

North Penrith – Stage 2A

Civils Report

Summary

The North Penrith Stage 2A development site is located to the east of the Stage 1 site currently under construction and to the North East of the Penrith Railway station. The development consists of 27 residential lots, 3 integrated lots yielding 8 dwellings, Thornton Park, Thornton House Heritage site, a super lot to the North and an access way connecting The Speedway Circuit, constructed as part of Stage 1 and Coreen Avenue.

Objectives

The objectives of this report are to:

- Summarise earthwork requirements to achieve the proposed site regrading strategy;
- Outline any temporary civil works associated with Stage 2A;
- Respond to the relevant Director General's Requirements (DGRs);

DGRs have been issued for the Stage 2A Infrastructure, landscaping and subdivision works at the North Penrith Defence Site, The Crescent, Penrith State Significant Development Application (SSD 5243) dated 16 April 2012. The DGRs that this report responds to are nominated in **Table 1**.

Table 1 DGRs addressed in this report

Director General's Requirements	Key Issues Addressed	Description
Stage 2A SSD 5243	4. Earthworks	• Provide detailed survey showing existing and proposed levels and proposed quantities of cut and fill including types of materials and their source; • Details on the type of fill including types of materials and their source; and • Details of the location for the disposal of excess cut and the methodology of transportation to this location.
Stage 2A SSD 5243	12. Sediment, Erosion and Dust controls (Construction & Excavation)	Detail measures and procedures to minimise and manage the generation and off-site transmission of sediment, dust and fine particles.

		Relevant Policies and Guidelines: - Managing Urban Stormwater – Soils & Construction Volume 1 2004 (Landcom) - Approved Methods for the Modelling and Assessment of Air Pollutants in NSW
Stage 2A SSD 5243	13. Utilities	In consultation with relevant agencies, the existing capacity and any augmentation requirements of the development for the provision of utilities including staging of infrastructure shall be assessed.
Stage 2A SSD 5243	16. Drainage	Drainage associated with the proposal, including stormwater and infrastructure.
Stage 2A SSD 5243	17. Servicing and Waste	Identify, quantify, and classify the likely waste streams to be generated during construction and describe the measures to be implemented to manage, reuse, recycle and safely dispose of this waste. Identify appropriate servicing arrangements (including but not limited to, waste management, loading zones, mechanical plant) for the site.

Methods and findings

Earthworks

The existing topography of the Stage 2A site varies with relatively steep grades observed at the South of the site ranging from approximately 6-13% falling from east to west and flattening off to the North to an average of around 3%.

The grading strategy for the Stage 2A site was prepared to reflect the findings and requirements as outline below:

- Catchment boundaries defined in Worley Parsons Stage 1 Construction Certificate documentation Reference 301015-02381-CI-S1 REV 02 dated October 2011;
- External Catchment assessment discussed in Worley Parsons '*North Penrith Drainage Stormwater and Groundwater Report*' October 2010;
- To reduce excessive grades and provide acceptable grading and access for individual lots;

- To fill any existing depressions, swale drains or grade trapped low points that would be created following the construction of the Stage 1 & Stage 2A works;
- Meet the existing levels at property boundaries outside of the proposed extent of works.

The site grading strategy was prepared using 12D, a 3D desktop software package for Civil Engineering and Surveying design and data processing.

It is estimated that the approximate gross fill requirement will be 3600 m³ to achieve the desired site grading. This could possibly be reduced to approximately 2300 m³ following the replacement of topsoil, boxing of roads and spoil from trenching and retaining wall excavation.

The minimum RL observed on the Stage 2A site is approximately RL 29.4m at the North Western end of the proposed super lot (Lot No. 2032, refer Appendix A for North Penrith Stage 2A Lot Layout Prepared by Craig & Rhodes). This exceeds the minimum habitable floor level of RL 25.9m specified in Worley Parsons '*North Penrith Regional Flooding Assessment*' dated 18/10/10.

Re-use of existing materials

Cut and fill

Cut material that has been deemed acceptable for use as engineered fill following inspection from an experienced geotechnical engineer will be carted to regrade and fill areas, trimmed and compacted to suit proposed levels.

The Geotechnical Assessment Engineering report for Stage 2A (draft only) by Geotechnique Pty Ltd Job No. 12609/1, has not reported any major constraints apart from some areas of the site with existing uncontrolled fill. These areas will require further assessment on site to determine their suitability for use as fill in regrade areas.

Topsoil

The detail site regrading design strategy will provide for topsoil stripping and replacement to regrade areas as well as berms and batters. The topsoil depth will be determined following detailed geotechnical investigation of the Stage 2A area.

Existing hardstand areas

The Stage 2A site contains approximately 5000 m² of flexible pavement and 300 m² of concrete paved areas to be removed/recycled.

