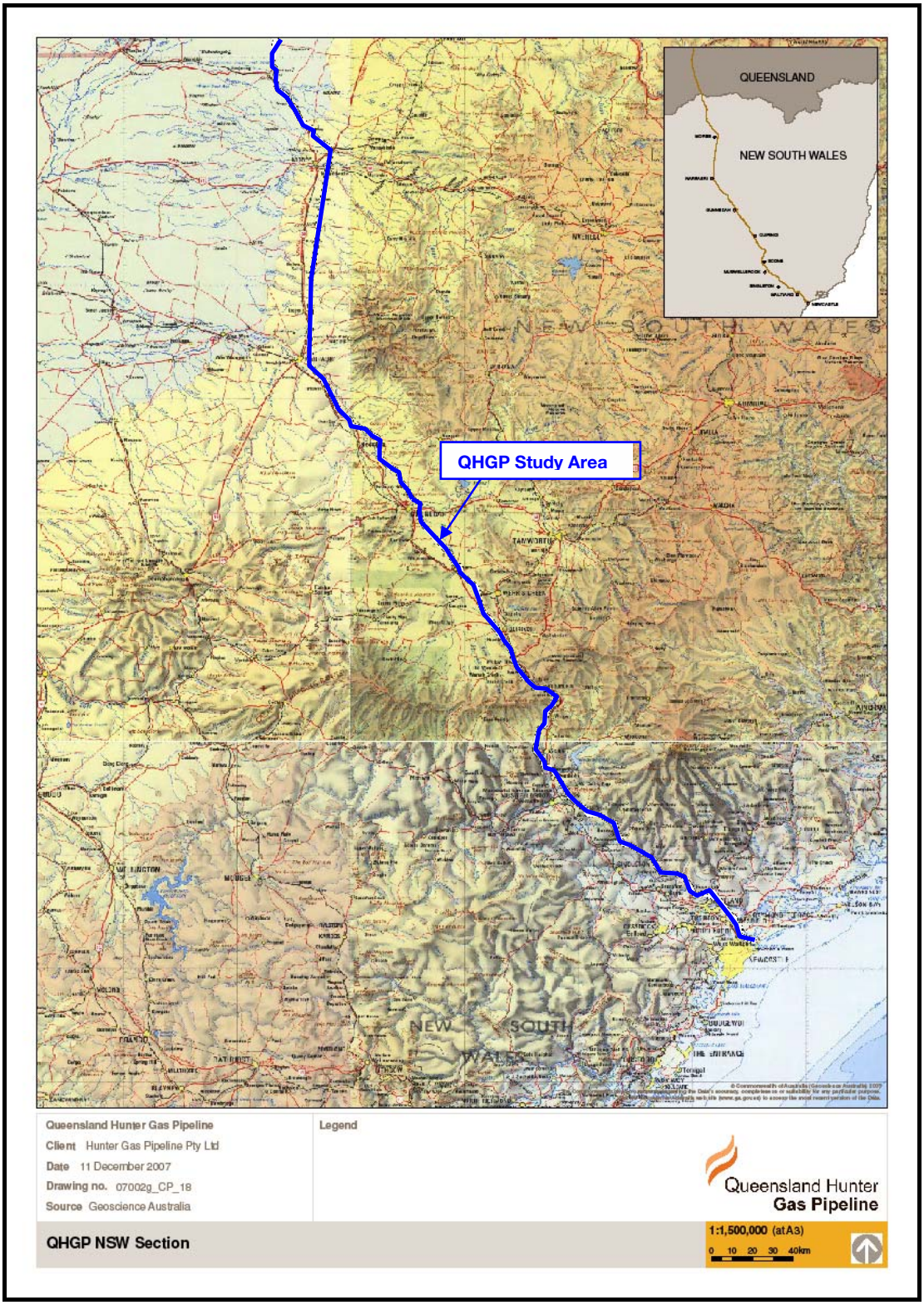

Figure 1 – A General View of QHGP Study Area
(Original plan supplied by the Client on 17 December 2007)

Appendix B
Figures 2a to 2q – Pipeline Study Areas

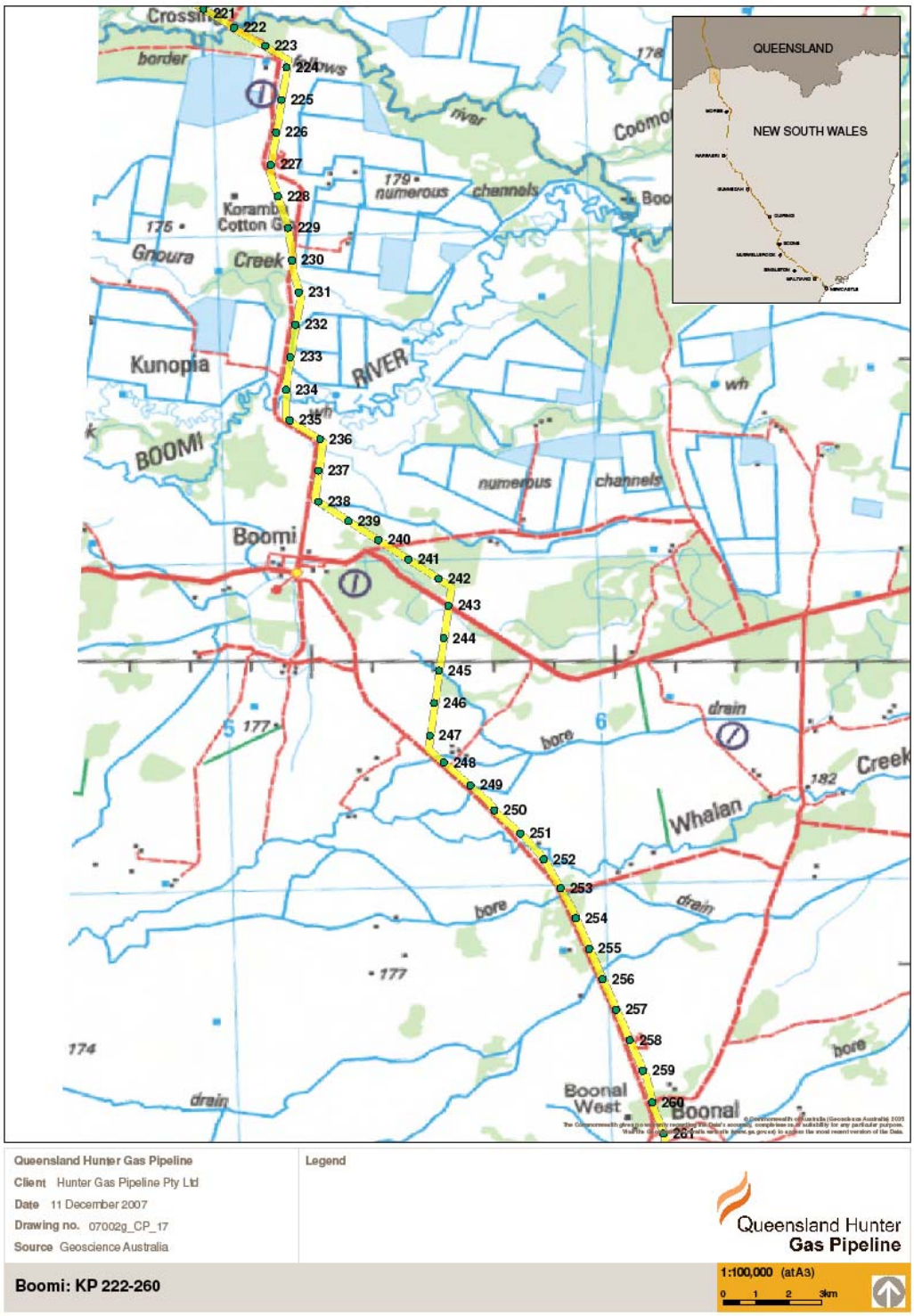

Figure 2a – Study Area in Boomi (KP222-260)
(Original plan supplied by the Client on 17 December 2007)

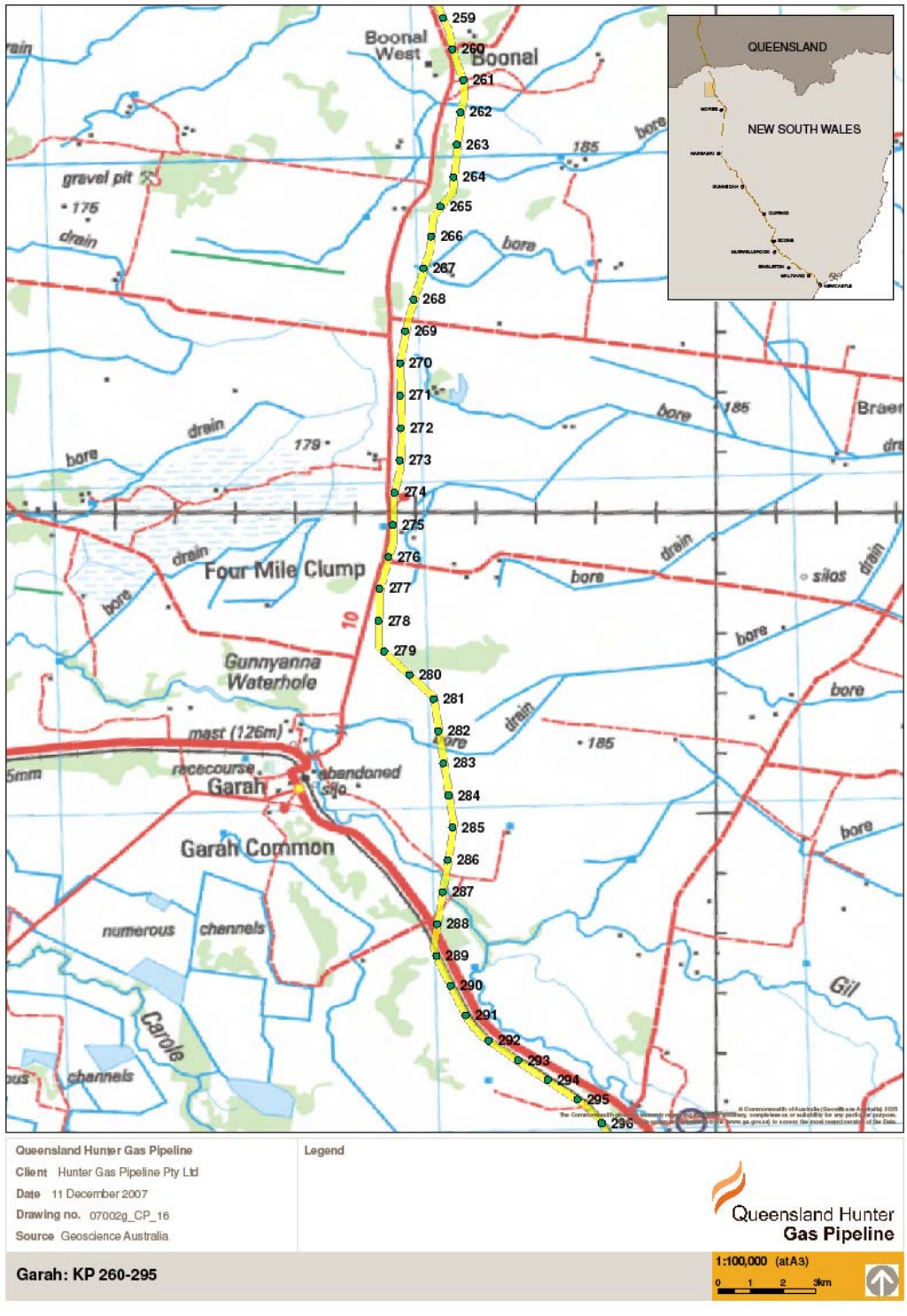

Figure 2b – Study Area in Garah (KP260-295)
(Original plan supplied by the Client on 17 December 2007)

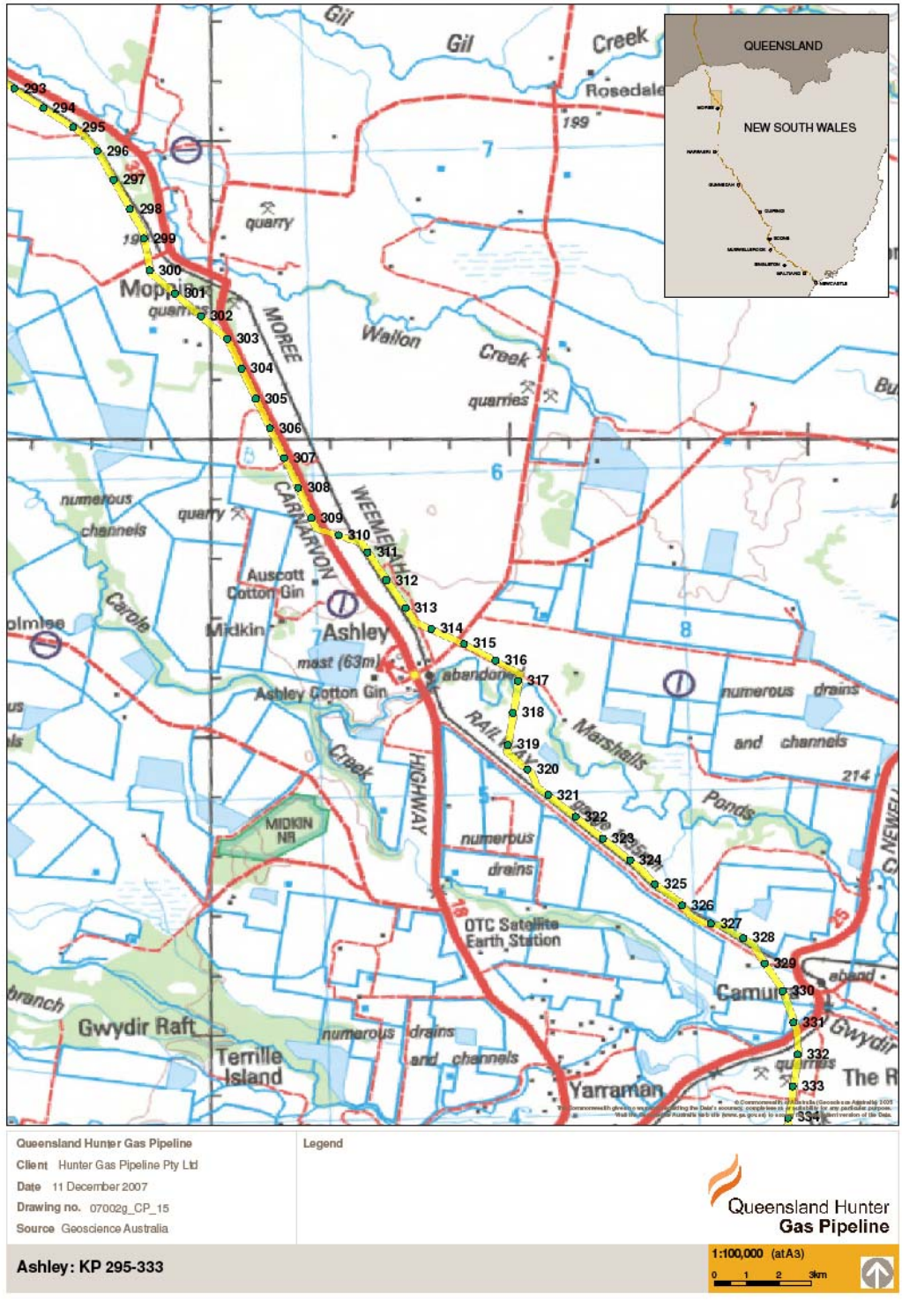

Figure 2c – Study Area in Ashley (KP295-333)
(Original plan supplied by the Client on 17 December 2007)

