RPS

APPENDIX 9

Engineering Infrastructure Report

TABEC
Civil Engineering Consultants

NORTH BALDIVIS

CEDAR WOODS

ENGINEERING INFRASTRUCTURE REPORT

CLIENT: CEDAR WOODS

PROJECT: 2319 – NORTH BALDIVIS

TITLE: NORTH BALDIVIS ENGINEERING INFRASTRUCTURE REPORT

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1 INTRODUCTION AND SUMMARY

1.1 Introduction

This report has been prepared by TABEC Pty Ltd to provide broad servicing and infrastructure advice for the proposed subdivision of Lots 460, 461, 462 and 463, Baldivis Road, Baldivis.

This report has been based on the civil engineering aspects of residential related land uses and summarises the availability of existing infrastructure assets in proximity to the landholding and the potential engineering infrastructure requirements to support urban development within the study area.

The investigation and preparation of the report are largely based on preliminary advice from the various service authorities. The information is preliminary and subject to change as the development process proceeds and more information and detail becomes available from the various service authorities.

2 THE STUDY AREA

The proposed development site is approximately 68 hectares and is located north of existing Mundijong Road, west of the Kwinana Freeway and east of Baldivis Road. The site is bounded to the north by the currently unmade Pug Road. The site is approximately 550 metres wide and 1220m in north-south length. The site is largely cleared and has previously been used for farming purposes. It is noted that balance of Lot 460 includes a proposed commercial area of approximately 1 ha which lies to the north west of the study area. The balance of Lot 463 is also approximately 1 ha in size, south of Mundijong Road.

Currently the site includes a variety of moderate to large trees and there are several surface water drains as well. Near the south-west corner of the site, a resource enhancement wetland (REW) has been identified by the Environmental Protection Authority. A 30m buffer will be maintained around the wetland however earthworks may impact in the buffer area and will be clarified during design phase.

There is a Tramway Nature Reserve parallel to Baldivis Road along the western boundary of the site. The Tramway Reserve contains various patches of vegetation and is approximately 70m in width.

The south-east corner of the site is shaped accordingly to reflect a future Main Roads WA separated grade interchange with Kwinana Freeway. The land requirement has been reflected on the Concept Plan, which is included in has been prepared by RPS as the basis of preliminary development assessment. This plan may be refined further pending advice from service agencies as the detail is confirmed.

2.1 Landform / Topography

Preliminary survey information has been completed along with McMullen Nolan's completed freeway culvert survey along the eastern boundary of the site in May 2013. A copy of the topographic contour info is provided in Figure 2. The survey identifies the current site levels with spot heights and half metre contours.

The site is generally very flat with levels along the eastern boundary only varying between about 4.7mAHD and 5.1mAHD. The site rises slightly toward the western boundary and the highest level along Baldivis Road is at about 6.7mAHD. Surface stormwater therefore generally grades toward the freeway in an easterly direction. Contour levels around the REW form the lowest part on site, with levels at about 4.3mAHD. Outside the site boundary, Mundijong Road and Baldivis Road will generally sit higher than the current surface levels within the project boundary.

2.2 Groundwater

The measured Annual Average Maximum Groundwater Level (AAMGL) is generally at or near the current ground surface levels across the site. The data produced from regional bores nominates an AAMGL level along the eastern boundary of about 4.5mAHD rising to approximately 4.9mAHD along Baldivis Road.

Therefore, groundwater control and subsurface drainage will form an integral design consideration and through the District Water Management Strategy, a determined outcome allows for drainage to be graded and a controlled outlet provided to the Peel Main Drain which is located on the eastern side of the Kwinana Freeway.

Careful consideration will also be required around the REW to ensure that any subsurface drainage is adequately designed in view of this environmental asset.

2.3 Acid Sulphate Soils

Preliminary site investigations have been carried out which indicates the risk of encountering acid sulphate soils within 3.0m of the existing surface is high.

Given that excavations and dewatering will be required for service installation, further detailed investigations for acid sulphate soils will be necessary. Subsequent management plans will be prepared to the satisfaction of the Department of Environmental Regulation to enable dewatering licenses to be requested prior to any subdivision activities.

3 SITEWORKS

Site works for urban development comprises the clearing of existing nominated vegetation, stripping topsoil on site and earth working of existing ground surfaces to facilitate a required form of development. Strict clearing requirements will be enforced to ensure the desired trees for retention are identified and suitably protected during civil works. Tree retention will be possible in the POS areas that don't have a drainage function, however the majority of the site will require significant fill and increase

in levels to support development. Therefore, clearing of remaining vegetation outside of the POS areas will be necessary.