The existing paved areas could be crushed and placed as road sub-grade in fill areas or treated to a standard compliant with RMS guidelines for road sub-base and base courses.

Landcom has a preference for re-using existing materials. However, the decision to re-use existing materials will require geotechnical testing and consultation with the contractor to confirm the approach to recycling.

Sediment & Erosion Control

The sediment & erosion control measures taken on site will be in accordance with Landcom's *Managing Urban Stormwater – Soils & Construction Volume 1 2004* and generally follow on from the North Penrith Project Application and Stage 1 CC design documentation prepared by Worley Parsons in assessing the requirements of stormwater management during construction.

The monitoring and assessment of air pollutants is to be in accordance with regulatory guidelines and industry standards and is to be undertaken by a suitably qualified consultant.

Utilities

The proposed utilities to service Stage 2A will be generally in accordance with Worley Parsons 'North Penrith Utilities Servicing Report', October 2010. The report by Worley Parson's highlights the strategy for sewer, potable water, gas, telecommunications and electricity for the entire North Penrith Development.

Drainage

The drainage concept for Stage 2A was largely based on previous design documentation for Stage 1, drainage and flooding assessment reports prepared by Worley Parsons and to also accommodate existing constraints and topography.

The concept drainage strategy for the Stage 2A State Significant Development Application (SSDA) provides an integrated system to cater for external catchments, proposed connections, defined catchment boundaries and inter-allotment drainage requirements.

A primary goal for the concept drainage design is to comply with Penrith City Council's Guidelines for Engineering Works for Subdivisions and Developments.

Servicing & Waste

Landcom's Triple Bottom Line program (TBL Program) is an integrated framework for achieving social, environmental and economic/financial sustainability. In relation to indicators for construction waste, Landcom has clear targets for the quantum of construction and demolition materials reused in site or elsewhere:

- Achieve 95% recovery (reuse and recycle) of total construction and demolition waste materials generated from the sum of civil works completed in that year.

Consultation

Penrith City Council was consulted prior to any design taking place to determine acceptable design procedures and preferred lot presentation. Following the completion of the concept site grading strategy, Penrith Council was further consulted to ensure that the concept grading, drainage and general design strategy was acceptable and within their engineering guidelines.

Conclusions

The grading strategy adopted for the Stage 2A site was largely dependent on existing topography as well as the requirements set by the Stage 1 CC design by Worley Parsons. The Stage 1 CC documentation specified catchment boundaries which largely governed road grading as well as concept drainage requirements.

Achieving the minimum habitable floor level for Stage 2A as set out in Worley Parsons '*North Penrith Regional Flooding Assessment*' dated 18/10/10 was not a design consideration when undertaking the grading strategy. This is due to the existing topography of the site being well above the assessed 100YR ARI habitable floor level of RL 25.9m.

The steeper grades observed in the residential portion of Stage 2A necessitated the design of retaining walls and batters to reduce to grades across individual lots and provide a better end product.

To achieve the desired grading strategy it is estimated that a net requirement of 2300 m³ of engineered fill will be required. This is likely to be sourced from stockpiles available on site following works associated with the construction of Stage 1.

Recommendations

Due to the extent of fill and retaining walls required as part of the concept grading strategy for the Stage 2A site, it will be a priority that the detail design of the walls and footing construction be discussed with Penrith City Council. The preferred method of fencing requirements along property boundaries, and the impact that this has on the retaining walls should also be addressed with Penrith City Council and other stakeholders (such as Dept. of Defence and adjoining residential owners).

Further works required:

- Geotechnical investigations to confirm the extents of uncontrolled fill encountered on the site;
- Structural design of proposed retaining walls and
- Testing of existing flexible and concrete pavement materials to determine suitability for re-use in the proposed road construction.

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1. Objectives of assessment

At a glance

A Civils Report has been prepared to discuss the concept site grading strategy, temporary sediment and erosion control methods, drainage and utilities design (servicing) and waste management for Stage 2A of the North Penrith Development.

The purpose of this report is to discuss:

- Outcomes and works associated with the regrading strategy for Stage 2A;
- Outline approximate cut and fill volumes to achieve the proposed grading strategy as well as discuss the sourcing of fill material;
- Detail proposed measures to be implemented as part of the Sediment & Erosion Control process;
- Discuss the concept drainage design strategy;
- Respond the Director General's Requirement's.