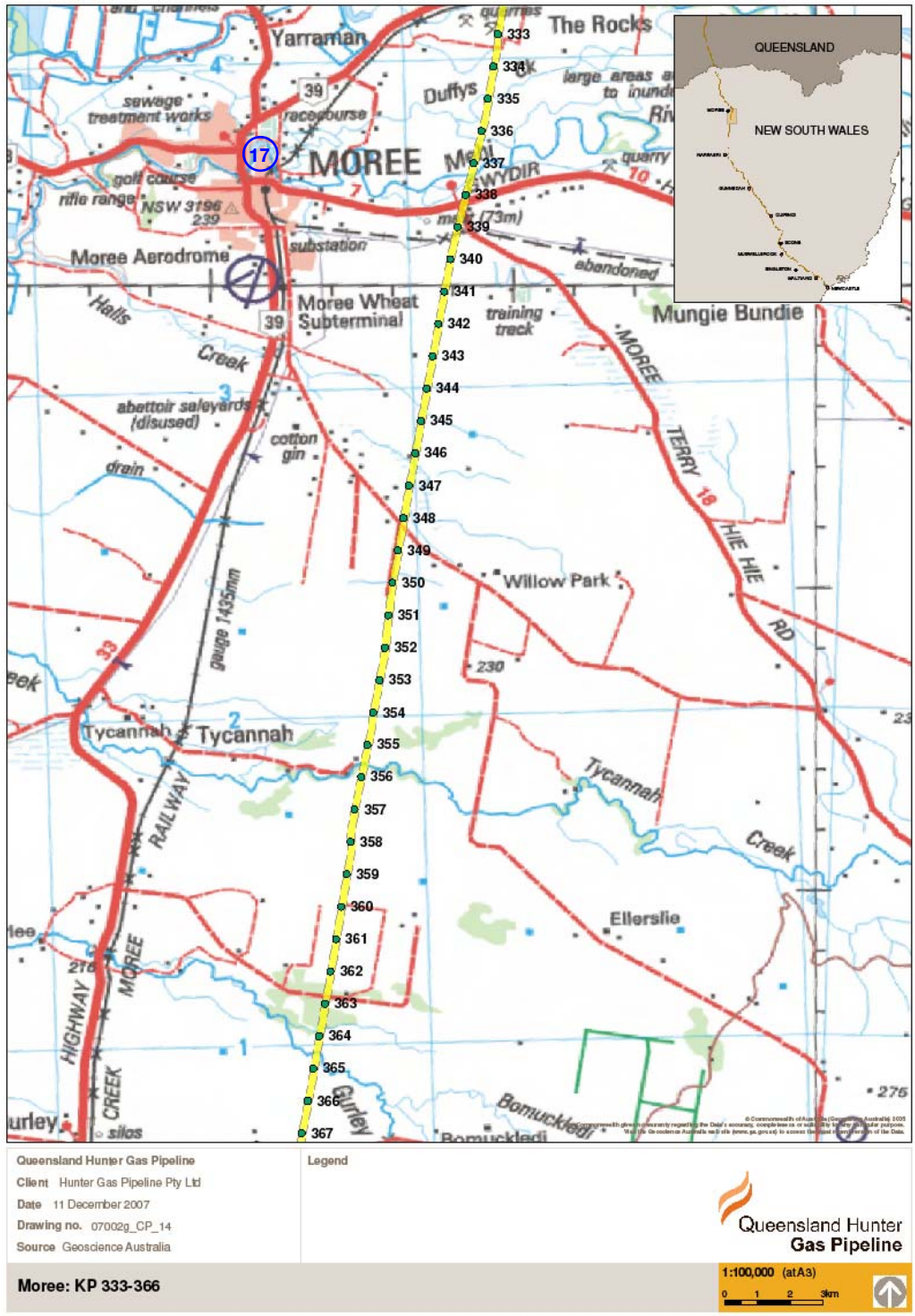

Figure 2d – Study Area in Moree (KP333-366)
(Original plan supplied by the Client on 17 December 2007)

Figure 2e – Study Area in Bellata (KP366-399)
(Original plan supplied by the Client on 17 December 2007)

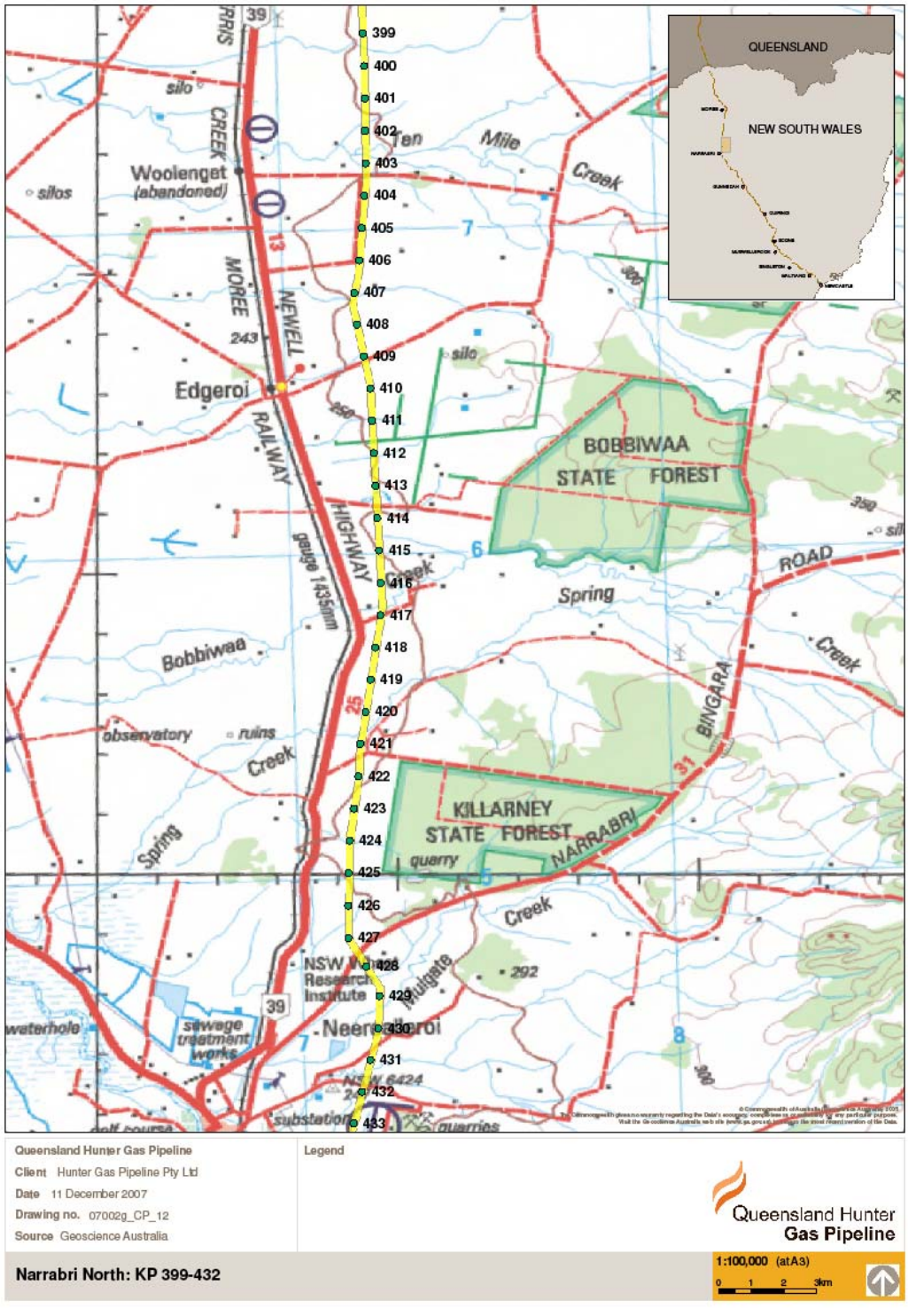

Figure 2f – Study Area in Narrabri North (KP399-432)
(Original plan supplied by the Client on 17 December 2007)

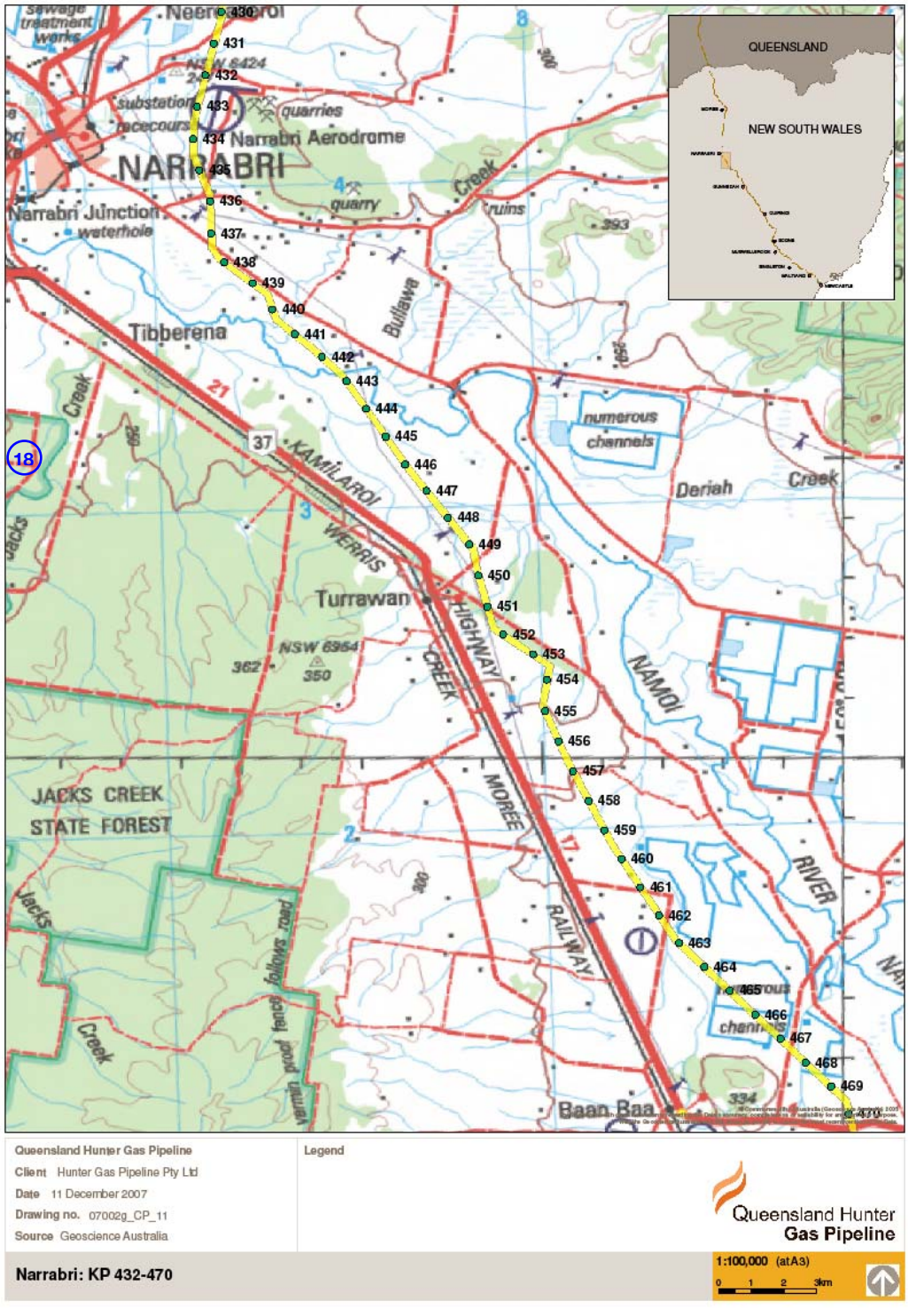

Figure 2g – Study Area in Narrabri (KP432-470)
(Original plan supplied by the Client on 17 December 2007)