It has been identified that no level adjustment or clearing in the REW will be undertaken.

Earth working of the site, particularly lot areas and road reserves will be required to ensure the positive drainage of the lots to the road reserves.

3.1 Earthworks

Preliminary geotechnical investigations have been carried out by Douglas Partners and detailed in a report dated June 2008 to assess the site conditions.

The Douglas Partners report defines the existing site in terms of three separate areas, which are characterised by varying conditions and therefore each contains specific site preparation requirements. The areas are shown in **Figure 3** which is extracted from the Douglas Partners report.

Area 1, largely along the western boundary of the site is comprised primarily of sand and may be defined currently as Class A. Area 2 forms the central part of the site and contains sand, with some clay and slightly clayey sand. This area is currently defined as varying between Class S to Class M in the current state. Area 3 forms mostly the eastern boundary and is comprised of clayey sand and sandy clay. The randomly distributed layers of clayey material results in this area being classified as ranging from Class M to Class E and therefore requires significant ground improvement.

Area 2 will generally require approximately 0.7m of additional fill on average above the existing ground level to achieve a Class S site. Approximately 1.6m of sand fill would be required to achieve a Class A site.

Area 3 will generally require approximately 1.2m of additional fill on average above the existing ground level to achieve a Class S site. Approximately 1.7m of sand fill would be required to achieve a Class A site.

The minimum development level for the project is 5.50mAHD. This level is set by the required clearance above the 1 in 100 year flood level in the Peel Main Drain as nominated by the Department of Water. Therefore, Area 2 is required to be raised by on average about 1.0m and Area 3 will generally be raised by about 1.1m in order to provide adequate protection.

As a consequence of lifting the ground level for flood protection, Class A sites may be achieved in most of the development areas. The drainage design will largely dictate finished earthworks designs rather than geotechnical requirements alone. If it were acceptable and pending design, Class S sites may result in some areas on site as opportunities will be sought to reduce the imported fill requirement as far as possible.

The concept earthworks design over the project area is included in **Figure 3** to illustrate the clearances above natural and ground water levels. The figure illustrates the drainage catchment areas also.

It is intended that level lots will be created as there is minimal landform that could be maintained due to the significant fill required across the site. Consequently, minimal retaining will be required. Some

treatments to include retaining walls may be necessary to contain drainage facilities and manage the level differences in some areas however the heights would be very limited.

In accordance with standard practice, stripping of topsoil and any other organic material from the site will be required prior to the placement of clean sand fill material. Topsoil is generally fairly shallow on site, however it has been found up to depths of 0.25m in isolated areas as reported by Douglas Partners. The above fill requirements do not allow for the removal and replacement of topsoil and given the sensitivity to cost implications, close inspections to ensure minimum stripping is carried out will be undertaken during site works.

Prior to the placement and compaction of imported fill on the western clayey portion of the site, the existing surface clay material would be shaped and graded toward the road reserves. The intention is to encourage lateral movement of the stormwater and more efficient use of the sub-soil drains by directing perched water away from development areas toward an outlet.

4 ROADS AND TRAFFIC

Access to the development is available from Baldivis Road to the immediate west which is a City of Rockingham asset. The current concept development plan proposes two intersections to be constructed onto Baldivis Road across the Tramway reserve. Access from Pug Road to the north will also be available based on the concept subdivision plan which is currently an unmade road. Direct access from Mundijong Road to the south is not possible.

Mundijong Road has recently been upgraded and extended through to Mandurah Road. An un-signalised staggered T-intersection at Baldivis Road has been constructed with Mundijong Road as the priority route. Levels at the intersection have been raised from the natural surface by approximately 6m. Baldivis Road, now therefore ramps up to the intersection over a length approximately 280m. The alignment of Baldivis Road (north) now varies and occupies part of the Tramway reserve to suit the staggered T-intersection design.

Currently, Baldivis Road exists along the boundary of the site as a two lane undivided rural road with an 80km/hr speed limit. It is understood the City of Rockingham intends to ultimately widen Baldivis Road and construct a 5m pavement width in each direction. Baldivis Road will therefore become an Integrator 'A' profile as shown in the East Baldivis District Structure Plan Traffic Report. This would form a 3.5m vehicle lane and a 1.5m cycle lane in each direction. Medians up to 2.5m in width may be provided in sections or may simply be line marked. Intersections onto Baldivis Road will therefore need to cater for the ultimate Baldivis Road configuration and address these future upgrade requirements.

Additional widening along Baldivis Road will be required at intersection locations to provide for turning pockets and passing.