Stage 2A Concept Design Objectives

The objectives of the Stage 2A design process are highlighted below:

- Cater for external catchments and existing levels of neighbouring properties;
- Grading of roads and lots to meet the catchment boundaries set the in the Stage 1 CC documentation, while meeting the design requirements of Penrith City Council and Austroads;
- Provide an end product that would return a good result for the individual residential lots by implementing grading and retaining strategies;
- Provide a stormwater drainage network that has the capacity to convey stormwater runoff generated for events up to and including:
 - 5 year Average Recurrence Interval (ARI) event
 - Consideration of the flows generated from the Major 100 year ARI event
 - Resulting overland flows within roads, footpaths as well as habitable area;
- Minimisation of imbalances of cut and fill;
- Meet access requirements and suitable connection to existing and proposed infrastructure;
- Provide a design in keeping with Worley Parson's '*North Penrith Regional Flooding Assessment Report*' October 2010 and '*North Penrith Drainage Stormwater and Groundwater Report*' October 2010.

2. Site analysis

At a glance

The North Penrith Stage 2A development site is located to the East of the Stage 1 site currently under construction and to the North East of the Penrith Railway station. The development consists of 27 residential lots, 3 integrated lots yielding 8 dwellings, Thornton Park, Thornton House Heritage site, a super lot to the North and an access way connecting The Speedway Circuit, constructed as part of Stage 1 and Coreen Avenue.

North Penrith - Stage 2A

The extent of the Stage 2A works is shown shaded in Diagram 1.

Diagram 1 **North Penrith Stage 2A**



The existing topography of the Stage 2A site varies with relatively steep grades observed at the South of the site ranging from approximately 6-13% falling from East to West and flattening off to the North to an average of around 3% falling from East to West.

Stakeholders at property boundaries

The North Penrith Stage 2A site shares property boundaries with:

- Department of Defence to the South West;
- Existing residential properties to the East.

3. Regulatory context

At a glance

Earthworks

The earthworks for the site grading strategy has been prepared based on relevant Local Government Guidelines, Government Policies and professional standards appropriate to the industry for each of the following:

- Previous Construction Certification designs and documentation prepared for Stage 1 of the North Penrith site;
- Existing infrastructure/Internal road design;
- Stormwater drainage.

Stage 1 Construction Design & Documentation

The Stage 1 Construction Certificate design & documentation prepared by Worley Parson's provided the initial grading and drainage layout leading from Stage 1 into the Stage 2A site. The Stage 1 design levels for the Speedway Circuit as well as the intersection grading between The Speedway and Mountain View Crescent governed the levels adopted along the Western boundary of Stage 2A as well as associated drainage concept.

Existing Infrastructure/Internal Road Design

The Southern connection to 'The Crescent' dictated the required finished surface levels for the grading of the proposed 'Mountain View Crescent'.

The existing levels along the Penrith Training Depot boundary to the South West of the site, as well as the existing levels of the residential areas to the East, require the construction of retaining walls to suit the proposed grading as well as cater for the diversion of runoff from external catchments.

In preparing the grading for the internal road design of 'Mountain View Crescent' the following policies and guidelines were applied:

- Relevant Australian Standards;
- Penrith City Council Guidelines for Engineering Works for Subdivisions and Developments;
- Austroads;
- Landcom Street Design Guidelines

Sediment & Erosion Control

The following legislative controls and guides have been used in developing the sediment and erosion control strategy for the Stage 2A concept design:

- Penrith City Council Guidelines for Engineering Works for Subdivisions and Developments;
- Protection of Environments Operations Act 1997; and

- NSW Managing Urban Stormwater – Soils and Construction Manual (2004) 'Blue Book'.

The sediment and erosion control strategy and details have been documented in Brown Consulting's North Penrith Stage 2A State Significant Development Application drawing set Reference X12016-PA Rev 03 dated 19/06/2012 on Drawing No's. 701, 702, & 703.

Drainage

A general stormwater drainage strategy has previously been prepared for the entire North Penrith development as well as an individual strategy for Stage 1. In preparing the stormwater drainage network the following policies, guidelines and approved reports were applied/considered:

- Relevant Australian Standards;
- Australian Rainfall and Runoff Volume 1, Institute of Engineers, 2001
- Penrith City Council Guidelines for Engineering Works for Subdivisions and Developments; and
- Worley Parson's '*North Penrith Regional Flooding Assessment Report*' October 2010 and '*North Penrith Drainage Stormwater and Groundwater Report*' October 2010.

Servicing & Waste

Relevant legislation, policies, guidelines and references applicable to servicing and waste are listed below:

- Waste Avoidance and Resources Recovery Act 2001 (WARR Act);
- Protection of the Environment Operations Act, 1997;
- Protection of the Environment Operations (Waste) Regulations, 2008;
- Protection of the Environment Operations (General) Regulations, 2009;
- Waste Avoidance and Resource Recovery Act, 2001;
- NSW Government Department of Environment and Conservation Assessment, Classification and Management of Liquid and Non-liquid Wastes, 2004;
- NSW Sustainability Policy 2008 – specifically WRAPP requirements;
- Austroads Environmental Strategy, AP-S27 2002;
- Austroads Guide to Road Design Part 7 2008 – Geotechnical Investigation and Design;
- North Penrith Stage 1 Project Application Preliminary Construction Environmental Management Plan, Worley Parsons, October 2010.