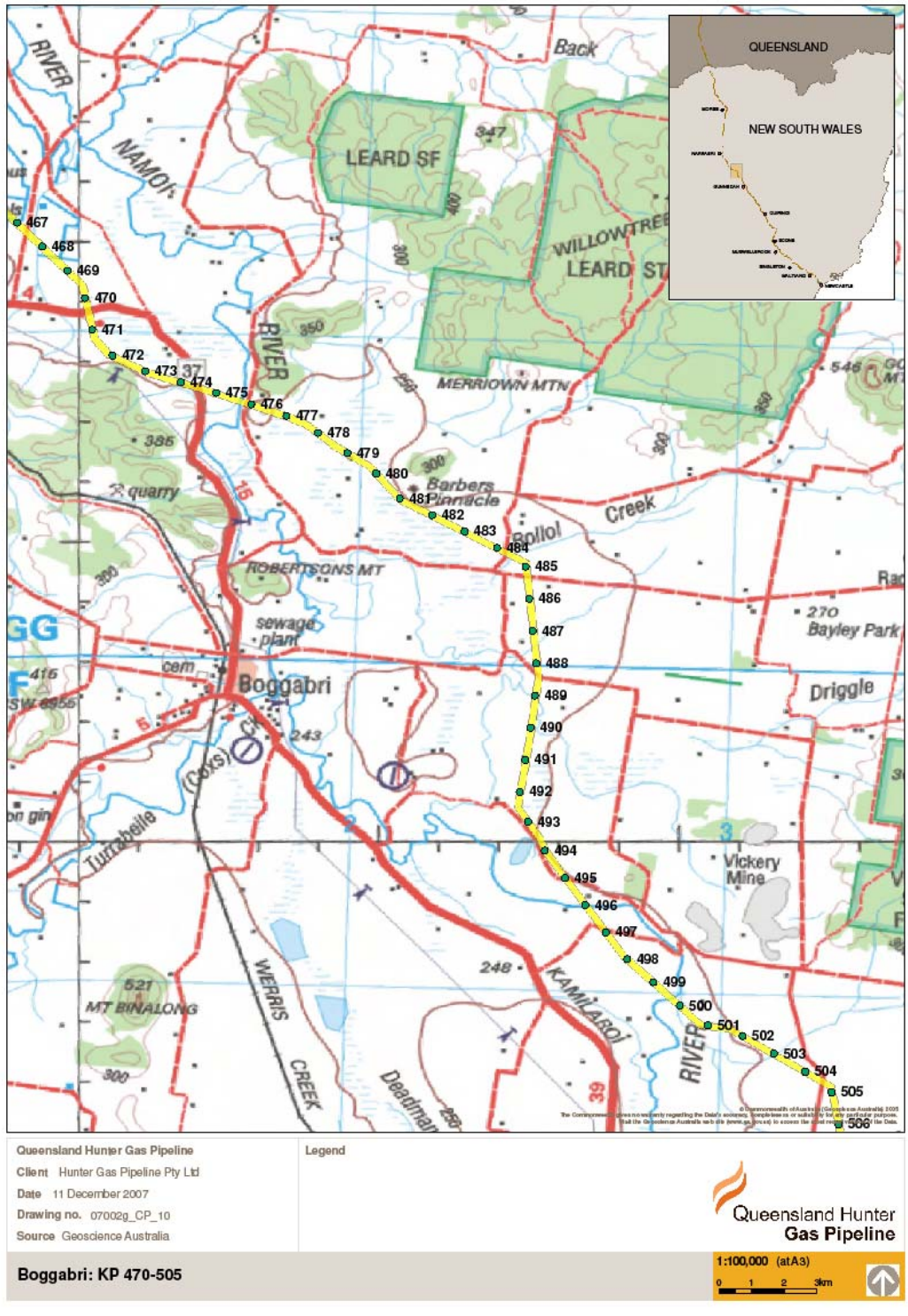

Figure 2h – Study Area in Boggabri (KP470-505)
(Original plan supplied by the Client on 17 December 2007)

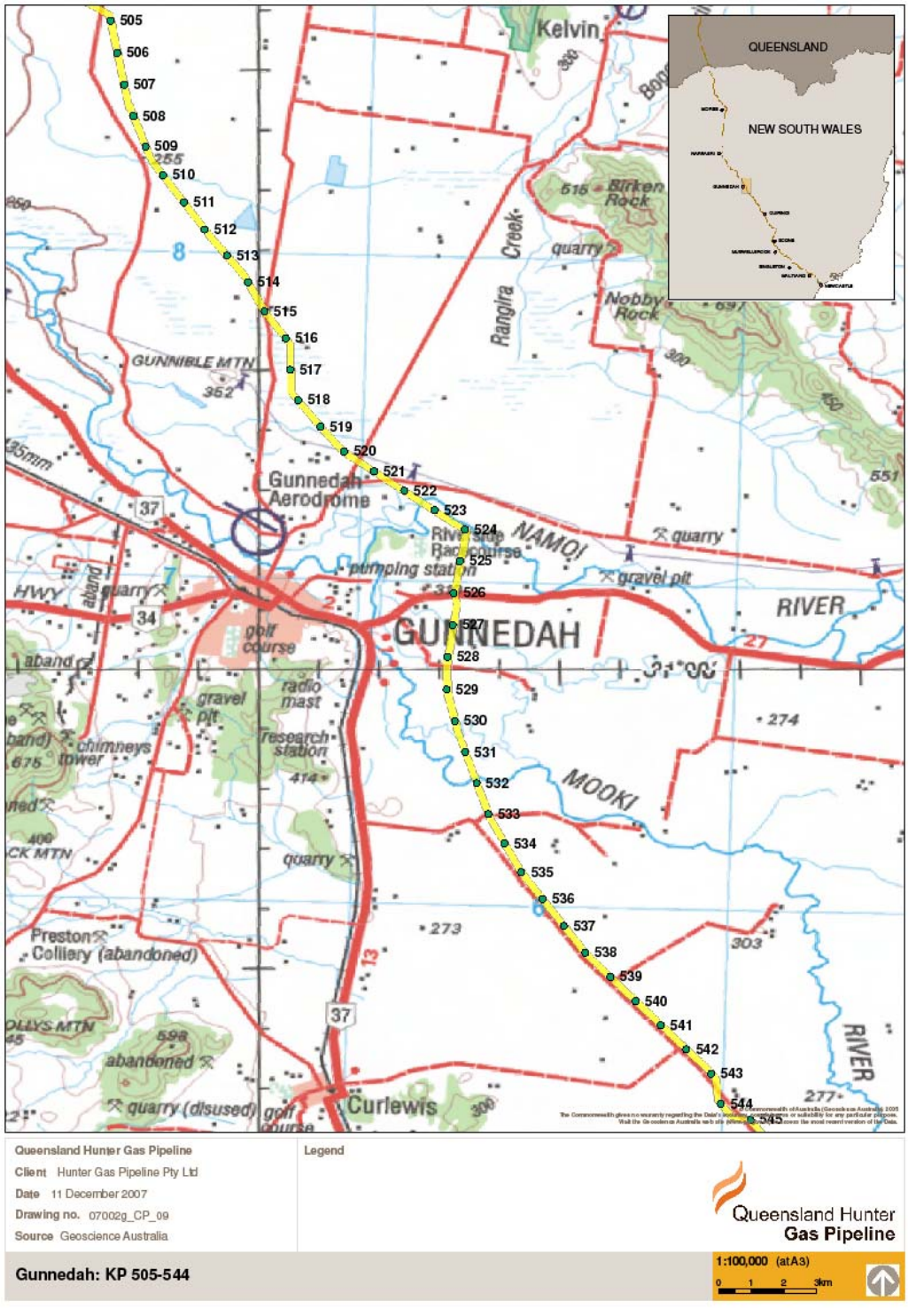

Figure 2i – Study Area in Gunnedah (KP505-544)
(Original plan supplied by the Client on 17 December 2007)

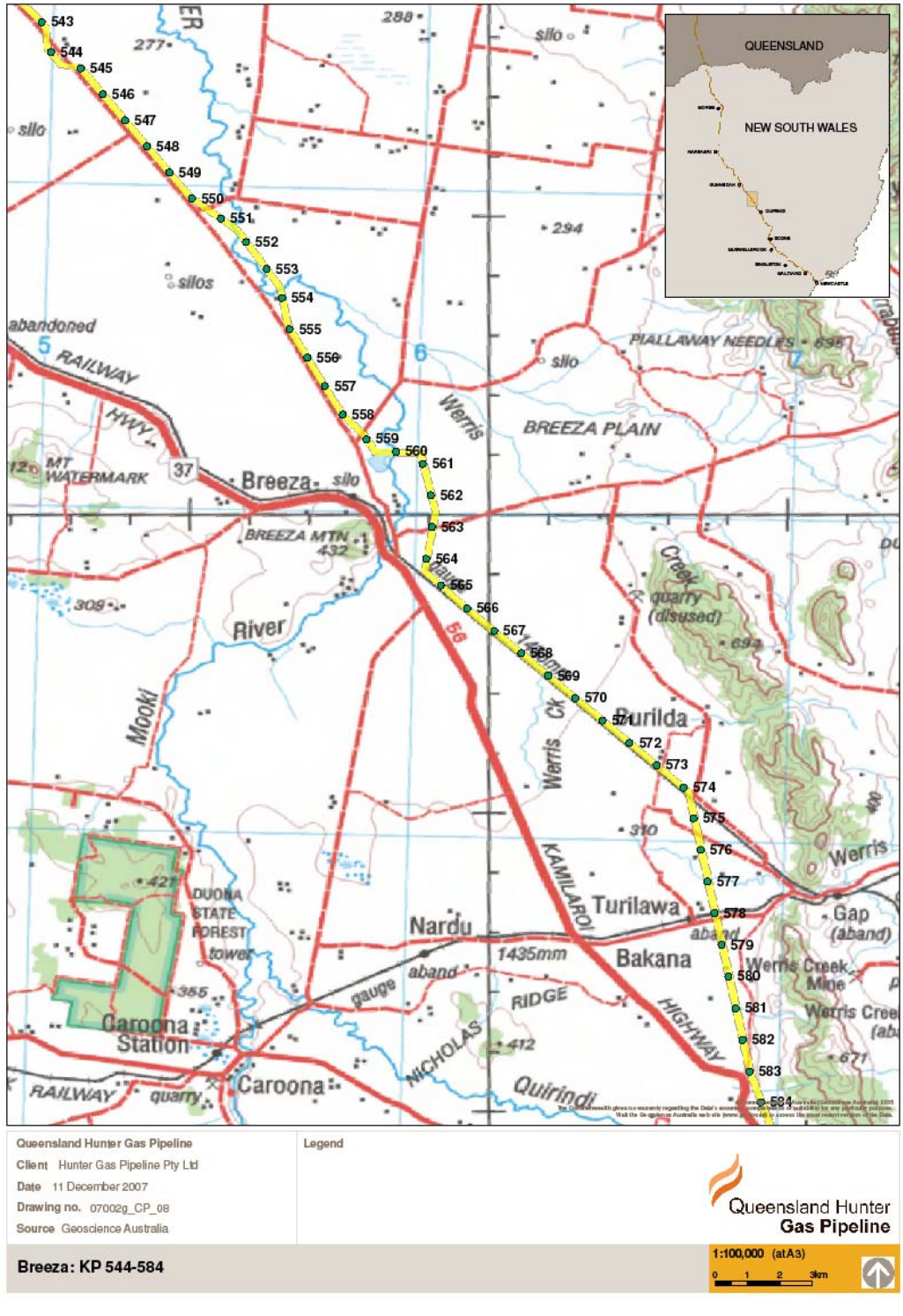

Figure 2j – Study Area in Breeza (KP544-584)
(Original plan supplied by the Client on 17 December 2007)

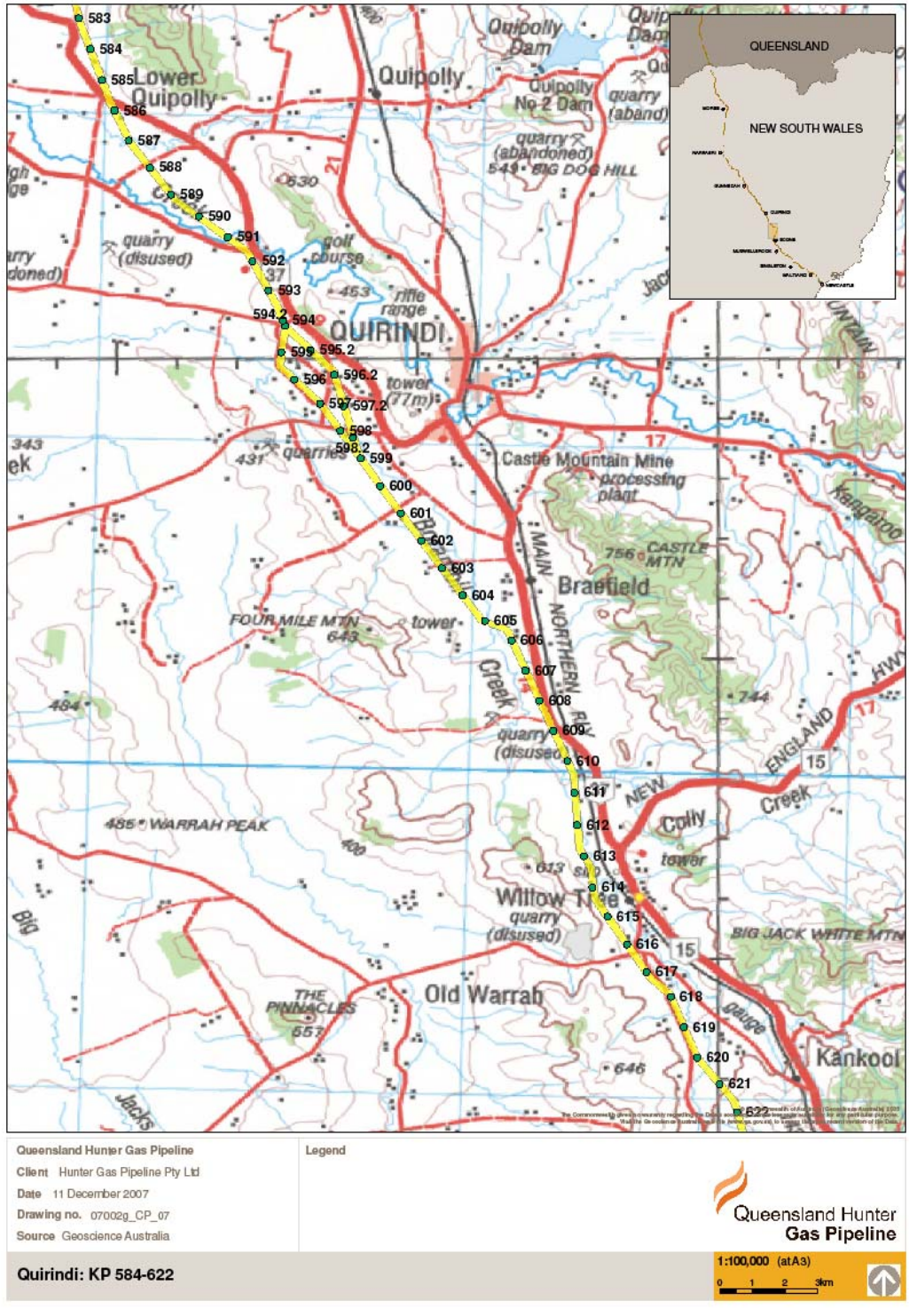

Figure 2k – Study Area in Quirindi (KP584-622)
(Original plan supplied by the Client on 17 December 2007)

Figure 2l – Study Area in Murrurundi (KP622-665)
(Original plan supplied by the Client on 17 December 2007)

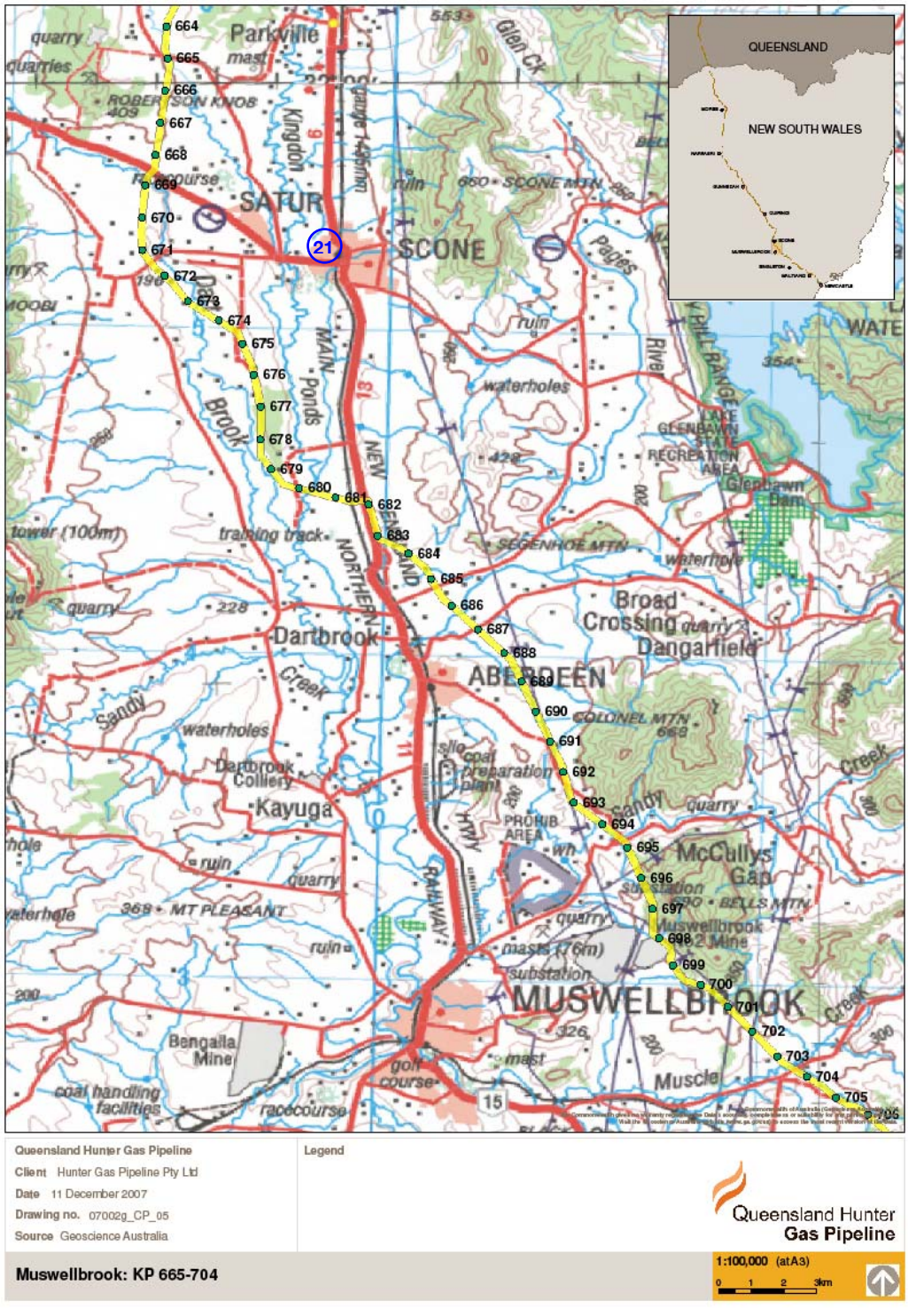

Figure 2m – Study Area in Muswellbrook (KP665-704)
(Original plan supplied by the Client on 17 December 2007)

Figure 2n – Study Area in Singleton North (KP704-734)
(Original plan supplied by the Client on 17 December 2007)

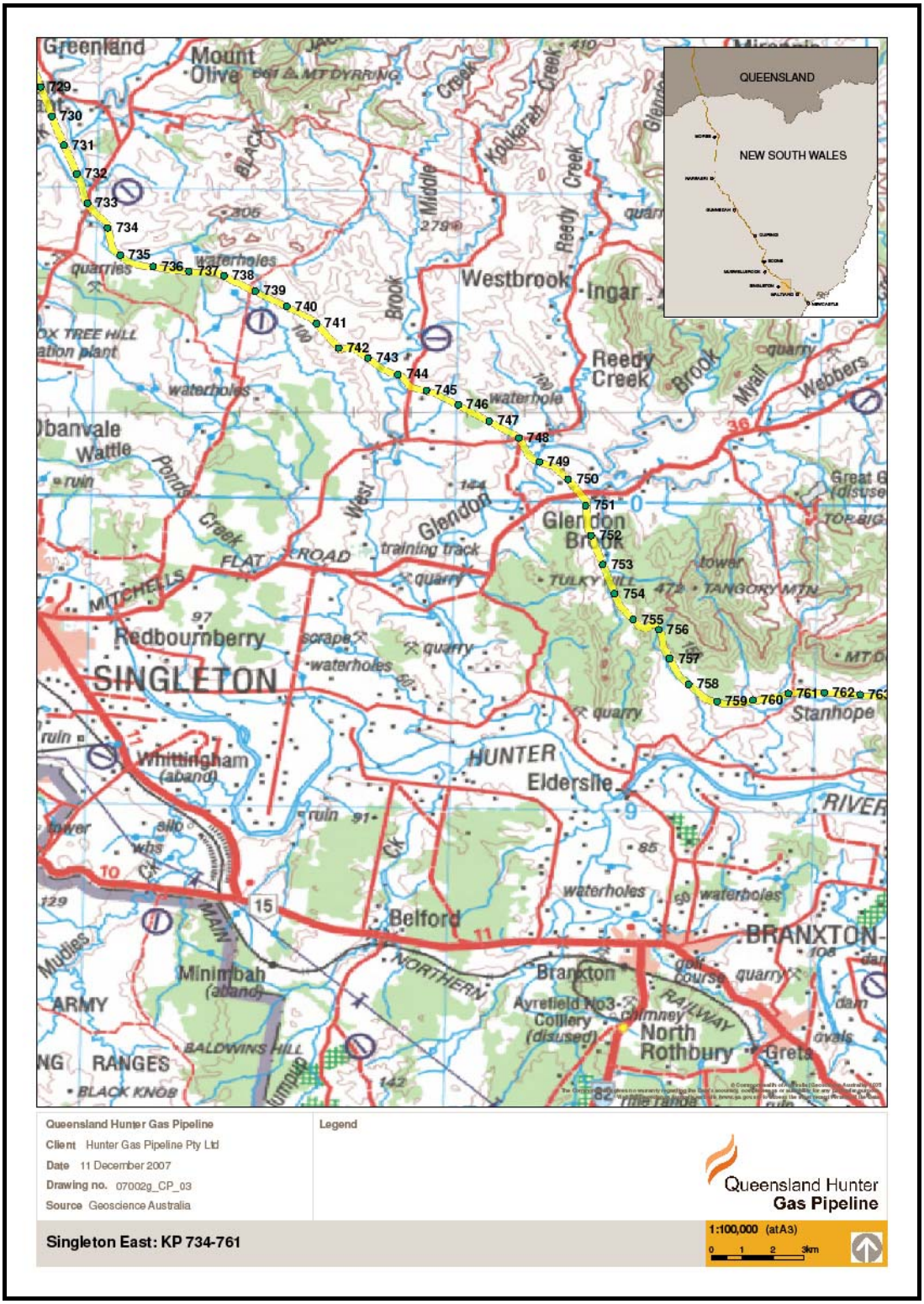

Figure 2o – Study Area in Singleton East (KP734-761)
(Original plan supplied by the Client on 17 December 2007)

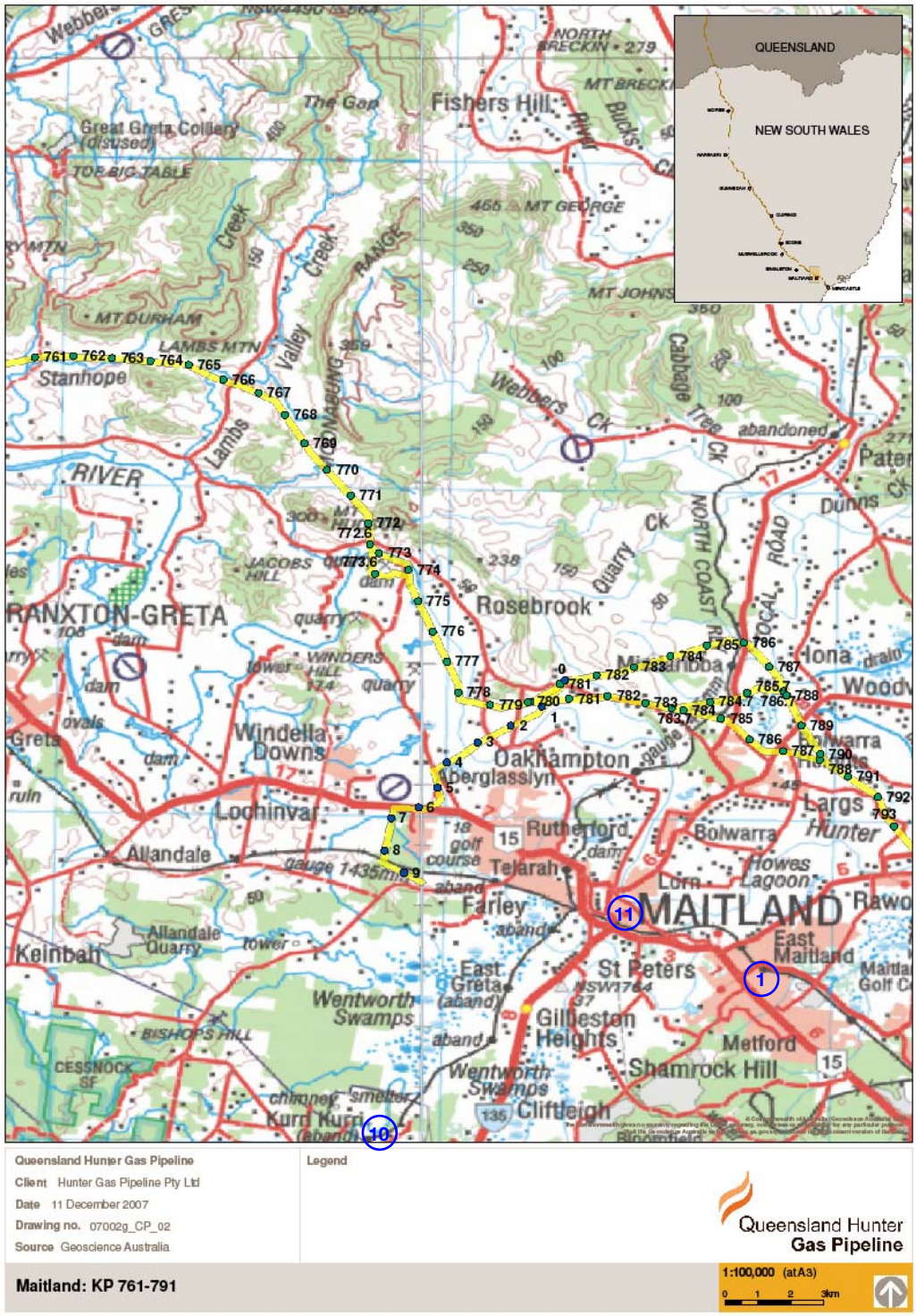

Figure 2p – Study Area in for Maitland (KP761-791)
(Original plan supplied by the Client on 17 December 2007)