4. Methods and results

At a glance

Earthworks

A site grading strategy for the concept design of North Penrith Stage 2A was prepared to reflect various guidelines, existing designs, existing infrastructure and reports as well as preferred design criteria of Landcom in reducing cut and fill imbalance, while providing a satisfactory end product for individual lots.

The industry standard 3-Dimensional spatial software package, '12D', was used to generate existing and concept design surfaces. From this, an estimate of bulk volumes between the two surfaces was calculated to provide an approximate cut and fill range in 0.5m segments.

The site grading strategy will require cut excavation from existing surface generally no deeper than 1.5m and a small amount of fill no greater than 2.5m deep within the proposed residential area that is intended to provide 31 proposed lots. Generally only a small amount of cut & fill will be required outside of the proposed residential area. This will consist of filling an existing table drain and depression to avoid ponding and trapped low points in the Thornton Park and the Northern Super Lot.

Methods

Earthworks

Modelling Techniques

The site grading strategy was prepared using 12D, a 3D desktop software package for Civil Engineering and Surveying design and data processing.

12D has the ability to calculate the bulk volume difference between two digital 'surfaces' to facilitate the preparation of cut and fill estimates. Two surfaces were used in the model for the Stage 2A design to determine cut and fill estimates. The 'existing' surface was generated using the 'Digital Terrain Model' (DTM) provided by Craig & Rhodes which was based survey data collected in the field. The DTM of the design surface was generated in 12D using points created as part of several design functions available within the program.

Design Constraints

The grading strategy for the Stage 2A site was prepared to reflect the findings and requirements as outline below:

- Catchment boundaries defined in Worley Parsons Stage 1 Construction Certificate documentation Reference 301015-02381-CI-S1 REV 02 dated October 2011;
- External Catchment assessment discussed in Worley Parsons '*North Penrith Drainage Stormwater and Groundwater Report*' October 2010; and
- To reduce excessive grades and provide acceptable grading and access for individual lots;

- To fill any existing depressions, swale drains or grade trapped low points that would be created following the construction of the Stage 1 & Stage 2A works;
- Meet the existing levels at property boundaries outside of the proposed extent of works;
- Provide drainage infrastructure and overland flow paths to ensure that internal works are not affected by external catchments in both minor and major storm events;
- Maintain existing drainage systems as identified in Worley Parsons reports mentioned above;
- Match existing and proposed infrastructure.

Sediment, erosion and air quality control

In order to reduce the potential for sediment runoff and erosion during construction Brown Consulting have prepared details that have been documented in Brown Consulting's North Penrith Stage 2A State Significant Development Application drawing set Reference X12016-PA Rev 03 dated 19/06/2012 on Drawing Nos. 701, 702, & 703.

Possible methods to reduce the potential for impact on air quality in the way of odour, dust, windblown soil & exhaust emissions arising from construction activities are:

- Works in accordance with Sediment & Erosion Control details prepared by Brown Consulting for the North Penrith Stage 2A development;
- Temporary hardcore roadway in areas where vehicle movements are frequent i.e. adjacent to temporary site access points.
- Establishment of exclusion zones for construction plant to minimise the footprint of works;
- Material transported on or off site to be covered while in transit;
- Plant and equipment to be regularly serviced to ensure they are in working order to minimise exhaust emissions;
- Promote ground cover on stockpiles if required;
- Remove from site any organic waste that has the potential to emit an odour;
- Undertake dust suppression by water carts (non-potable, if/when can be reasonably sourced at the site) by routinely dampening down surfaces.
- Cease works that have the potential to disturb un-stabilised ground in high wind events and/or implement additional dust suppression mechanisms as required.

The monitoring and assessment of air quality, when required, should be in accordance with regulatory guidelines and standard industry practices. Any assessment or monitoring of air quality should be undertaken by a suitably qualified professional.

Utilities

The proposed utilities to service Stage 2A will be generally in accordance with Worley Parsons 'North Penrith Utilities Servicing Report', October 2010. The report by Worley Parsons highlights the strategy for sewer, potable water, gas, telecommunications and electricity for the entire North Penrith Development. A diagrammatic representation and location of the proposed services is demonstrated on *Figure 2- Reference No. 301015-00NP-SER-F02* of Worley's report and is attached to this document in Appendix B. Some minor adjustments of the Utilities layout shown will be required at the detailed design stage to suit the proposed Stage 2A layout amendments.

The report by Worley Parsons also identifies the location of existing services which provide possible connections points for the proposed development; such as the existing services in 'The Crescent' towards the Southern end of the site.