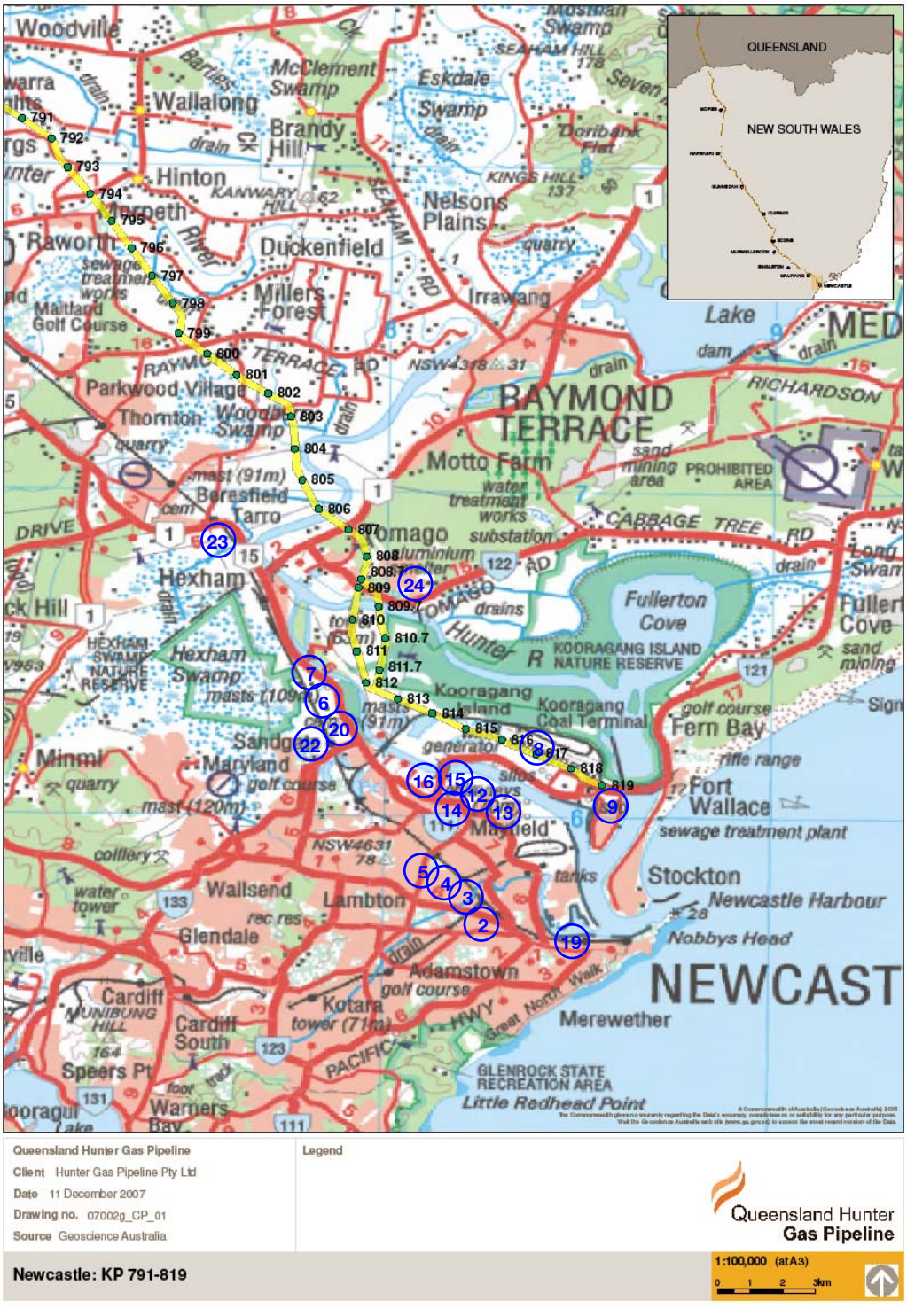

Figure 2q – Study Area in Newcastle (KP791-819)
(Original plan supplied by the Client on 17 December 2007)

Appendix C
Table 2 - Water Body Crossings

Table 2 - Water Body Crossings

Section	KP Start	KP End	KP registered by Manidis Roberts	Possible crossing method option indicated by Manidis Roberts
Boomi (KP 222 260)				
MacIntyre River (or Barwon River)*	221	222	222	Dam & Pump, Flume and HDD
Gnoura Creek	230	231		
Multiple unknown water channels	232	234		
Boomi River*	234	235	234	HDD
An unknown water channel	236	237		
An unknown water channel	238	239		
An unknown water channel	243	244		
An unknown bore drain	245	246		
An unknown bore drain	247	248		
An unknown bore drain	249	250		
Whalan Creek	251	252	251.5	Dam & Pump and Flume
An unknown bore drain	253	254		
An unknown bore drain	255	256		
Garah (KP 260 295)				
An unknown water channel	261	262		
An unknown water channel	266	267		
An unknown water channel	267	268		
An unknown water channel	282	283		
Gil Gil Creek*	286	287	286.5	HDD w/ Moree Weemelah Railway & Garnarvon Highway?
Ashley (KP 295 333)				
Marshalls Ponds Creek	316	317	317	Dam & Pump and Flume
Multiple unknown water channels	326	329		
Multiple unknown water channels	330	331		
Gwydir River*	331	332	331	HDD w/ railway & highway?
Moree (KP 333 366)				
An unknown water channel	333	334		
Duffys Creek	334	336		
Mehi River	337	338	337.5	HDD w/Gwydir Highway & abondoned railway line
An unknown water channel	344	345		
An unknown water channel	346	347		
An unknown water channel	347	348		
An unknown water channel	349	350		
Tycannah Creek*	355	356	355.5	Dam & Pump, Flume and HDD
An unknown water channel	363	364		
Gurley Creek	364	365	364.5	Dam & Pump, Flume and HDD
Bellata (KP356 399)				
Multiple unknown water channels	371	372		
Multiple unknown water channels	381	382		
An unknown water channel	384	385		
An unknown water channel	386	387		
Myall Hollow Creek*	389	390	390	Dam & Pump, Flume and HDD
Multiple unknown water channels	391	392		
An unknown water channel	395	396		
An unknown water channel	397	398		
An unknown water channel	399	400		

Section	KP Start	KP End	KP registered by Manidis Roberts	Possible crossing method option indicated by Manidis Roberts
Narrabri North (KP 399 432)				
An unknown water channel	399	400		
Ten Mile Creek	401	404		
An unknown water channel	407	408		
An unknown water channel	408	409		
An unknown water channel	410	411		
An unknown water channel	412	413		
An unknown water channel	413	414		
An unknown water channel	414	415		
Bobbiwaa Creek	416	417		
Spring Creek	420	421		
An unknown water channel	424	425		
An unknown water channel	425	426		
An unknown water channel	426	427		
An unknown water channel	428	429		
Mulgate Creek	429	430		
Multiple unknown water channels	431	432		
Narrabri (KP 432 470)				
Multiple unknown water channels	434	436		
Multiple unknown water channels	440	441		
Namoi River*	442	443	442.5	Dam & Pump, Flume and HDD
Multiple unknown water channels	444	445		
An unknown water channel	447	448		
An unknown water channel	448	449		
An unknown water channel	450	451		
Multiple unknown water channels	451	452		
An unknown water channel	453	454		
An unknown water channel	455	456		
An unknown water channel	458	459		
An unknown water channel	462	463		
Multiple unknown water channels	464	467		
Multiple unknown water channels	467	469		
Boggabri (KP 470 505)				
Namoi River*	475	476	475	HDD w/ Kamiaroi Highway?
Bollol Creek	484	485		
An unknown water channel	487	488		
An unknown water channel	488	489		
Namoi River*	496	497		
Namoi River*	499	500	496	Dam & Pump, Flume and HDD
An unknown water channel	499	500	499.5	Dam & Pump, Flume and HDD
An unknown water channel	502	503		
Gunnedah (KP 505 544)				
An unknown water channel	509	510		
An unknown water channel	519	520		
Multiple unknown water channels	521	523		
Namoi River*	522	524	522.5	Dam & Pump, Flume and HDD
An unknown water channel	527	528		
An unknown water channel	528	529		
An unknown water channel	530	531		
Mooki River*	531	532	532	Dam & Pump, Flume and HDD

Section	KP Start	KP End	KP registered by Manidis Roberts	Poss ble crossing method option indicated by Man dis Robertes
Breeza (KP 544 584)				
Mooki River*	551	552	551.5	Dam & Pump, Flume and HDD
Mooki River*	553	554	554	Dam & Pump, Flume and HDD
Mooki River and an unknown surface water body*	559	560	559.5 and 560	Dam & Pump, Flume and HDD
Werris Creek	568	569		
Werris Creek	576	577		
An unknown water channel	581	582		
An unknown water channel	583	584		
Quirindi (KP 584 622)	**KP Start**	**KP End**		
An unknown water channel	585	586		
An unknown water channel	587	588		
Quirindi Creek	591	592	591	HDD w/ Quirindi Premer Road?
An unknown water channel	597	598		
An unknown water channel	597.2	598		
An unknown water channel	598	599		
Borambil Creek	601	602		
Borambil Creek	605	606		
An unknown water channel	610	614		
An unknown water channel	618	619		
An unknown water channel	620	621		
Murrurundi (KP 622 665)	**KP Start**	**KP End**		
An unknown water channel	622	623		
An unknown water channel	625	626		
Mu tip e unknown water channels	626	626.7		
An unknown water channel	629	630		
Pages River*	630	631		
An unknown water channel	632	633		
An unknown water channel	635	636		
An unknown water channel	638	639		
An unknown water channel	640	641		
An unknown water channel	641	642		
An unknown water channel	644	645		
Mu tip e unknown water channels	646	647		
An unknown water channel	648	649		
Petwyn Valley Creek	651	652	651.5	Dam & Pump and Flume
An unknown water channel	653	654		
An unknown water channel	654	655		
An unknown water channel	657	658		
An unknown water channel	658	659		
An unknown water channel	663	664		
An unknown water channel	664	665		
Muswellbrook (KP 665 704)	**KP Start**	**KP End**		
An unknown water channel	665	666		
Dartbrook Creek*	668	669		
Dartbrook Creek*	673	674		
Dartbrook Creek*	678	679		
Dartbrook Creek*	678	680		
Kingdon Ponds*	680	681	680	HDD w/ New England Highway & Main North Rai way
An unknown water channel	684	685		
An unknown water channel	686	687		
Mu tip e unknown water channels	688	691		
An unknown water channel	691	692		
Sandy Creek	692	694		
An unknown water channel	694	695		
An unknown water channel	696	697		
An unknown water channel	697	698		
An unknown water channel	699	701		
Muscle Creek	703	704		

Section	KP Start	KP End	KP registered by Manidis Roberts	Possib e crossing method option indicated by Manidis Roberts
S ngleton North (KP 704 734)				
Mul iple unknown water channels	704	707		
An unknown wa er channel	709	712		
An unknown wa er channel	712	713		
An unknown wa er channel	713	714		
An unknown wa er channel	715	716		
Foy Brook and multiple unknown water channels	716	717	716	Dam & Pump, Flume and HDD
Cross Creek	719	721		
An unknown wa er channel	723	724		
An unknown wa er channel	724	725		
An unknown wa er channel	725	726		
An unknown wa er channel	727	728		
Fal Brook	732	733	732	Dam & Pump, Flume and HDD
An unknown wa er channel	733	734		
Singleton East (KP 734 761)				
An unknown wa er channel	734	736		
An unknown wa er channel	739	740		
West Brook	743	744		
An unknown wa er channel	745	746		
Reedy Creek	747	748		
Glendon Brook	748	749	749	Dam & Pump, Flume and HDD
Mul iple unknown wa er channels	753	754		
An unknown wa er channel	755	756		
An unknown wa er channel	756	759		
An unknown wa er channel	759	760		
Stanhope Creek	760	761		
Maitland (KP 761 791)				
Stanhope Creek	761	764		
Lambs Va ley Creek	765	766		
An unknown wa er channel	769	770		
Mul iple unknown wa er channels	772.6	775		
An unknown wa er channel	777	778		
An unknown wa er channel	778	779		
An unknown wa er channel	781	782		
An unknown wa er channel	783	784		
An unknown surface water body	784.7	788		
An unknown wa er channel	785	788		
An unknown wa er channel	788	790		
An unknown water channel	3	4		
An unknown water channel	7	8		
Newcastle (KP 791 819)				
Hunter River (and Patterson River)*	794	795	794.3	HDD w/ Morpeth Road
Hunter River*	796	797		
Woodberry Swamp	800	801		
An unknown water channel	802	804		
An unknown water channel	805	806		
Hunter River*	806	807	806	HDD
Hunter River*	809	810	810	HDD
Hunter River*	809	810.7	810	HDD
An unknown surface water body	812	813		
An unknown surface water body	814	815		
An unknown surface water body	815	816		

**Listed in Daily River Information Provided by NSW Department of Natural Resources*

Appendix D
Figures 4a to 4e - Acid Sulphate Soil Risk Maps

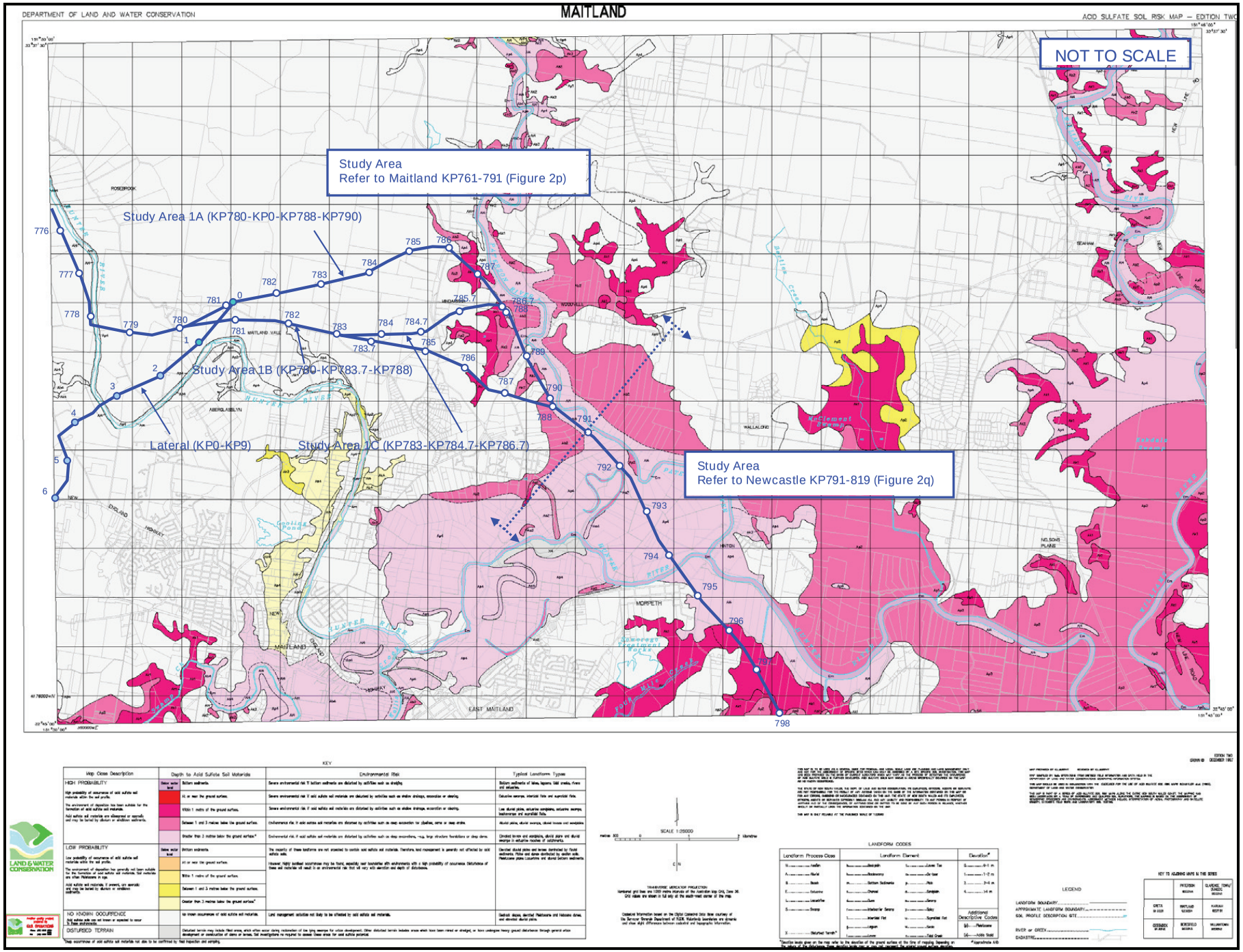

Figure 4a – Acid Sulphate Soil Risk Map for Maitland (The original plan prepared by NSW Department of Natural Resources)

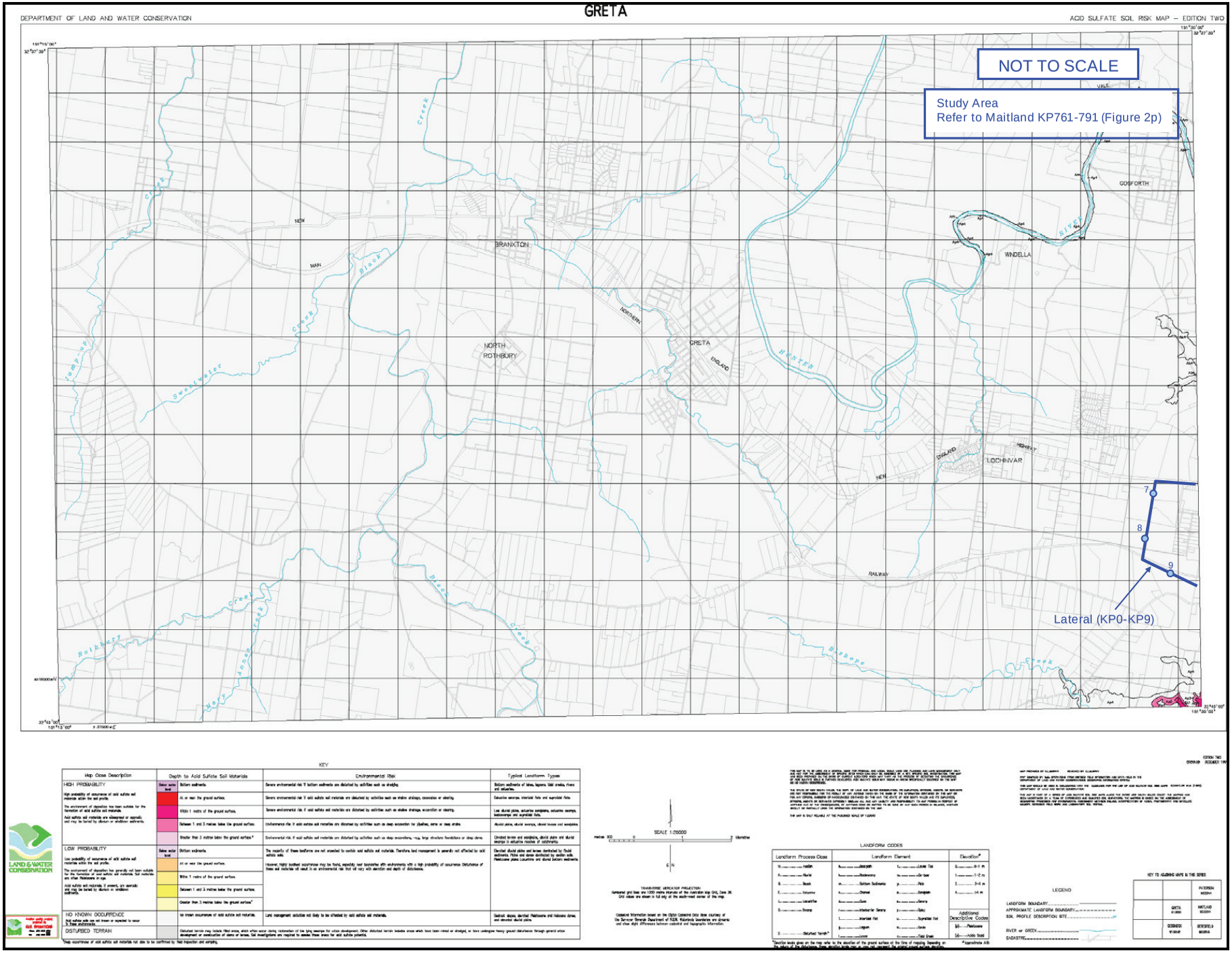

Figure 4b – Acid Sulphate Soil Risk Map for Greta (The original plan prepared by NSW Department of Natural Resources)

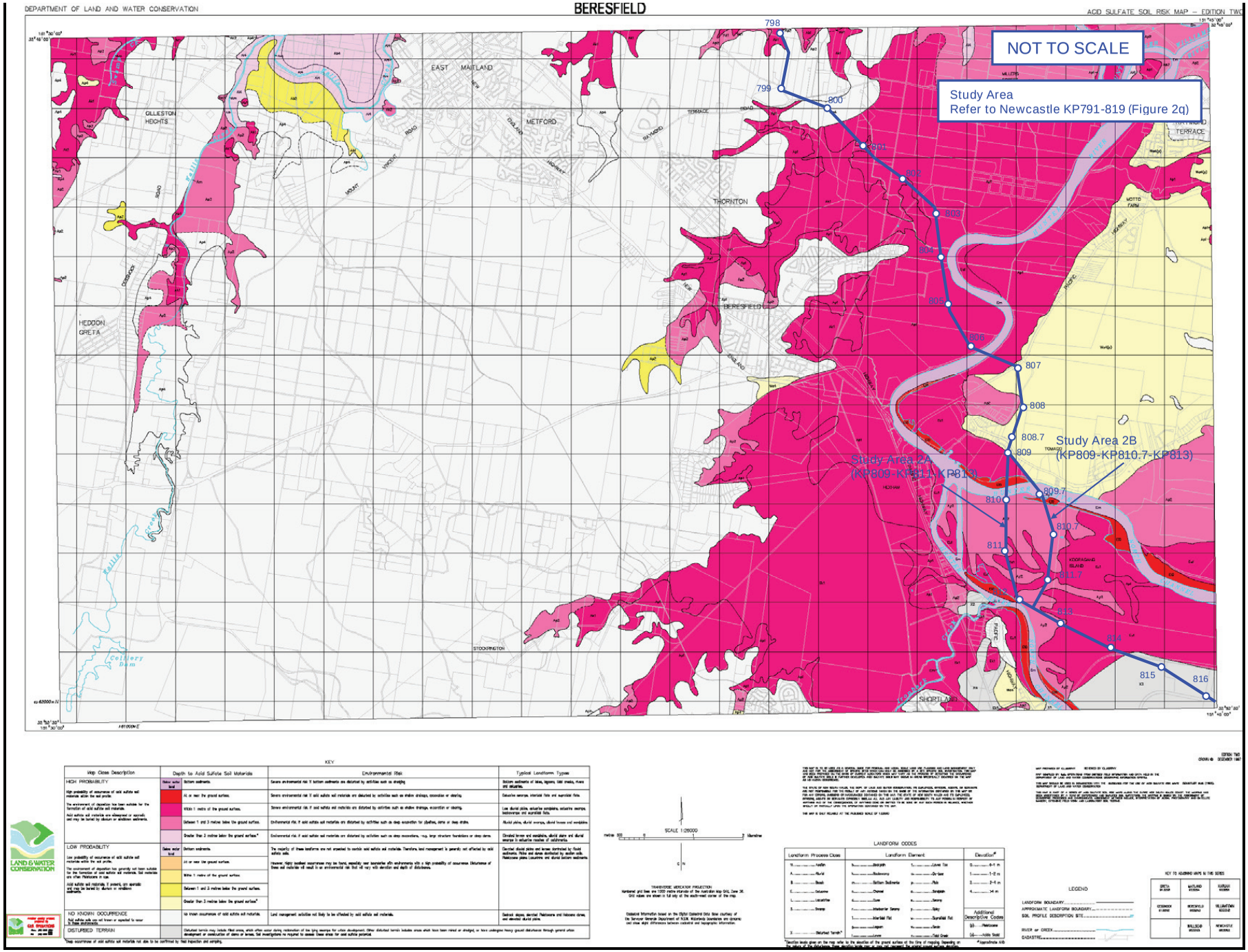

Figure 4c – Acid Sulphate Soil Risk Map for Beresfield (The original plan prepared by NSW Department of Natural Resources)

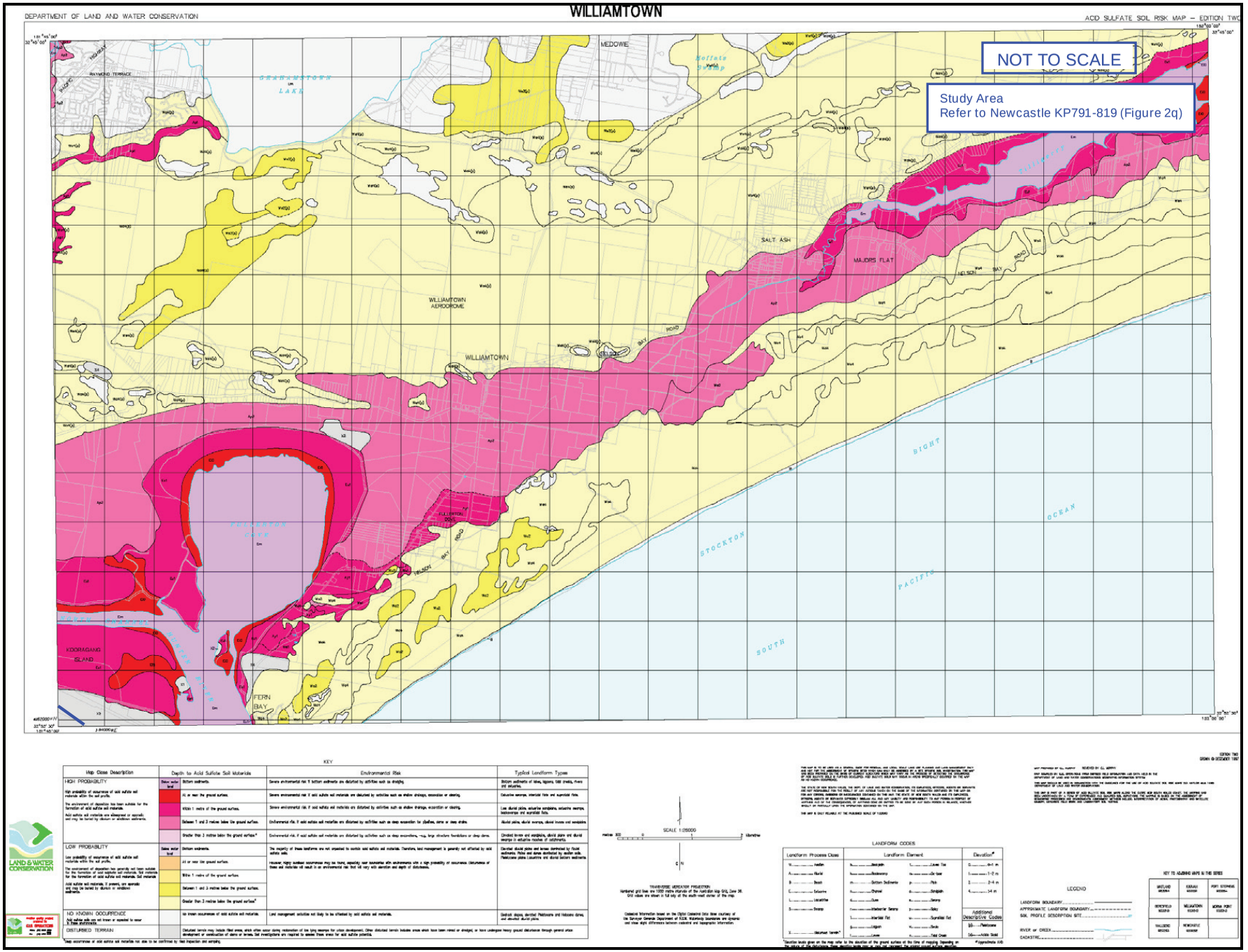

Figure 4d – Acid Sulphate Soil Risk Map for Williamtown (The original plan prepared by NSW Department of Natural Resources)