Drainage

The drainage concept for Stage 2A was largely based on previous design documentation for Stage 1, drainage and flooding assessment reports prepared by Worley Parsons and to accommodate existing constraints and topography.

The concept drainage strategy for the SSDA provides an integrated system to cater for external catchments, proposed connections, defined catchment boundaries and inter-allotment drainage requirements.

The assessment of the external eastern catchments draining to Stage 2A across the site boundary was undertaken by requesting further survey detail of Lemongrove Road to accurately define the existing crest location as well as a review of GIS contour data obtained from Department of Lands available on the Brown Consulting data base. The flows generated by these catchments were estimated using the Probabilistic Rational method in order to devise a concept drainage method to capture these flows. The method developed to capture and divert the external flows along the Eastern boundary, and away from the proposed lots, is via a proposed pit, pipe, and channel drainage system on the high side of a rear (Eastern) retaining wall running adjacent to the boundary. This system will capture the flows, from storm events up to and including the 100 year ARI, generated from the residential lots off Lemongrove Road and convey a portion of the external catchment to the internal North Penrith Drainage system. The remaining flows will be directed South to the existing drainage infrastructure in The Crescent. This proposed method of conveyance is consistent with Worley Parsons Regional Flooding Assessment, October 2010.

The internal drainage assessment has been based on the Probabilistic Rational Method following guidelines set by Penrith Council for fraction impervious factors, time of concentrations etc. for the assumed catchments as well as Stage 1 documentation and best management practices. In order to present a detail design and sufficient calculations for Construction Certificate approval further detailed analysis will be undertaken using the drainage analysis and design software programs DRAINS and the integrated drainage design package available in 12D.

Servicing & Waste

Initially, waste will be classified and separated on site for recycling and re-use. Material will be further segregated once it has arrived at a recycling facility. Landcom aims to achieve 95% recovery (reuse and recycle) of total construction and demolition waste materials generated from the sum of civil works completed in that year.

Waste will be managed in accordance with the NSW Government's Waste Reduction and Purchasing Policy (WRAPP) and the regulatory policies, guidelines, and references mentioned within this report.

The demolished materials will that have been assessed to be fit for re-use will be loaded and stockpiled accordingly using an assumed 35T excavator with heavy rigid truck tippers. The Main Works Contractor (MWC) will need to confirm the availability of plant and machinery at the time of construction.

Any demolished materials considered unfit for re-use/recycling requiring disposal shall be loaded wholly within the site using an assumed 35t excavator and carted to an approved waste handling facility that receives that type of waste.

Chemicals fuels and any lubricant containers encountered or generated as part of construction works as well as solid and liquid waste will be disposed of in accordance with the OEH guidelines.

It is the responsibility of the site project manager and MWC to ensure that the waste identification, classification and handling is dealt with in accordance with the associated legislation, policies and guidelines referenced in this report, as well as Worley Parsons' Construction Environmental Management Plan.

Results

Site Grading Strategy

A table detailing the approximate range of cut and fill calculated by 12D between the concept designs finished surface and the existing surface is provided in **Table 2**.

Table 2 – Stage 2A Cut & Fill Range

Range (m)	Cut (m ³)	Fill (m ³)
-1.5 to -1.0	150	
-1.0 to -0.5	1490	
-0.5 to 0	3260	
0 to 0.5		5060
0.5 to 1		2360
1 to 1.5		865
1.5 to 2		200
2 to 2.5		15
Totals	4900	8500
Balance		3600 (m ³) Fill Required

The range of cut and fill in Table 2 does not provide for topsoil stripping or removal/reuse of existing pavements & paved area materials.

It is expected that the approximate fill requirement will be reduced to approximately 2300 m³ following replacing of topsoil, boxing of roads, spoil from trenching as well as retaining wall excavation.

The minimum RL observed on the Stage 2A site is approximately RL 29.4m at the North Western end of the proposed super lot (Lot No. 2032, refer Appendix A for North Penrith Stage 2A Lot Layout Prepared by Craig & Rhodes). This exceeds the minimum habitable floor level of RL 25.9m specified in Worley Parsons *'North Penrith Regional Flooding Assessment'* dated 18/10/10.

The site grading strategy has been documented in the North Penrith Stage 2A SSDA drawings by Brown Consulting Ref X12016-PA-601 & 602 Rev 03 dated 20/06/2012. The site regrading plan has been prepared in accordance with the Director General's requirements and shows existing and proposed surface levels.