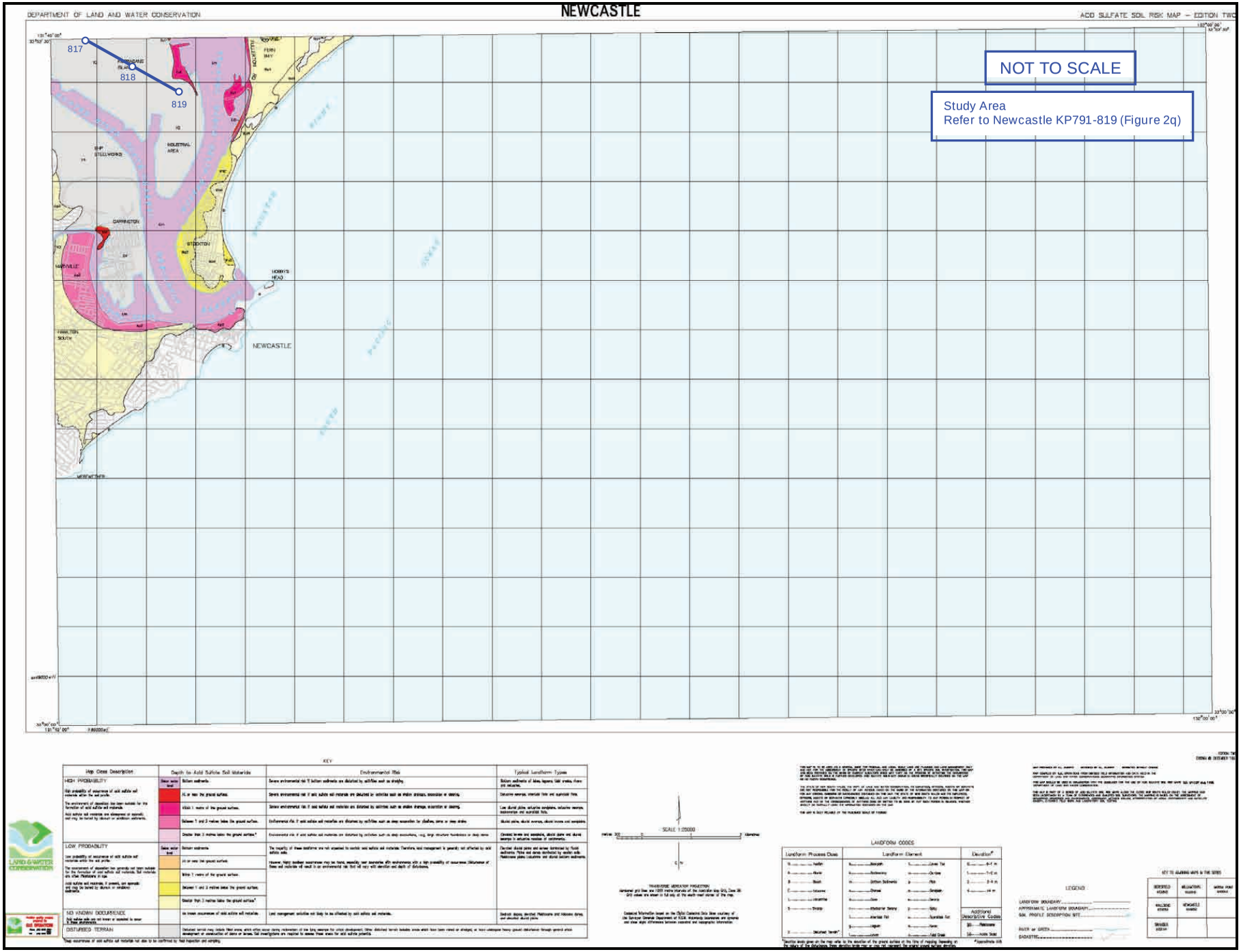

Figure 4e – Acid Sulphate Soil Risk Map for Newcastle (The original plan prepared by NSW Department of Natural Resources)

Appendix E
Table 7 - QHGP Study Areas Affected by Acid Sulphate Soils

Table 7 - QHGP Areas Affected by Acid Sulphate Soils

Section	Risk Map	KP	In-Between	Probability	KP	In-Between	Probability	KP	In-Between	Probability	KP	In-Between	Probability
		Single Areas											
		776		Not Known									
			776-777	Not Known									
		777		Not Known									
			777-778	Not Known									
		778		Not Known									
			778-779	Not Known									
		779		Not Known									
			779-780	Not Known									
		780		Not Known									
		Divided Areas											
		Study Area 1A (KP780-KP0-KP790-KP788)			**Study Area 1B (KP780-KP783.7-KP788)**			**Study Area 1C (KP783-KP784.7-KP786.7)**			**Lateral (KP0-KP9)**		
		780		Not Known	780		Not Known	783		Not Known	0		Not Known
			780-781	Not Known		780-781	Not Known		783-784	Not Known		0-1	Not Known
		781		Not Known	781		Not Known	784		Not Known	1		Not Known
			781-0	Not Known		781-782	Not Known		784-784.7	Not Known		1-2	Not Known
		0		Not Known	782		Not Known	784.7		Not Known	2		Not Known
			0-782	Not Known		782-783	Not Known		784.7-785.7	Not Known		2-3	Not Known
		782		Not Known	783		Not Known	785.7		Not Known	3		Not Known
			782-783	Not Known		783-783.7	Not Known		785.7-786.7	High		3-4	Not Known
Maitland (Figure 2p)		783		Not Known	783.7		Not Known	786.7		High	4		Not Known
			783-784	Not Known		783.7-785	Not Known					4-5	Not Known
		784		Not Known	785		Not Known				5		Not Known
			784-785	Not Known		785-786	High					5-6	Not Known
		785		Not Known	786		High				6		Not Known
			785-786	Not Known		786-787	High					6-7	Not Known
		786		Not Known	787		Not Known				7		Not Known
			786-787	High		787-788	High					7-8	Not Known
		787		High	788		High				8		Not Known
			787-786.7	High								8-9	Not Known
		786.7		High							9		Not Known
			786.7-788	High									
		788		High									
			788-789	High									
		789		Not Known									
			789-790	High									
		790		High									
			790-788	High									
		788		High									
		Single Areas											
		788		High									
			788-791	High									
		791		High									
			791-792	High									
		792		High									
			792-793	High									
		793		High									
			793-794	High									
		794		High									
			794-795	High									
		795		High									
			795-796	High									
		796		High									
			796-797	High									
		797		High									
			797-798	High									
		798		High									
			798-799	High									
		799		Not known									
			799-800	Not known									
		800		Not known									
			800-801	High									
		801		High									
			801-802	High									
		802		High									
			802-803	High									
		803		High									
			803-804	High									
		804		High									
			804-805	High									
		805		High									
			805-806	High									
		806		High									
			806-807	High									
Newcastle (Figure 2q)		807		Low									
			807-808	Low									
		808		Low									
	Beresfield (Figure 4c)		808-809	Low									
		808.7		Low									
			808.7-809	High									
		809		High									
		Divided Areas											
		Study Area 2A (KP809-KP811-KP813)			**Study Area 2B (KP809-KP810.7-KP813)**								
		809		High	809		High						
			809-810	High		809-809.7	High						
		810		High	809.7		High						
			810-811	High		809.7-810.7	High						
		811		High	810.7		High						
			811-812	High		810.7-811.7	High						
		812		High	811.7		High						
			812-813	High		811.7-813	High						
		813		High	813		High						
		Single Areas											
		813		High									
			813-814	High									
		814		High									
			814-815	High									
		815		Disturbed Terrain									
			815-816	Disturbed Terrain									
		816		Disturbed Terrain									
	Williamtown (Figure 4d)		816-817	Disturbed Terrain									
		817		Disturbed Terrain									
			817-818	Disturbed Terrain									
	Newcastle (Figure 4e)	818		Disturbed Terrain									
			818-819	Disturbed Terrain									
		819		Disturbed Terrain									

Appendix F
Registered Contaminated Sites, and Site and Notice Details

Management overview
Site auditor scheme
Guidelines under the CLM Act
Record of EPA notices
Engaging a consultant
Information on gasworks sites
Regulatory Impact Statement - Proposed Underground Petroleum Storage Systems Regulation
Frequently asked questions
More information about land

Site and notice details

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Area No: 3061

The information below was correct at the time the notices were issued.

Site: BHP Kooragang
Address: Cormorant Road, Kooragang, 2304
LGA: Newcastle City Council

Occupier: BHP Rod and Bar Division
Owner: BHP

Lot 1 DP 581473 Lot 2 DP 581473 Lot 11 DP 841542 Lot 12 DP 841542

Notices relating to this site (1 current and 1 former)

(Map) where available, maps show the part of the site affected by the notice

Notice recipient	Notice type & number		Status	Date
Broken Hill Proprietory Company Ltd	Remediation Order	357 Map	Current	Issued 18 Oct 1993
Broken Hill Proprietory Company Ltd	Remediation Order	295	Former	Issued 23 Aug 1991 Revoked 18 Oct 1993

Print-friendly version

30 January 2008

Heggies Pty Ltd
Environmental Engineers & Scientists
2 Lincoln Street
Lane Cove NSW 2066

CERTIFIED MAIL

The Manager
Broken Hill Proprietary Co Ltd
Rod & Bar Products Division
Selwyn Street
MAYFIELD NSW 2304

Heggles Pty Ltd
Environmental Engineers & Scientists
2 Lincoln Street
Lane Cove NSW 2066

270042D7
Notice No.357
Area No.3061

Contact: Colin Halverson

18 OCT 1993

ENVIRONMENTALLY HAZARDOUS CHEMICALS ACT, 1985
NOTICE UNDER SECTION 35

WHEREAS:-

A. The above company is the occupier of Premises at Cormorant Road, Kooragang Island, known as Kooragang Island Emplacement Facility; and

B. The Premises have been or are being used for or in connection with the carrying on of a prescribed activity, namely an act of manufacturing, processing keeping, distributing, conveying, using, selling or disposing of a chemical or chemical waste or any act related to such act; and

C. That part of the Premises defined by AMG co-ordinates E568686.96 N6363142.76 to E568707.63, N6363255.64 to E569060.93, N6363190.93 to E569040.26, N6363078.05 in Drawing No 181997, dated 27 August 1993 and signed by D F Wood, Registered Surveyor, is reasonably believed to be contaminated as a consequence of the carrying on of the prescribed activity or activities; and

D. The part of the Premises referred to in C. above are reasonably believed to be affected by asbestos and asbestos wastes; and

E. The part of the Premises referred to in C. above are deemed to be environmentally degraded as a consequence of being affected by the contaminants described in Clause D; and

F. A notice under Section 35 of the Environmentally Hazardous Chemicals Act was served on the premises on 23 August 1991.

TAKE NOTICE THAT

In accordance with the powers vested in the Environment Protection Authority (EPA) by the provisions of Section 35 of the Environmentally Hazardous Chemicals Act, 1985, (the "Act"), the EPA until further notice directs that:

1. This Notice revokes the directions given in the previous Notice relating to the Premises and served on the occupier of the premises on 23 August 1993 under Section 35 of the Environmentally Hazardous Chemicals Act.

2. The following conditions of this Notice apply only to that part of the Premises as described in C. above.

3.(1) Should the Occupier wish to undertake any works on the Premises which could constitute prescribed remedial action, the Occupier shall do so only in accordance with a direction in writing given by the EPA.

(2) The Occupier shall give the EPA prior notice before commencing any works approved pursuant to sub-clause (1).

(3) For the purposes of this Clause, prescribed remedial action is as defined in Section 33(2) of the Act, namely a reference to -

(a) ascertaining the nature and extent of the contamination of the Premises;

(b) preparing a remedial action plan for the Premises and, if required, a long-term management plan;

(c) removing the cause of the contamination from the Premises;

(d) reducing the contamination of the Premises;

(e) eliminating or reducing any danger arising from the contamination of the Premises; or

(f) restoring the Premises

(4) The EPA directs that should the Occupier wish to undertake any works on the Premises which have the effect or intention of:

(a) dispersing or covering the contamination,

(b) removing of disposing of any soil, sand, rock, water or any solid or liquid material of any kind from the Premises;

(c) vacating, or ceasing to carry on any activity upon the Premises or any part thereof;

(d) disturbance below a depth of R.L. 6.5 metres AHD.

the Occupier shall do so only in accordance with approval in writing given by the EPA and the Occupier shall give the EPA prior notice before commencing any such work.

4. If the Occupier becomes aware that the Premises to which this Notice relates is to be sold, or that occupancy of the Premises is to be otherwise relinquished:

(a) within one month of becoming aware, the Occupier shall inform the EPA in writing; and

(b) where the Occupier is advised of the name of the prospective owner or occupier, the Occupier, within 48 hours, in writing shall:

(i) notify the EPA; and

(ii) notify the intending purchaser or occupier of the conditions of this Notice.

This Notice does not derogate from the provisions of any relevant Environmental Planning

Instrument which may control the use of land on which the Premises are located or from any other Act administered by the EPA.

Failure to comply with this Notice may result in proceedings being commenced under Section 57 of the Environmentally Hazardous Chemicals Act, 1985 to remedy or restrain a breach of the directions given herein. The maximum penalty under Section 54 for an offence by Corporation is $ 215,000 or $ 60,000 if by an individual. The EPA retains the power to commence a prosecution for any offence committed under any Pollution Control Act. The Occupier is advised that it is an offence if an occupier, without lawful authority, wilfully or negligently disposes of a waste or causes any substance to leak, spill or otherwise escape in a manner which harms or is likely to harm the environment pursuant to Sections 5 and 6 of the Environmental Offences and Penalties Act, 1989.

The maximum penalty in the case of a Corporation is one million dollars.