Retaining walls

The grading strategy prepared to suit the proposed layout and design considerations necessitated the design of retaining walls along proposed and existing property boundaries. The location of the retaining walls, as shown on the SSDA drawings prepared by Brown Consulting, are located along the following boundaries:

- Penrith Training Depot to the South West;
- Fronting Speedway Circuit;
- Between lots in the proposed 31 lot residential area;
- In the proposed vegetated median between carriageways of 'Mountain View Crescent' and
- To the rear (Eastern) boundary of the proposed lots adjacent to the existing residences on the Western side Lemongrove Road. This retaining wall also forms an integral part of the concept drainage strategy in diverting upstream external catchments in accordance with Worley Parson's '*North Penrith Drainage Stormwater and Groundwater Report*' October 2010.

The location of the required retaining walls is shown on drawing number X12016-PA-602 dated Rev 03 19/06/2012 of the Brown Consulting North Penrith Stage 2A SSDA drawing set. The characteristics of the retaining walls are summarised in **Table 3**.

Table 3 – Retaining wall characteristics

Wall No.	Approximate Length (m)	Maximum Height (m)	Average Height (m)
RW1	93	1.5	1.5
RW2	130	2	1.5
RW3	98	2	1
RW4	125	1.3	1.3
RW5	195	1.4	1

Potential Sources of Fill

It is estimated that a bulk fill volume of 8500 m³ will be required as part of the grading strategy for the Stage 2A site.

To achieve the proposed levels, fill will first be sourced from cut areas within the Stage 2A site and carted to the fill areas. The sourcing of additional fill volumes, beyond that which can be generated from the cut areas/stockpile volumes of the entire North Penrith site, will be subject to negotiations between Landcom and the MWC. Landcom has a preference to import fill from Landcom development sites with an excess of cut. Should there be absence of appropriate fill generated from Landcom sites, clean engineered fill will be sourced from sites as close to the development as practicable.

Imported fill would need to be free of contamination and validated by a geotechnical engineer to ensure adequacy for use as engineering fill for road reserves and buildings.

Export of excess material

Suitable fill material will need to be imported to make up the deficit, and it is not expected any material will be removed from the Stage 2A site. If any material that is deemed not suitable to be reused on the site is encountered, it will be removed off site to an appropriate facility in accordance with relevant waste regulations.

5. Assessment

At a glance

The grading strategy prepared for the concept design of the North Penrith Stage 2A SSDA will require approximately 2300 m³ to be sourced during the construction of Stage 2A. The concept grading strategy for the SSDA has been undertaken to suit a number of constraints such as existing infrastructure, heritage requirements, reducing grades observed on lots and Stage 1 detail design documentation.

There may be some scope to alter the design slightly following SSDA approval and to better suit detailed engineering design for Construction Certificate. It is not anticipated however, that significant changes to the concept design for the SSDA will be required.

Groundwater & Salinity

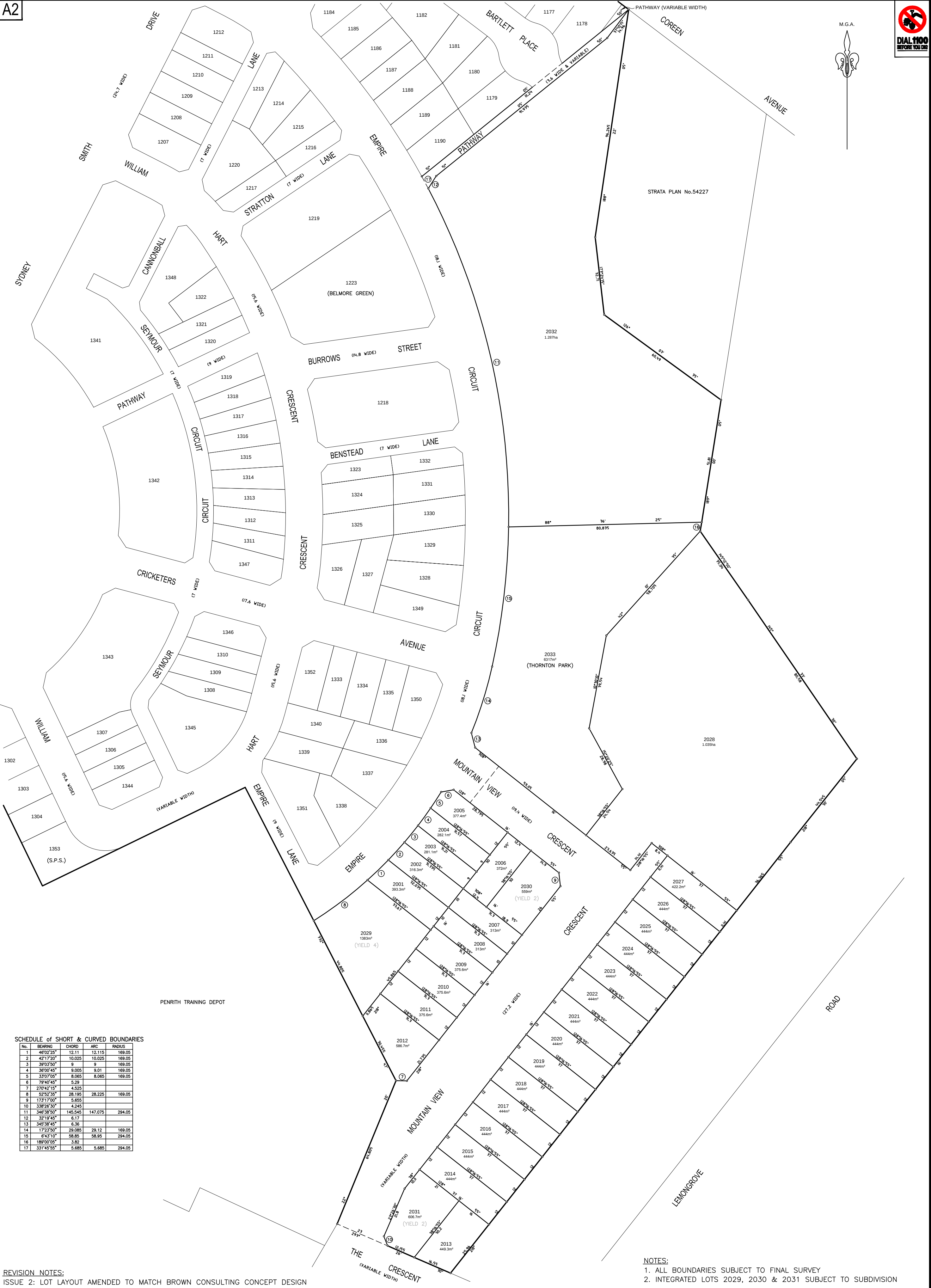
Review of the *'Geotechnical & Groundwater North Penrith Assessment Report'* by Geotechnique dated October 2010 and *'Geotechnical North Penrith – Stage 2A Assessment Report (Draft only)'*, Geotechnique Job No. 12609/1, identifies the following general comments:

- There are no known constraints that might impact on development and construction;
- The site is suitable for residential development;
- Excavation activities within the site are unlikely to encounter groundwater;
- Cut material should be placed as fill in areas deemed to have similar salinity classifications to limit the spreading of saline spoil;
- Additional geotechnical investigations will be required during detailed design to finalise the Soil & Water Salinity Management Plan; and
- Additional geotechnical investigations will be required during detailed design to determine the extent of anticipated cut volumes that can be reused as engineering fill within the site.

6. References

- *'North Penrith Stage 2A Road & Drainage Design for Project Application Ref X12016-PA'*, May 2012, Brown Consulting.
- *'North Penrith Regional Flooding Assessment'*, Worley Parsons, October 2010;
- *'North Penrith Drainage Stormwater & Groundwater Report'*, Worley Parsons October 2010;
- *'North Penrith Utilities Services Report'*, Worley Parsons, October 2010;
- *'North Penrith Defence Land Concept Plan Application Drawings'*, Worley Parsons, October 2010;
- *'North Penrith Defence Land Stage 1 Project Application Drawings'*, Worley Parsons, October 2010;
- *'Geotechnical & Groundwater North Penrith Assessment Report'*, Geotechnique, October 2010
- *'Geotechnical North Penrith – Stage 2A Assessment Report (Draft only)'*, Geotechnique, Job No. 12609/1.
- *'Guidelines for Engineering Works for Subdivisions and Developments – Part 1'*, Penrith City Council, April 1997.
- *'Australian Rainfall and Runoff Volume 1 & 2'*, Institute of Engineers, 2001

7. Appendix A – North Penrith Stage 2A Lot Layout



SCHEDULE of SHORT & CURVED BOUNDARIES

No.	BEARING	CHORD	ARC	RADIUS
1	46°02'25"	12.11	12.115	169.05
2	42°17'20"	10.025	10.025	169.05
3	39°03'50"	9	9	169.05
4	36°00'45"	9.025	9.01	169.05
5	33°07'05"	8.065	8.065	169.05
6	29°40'45"	5.29		
7	27°04'21"	4.525		
8	52°52'35"	28.195	28.225	169.05
9	173°17'00"	5.655		
10	338°26'30"	4.245		
11	346°38'50"	145.545	147.075	294.05
12	32°19'45"	6.17		
13	345°38'45"	6.36		
14	172°35'50"	29.085	29.12	169.05
15	6°43'10"	58.85	58.95	294.05
16	189°00'05"	3.82		
17	331°45'55"	5.685	5.685	294.05

REVISION NOTES:
ISSUE 2: LOT LAYOUT AMENDED TO MATCH BROWN CONSULTING CONCEPT DESIGN

- NOTES:
- ALL BOUNDARIES SUBJECT TO FINAL SURVEY
 - INTEGRATED LOTS 2029, 2030 & 2031 SUBJECT TO SUBDIVISION

Project:

NORTH PENRITH
STAGE 2A LOT LAYOUT

Principal:

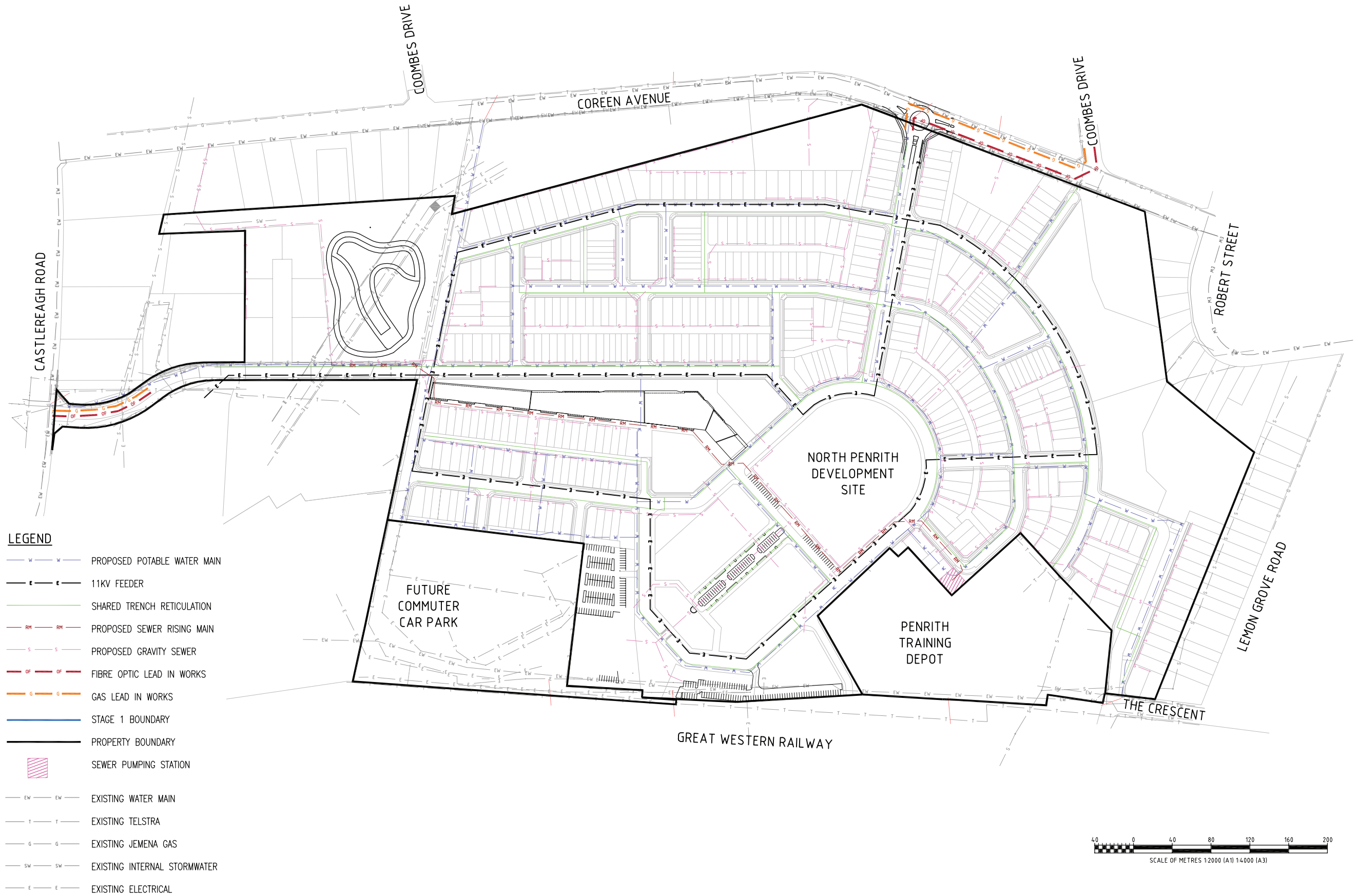
Scale: 1:1000@ A2
Date: 29/02/2012
Datum: N/A
Cal's: GH
Council Ref.:
L.G.A. PENRITH
Drawn: GH
Proj.Man: DB
UBD Ref.:
CRAIG & RHODES
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Sheet No. 1 of 1 Sheets

Appendix B

Worley Parson's North Penrith Proposed Services Plan



WorleyParsons
resources & energy



ISSUE	DATE	ISSUE DESCRIPTION
B	21.10.10	FINAL
A	08.10.10	ISSUED FOR REVIEW



**FIGURE 2
NORTH PENRITH PROPOSED SERVICES PLAN
301015-00NP-SER-F02**