NEIL SHEPHERD
DIRECTOR GENERAL
per:

(signed)

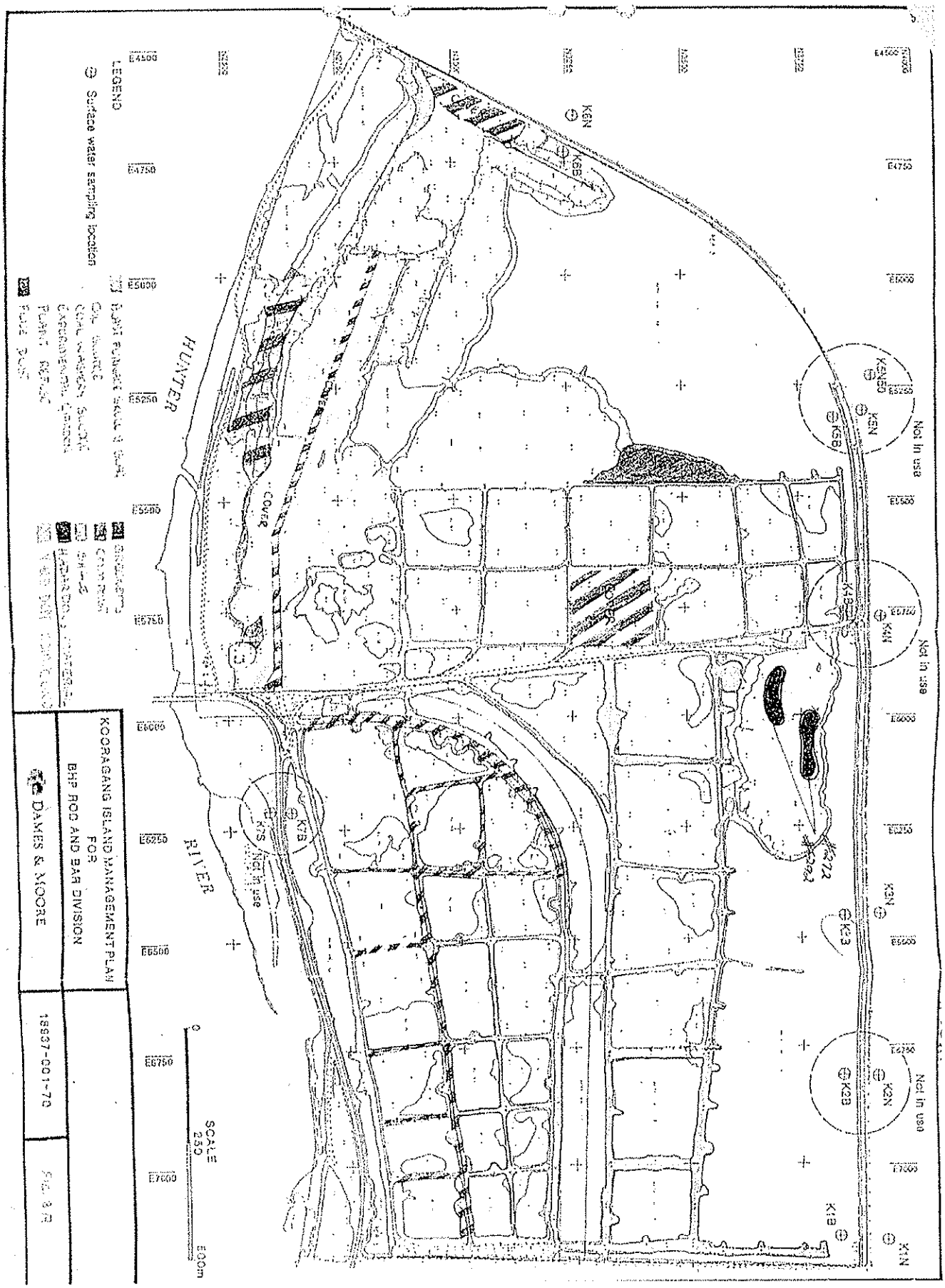
GEORGE DODDS
Regional Manager, Hunter
(by authorisation)

The role of the EPA is regulatory. Any advice required by the Occupier must be obtained as a result of the Occupier's own independent inquiries.

c.c. Town Clerk, Newcastle City Council
c.c. Register of Section 35 Notices

Map

Heggles Pty Ltd
Environmental Engineers & Scientists
2 Lincoln Street
Lane Cove NSW 2066



Heggies Pty Ltd
Environmental Engineers & Scientists
2 Lincoln Street
Lane Cove NSW 2066

CERTIFIED MAIL

The Manager 270042D7
Broken Hill Proprietary Co Ltd CH:BH
Rod & Bar Products Division
Selwyn Street
MAYFIELD NSW 2304

Heggies Pty Ltd
Environmental Engineers & Scientists
2 Lincoln Street
Lane Cove NSW 2066

ENVIRONMENTALLY HAZARDOUS CHEMICALS ACT, 1985
NOTICE UNDER SECTION 35

WHEREAS:-

1. The above company is the occupier of premises at Cormorant Road, Kooragang Island, and;

2. The premises are reasonably believed to be contaminated as a result of the dumping thereon of asbestos and asbestos wastes, and;

3. The premises are deemed to be contaminated by reason of their being environmentally degraded.

TAKE NOTICE THAT:-

In accordance with the powers vested in the State Pollution Control Commission by the provisions of Section 35 of the Environmentally Hazardous Chemicals Act, 1985, the Commission hereby directs that:

1. That part of the premises marked as "Asbestos Disposal Area" in Drawing No. 146791/2 shall be covered with an orange coloured marker mesh prior to covering with any refuse.

2. The area described in 1. above shall be covered to a height of not less than three metres with solid, inert refuse containing no putrescible material.

3. At the completion of covering with refuse, vegetation cover shall be established on the area described in 1. above and shall be maintained for a period of not less than two years.

4. No work shall be carried out on that part of the premises described in 1. above with the intention of, or having the effect of:-

   (a) reducing the contamination of the premises;

   (b) restoring or rehabilitating the premises;

   (c) removing from the premises, and disposing of, any contaminated material or any soil, sand, rock water or other solid or liquid material of any kind from the premises which would result in the disturbance of the surface of any land on the nominated area, except after prior notice to the Commission and in accordance with an approval, in writing, given by the Commission;

5. Where the premises to which this notice relates are to be sold, or occupancy of the

premises is to be transferred or responsibility for the premises otherwise relinquished the owner or occupier of the premises shall:-

(a) within one month of becoming aware of such sale, transfer or relinquishment inform the Commission in writing; and

(b) where the owner or occupier becomes aware of the name of the prospective owner or occupier, within 48 hours, in writing:

(i) notify the Commission of the name of the prospective owner or occupier; and

(ii) notify the intending purchaser or occupier of the conditions of this notice.

This Notice does not derogate from the provisions of any relevant Environmental Planning Instrument which may control the use of any premises to which this Notice applies.

Dr W Forrest
Acting Director
per:

(signed – 23/08/1991)
.....
A J Crapp
Regional Manager
Hunter & North Coast
(by authorisation)

Heggles Pty Ltd
Environmental Engineers & Scientists
2 Lincoln Street
Lane Cove NSW 2066

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Site and notice details

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Area No: 3183

The information below was correct at the time the notices were issued.

Site: Orica - Kooragang Island
Address: 15 Greenleaf Road, Kooragang, 2304
LGA: Newcastle City Council

Occupier: Orica Australia Pty Limited
Owner: Orica Australia Pty Limited

Lot 3 DP 234288

Notices relating to this site (2 current and 1 former)

(Map) where available, maps show the part of the site affected by the notice

Notice recipient	Notice type & number	Status	Date
Orica Australia Pty Limited	Note of Existence of Voluntary Remediation Proposal 26093	Current	Issued 08 Dec 2006
Not Applicable	Declaration of Remediation Site 21089	Current	Issued 16 Nov 2005
Orica Australia Pty Limited	Note of Existence of Voluntary Remediation Proposal 26061	Former	Issued 05 Dec 2005 Completed 08 Dec 2006

Print-friendly version

30 January 2008

Heggies Pty Ltd
Environmental Engineers & Scientists
2 Lincoln Street
Lane Cove NSW 2066

Notice No:	26093
Area No:	3183
Date:	8 December 2006
Proponent:	Orica Australia Pty Limited
Site:	The land to which this voluntary proposal relates is described as:
	15 Greenleaf Road, Kooragang Island , comprising Lot 3 of DP234288.

Please note: The *Contaminated Land Management Act 1997* does not require a copy of this Voluntary Proposal to be included on the public record.

Heggies Pty Ltd
Environmental Engineers & Scientists
2 Lincoln Street
Lane Cove NSW 2066

Environment Protection Authority

Declaration of remediation site

(Section 21 of the Contaminated Land Management Act 1997)

Declaration Number 21089; Area Number 3183

The Environment Protection Authority (EPA) declares the following land to be a remediation site under the Contaminated Land Management Act 1997 ("the Act").

1. Land to which this declaration applies ("the site")

The site incorporates the following areas in the local government area of Newcastle, New South Wales:

- Lot 3 DP 234288 (15 Greenleaf Road, Kooragang Island).

2. Nature of contamination affecting the site:

The EPA has found that the site is contaminated with the following substances ("the contaminants"):

- Arsenic; and
- Nutrients (specifically total ammonia and nitrate).

3. Nature of harm that the contaminants may cause:

The EPA has considered the matters in s.9 of the Act and for the following reasons has determined that the site is contaminated in such a way as to present a significant risk of harm to human health and the environment:

- Groundwater is contaminated with arsenic and ammonia at concentrations exceeding the Australian and New Zealand Conservation Council (2000) guidelines for the protection of aquatic ecosystems;
- Arsenic and ammonia contaminated groundwater has migrated off the site and may continue to migrate. The contaminated groundwater has the potential to impact the quality of the waters and sediment of the Hunter River; and
- There are potential human and biota exposure pathways to the contaminants.

4. Further action under the Act

The making of this declaration does not prevent the carrying out of a voluntary remediation of the site and any person may submit a voluntary remediation proposal for the site to the EPA. If the proposal satisfies the requirements of s.26 of the Act, the EPA may agree not to issue a remediation order to the person or persons bringing the proposal.

Orica Australia Pty Limited (Orica) intends to remediate the site under a voluntary remediation proposal to which it is seeking the EPA's agreement under the Act. The agreement would formalise remediation activities that have already been commenced at the site by Orica.

5. Submissions invited

The public may make written submissions to the EPA on:

- Whether the EPA should issue a remediation order in relation to the site; or
- Any other matter concerning the site.

Submissions should be made in writing to:

Director Contaminated Sites
Department of Environment and Conservation
PO Box A290
SYDNEY SOUTH NSW 1232

or faxed to 02 9995 5930

by not later than 2 December 2005.

Heggies Pty Ltd
Environmental Engineers & Scientists
2 Lincoln Street
Lane Cove NSW 2066

[SIGNED}

CAROLYN STRANGE
Director Contaminated Sites
Department of Environment and Conservation

Date: 16 November 2005

NOTE:

Remediation order may follow

If remediation of the site or part of the site is required, the EPA may issue a remediation order under s.23 of the Act.

Variation/Revocation

This declaration may be varied by subsequent declarations. It remains in force until it is otherwise revoked. A declaration may only be revoked when the EPA does not have reasonable grounds to believe that land is contaminated in such as way as to present a significant risk of harm (s.44 of the Act).

Information recorded by the EPA

Section 58 of the Contaminated Land Management Act 1997 requires the EPA to maintain a public record. A copy of this remediation declaration will be included in the public record.

Information recorded by councils

Section 59 of the Act requires the EPA to give a copy of this declaration to the relevant local council. The council is then required to note on its planning certificate issued pursuant to s.149 (2) of the Environmental Planning and Assessment Act that the land is currently within a remediation site. The EPA is required to notify council as soon as practicable when the declaration is no longer in force and the notation on the s.149 (2) certificate is no longer required.

Relationship to other regulatory instrument

This declaration does not affect the provisions of any relevant environmental planning instruments which apply to the land or provisions of any other environmental protection legislation administered by the EPA.

Notice No:	26061
Area No:	3183
Date:	5 December 2005
Proponent:	Orica Australia Pty Limited
Site:	Lot 3, DP 234288 (15 Greenleaf Road, Kooragang Island)

Please note: The Contaminated Land Management Act 1997 does not require a copy of this Voluntary Proposal to be included on the public record.

ieggies Pty Ltd
Environmental Engineers & Scientists
2 Lincoln Street
Lane Cove NSW 2066

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Site and notice details

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Area No: 3073

The information below was correct at the time the notices were issued.

Site: Genkem Pty Ltd
Address: School Drive, Tomago, 2322
LGA: Port Stephens Council

Occupier: Genkem Pty Ltd

Lot 1411 DP 582135

Notices relating to this site (1 current and 0 former)

(Map) where available, maps show the part of the site affected by the notice

Notice recipient	Notice type & number		Status	Date
Genkem Pty Ltd	Remediation Order	275	Current	Issued 24 Sep 1991

Print-friendly version

30 January 2008

Heggies Pty Ltd
Environmental Engineers & Scientists
2 Lincoln Street
Lane Cove NSW 2066

CERTIFIED MAIL

Genkem Pty Ltd
25 School Drive
TOMAGO NSW 2259

270188D1
TH:BH

ENVIRONMENTALLY HAZARDOUS CHEMICALS ACT, 1985
NOTICE UNDER SECTION 35

WHEREAS

1. Genkem Pty Ltd (the company) is the occupier of premises (the premises) located at 25 School Drive, Tomago New South Wales.

2. The premises are deemed to be contaminated by reason of the presence of lead and chromium in soils and ground water on the premises and in the surrounding area.

TAKE NOTICE THAT

In accordance with the powers vested in the State Pollution Control Commission by the provisions of Section 35 of the Environmentally Hazardous Chemicals Act, 1985, the Commission hereby requires:

1. The company to conduct a comprehensive investigation to:-

   (A) Determine the extent of contamination of the premises and the surrounding environment including soils and ground water by lead and chromium. The investigation should determine the spatial distribution and mobility of pollutants and assess their potential for environmental harm.

   (B) Recommend a plan of action to decontaminate and rehabilitate the premises and surrounding environment. The plan must include decommissioning and decontamination of the effluent disposal pond and provision of an environmentally acceptable method for disposing of wastewater which does not meet discharge limits specified in the company's licence under the State Pollution Control Commission Act.

   (C) Provide a timetable for completion of all work required by condition 1(B).

2. The investigation required by condition I(A) shall be conducted by an experienced environmental consultant. Details of the investigation shall be submitted to the Commission for approval within 30 days of the date of this Notice.

3. The investigation; rehabilitation and decontamination plan; and timetable for action required by conditions 1(A) and 1(B) shall be submitted to the Commission within 90 days of the Commission approving details of the investigation.

Heggies Pty Ltd
Environmental Engineers & Scientists
2 Lincoln Street
Lane Cove NSW 2066

Dr W Forrest
Acting Director
per:

(signed) 24 September, 1991

A J Crapp
Regional Manager
Hunter & North Coast
(by Authorisation)

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