4.1 Traffic Intersections

From the Mundijong and Baldivis Road intersection, there is a distance of approximately 310m to the southernmost access into the project. There is a further 700m between the next access point to the project and a further 215m to the future Pug and Baldivis Road intersections. Access to the existing

Rockingham Regional Memorial Park however is about 250m from the southern access into the project site.

Cardno Traffic Engineers have assessed the concept plan in relation to stopping and intersection sight distances and how this relates to intersection spacing along Baldivis Road. Egress capacity has also been considered regarding the ability of vehicles to exit from an access into a traffic stream.

It is advised the trip generation from the Memorial Park is expected to be low therefore a minimum spacing of 190m is considered sufficient.

Based on the Cardno advice, the preliminary intersection spacing nominated along Baldivis Road is also sufficient both in terms of safe distances and egress capacity for vehicle movements.

There may be a requirement to upgrade the intersection access to the Rockingham Regional Memorial Park. This will be resolved at detailed stage and if necessary would be completed with regard to the potential upgrade to Baldivis Road.

4.2 Internal Roads

A variety of road reserve widths have been nominated in the current concept plan in accordance with relevant road hierarchy. Roads will be paved with asphalt and kerbed in accordance with relevant guidelines. Alternative treatments such as brick paving and coloured asphalt may be incorporated which will be resolved at the design stage. Due to the flat nature of the site, it is not expected that significant road grades will be necessary. Some parking throughout the development is expected to be included, which would be appropriately positioned particularly around laneway lots. The road reserves will also include pedestrian and dual use path networks. Pavements will be designed and constructed to the City of Rockingham's engineering standard specifications.

5 ACOUSTIC ASSESSMENT

Herring Storer Acoustics completed a preliminary assessment in December 2009 over the project site based on the traffic utilising Kwinana Freeway, Mundijong Road and Baldivis Road. The modelling considers growth forecast in the area and noise levels in 2025 including planned road upgrades surrounding the site.

The report recommends that a noise wall is constructed along the Kwinana Freeway boundary with an approximate height of 2.4m. This may be constructed with either a wall an earth bund or both. Given the current concept plan, it appears a wall will be most appropriate to reduce the impact on lot yield. The height of the noise wall is preliminary and the ultimate height would depend on the designed finished level within the development.

Due to the Mundijong Road reconstruction involving significant level increase, along with the Baldivis Road intersection, Herring Storer recommends future residences affected should be modified to include quiet house designs and houses that are orientated to protect outdoor living spaces for compliance with the acoustic criteria. Therefore, a noise wall is not proposed along the southern or western boundaries of the site. These building recommendations only apply to the first row of houses fronting these roads.

The preliminary assessment and recommendations will be confirmed in detail as the project proceeds with refined modelling and subdivision design. The ultimate location and height of the acoustic wall will be verified at that time.

6 STORMWATER DRAINAGE

The site is within the Peel-Harvey catchment and therefore, surface stormwater collected on site grades toward the Peel Main Drain (PMD) which is located along the eastern boundary of the Kwinana Freeway. Surface water currently collected on site drains through existing irrigation channels in easterly direction. There are 4 culverts in total under the Freeway providing the PMD connection which includes two 700mm and two 600mm culverts spaced approximately 350m apart.

A constraint for the stormwater disposal is the low lying nature of the site with high groundwater table and that a significant portion of the site contains clayey material. Consequently there are limited opportunities for infiltration on site. Discharge of stormwater water through the Freeway culverts is possible however the flow rate is restricted to a maximum permissible outflow of 4.5L/s/ha.

Due to the presence of predominantly sand in the western part of the site, stormwater has better capacity for infiltration in these areas. Design of drainage facilities will therefore consider the appropriate site conditions. The clayey areas of the site have a lower permeability and therefore reduced capacity for stormwater infiltration. To achieve on site stormwater disposal using soak wells and sumps in these areas, raising of the natural surface with free draining material will be required with clearance provided above the clay layer and groundwater level.

A design option may include opportunity to regrade the clay layer toward POS and drainage areas to direct perched water into the subsoil drainage network which will provide an outflow for stormwater.

Stormwater runoff collected from the site will be conveyed via the road network to a conventional pit and pipe drainage network, and discharged into POS areas where drainage basins and facilities will be located. Flush kerbing will be utilised in the road design where possible for immediate collection of runoff from impervious areas.

Offline stormwater basin designs are proposed because this type of treatment facility will reduce downstream stormwater flows in major events. This approach is preferred from an environmental perspective so that the frequent storm water could be treated with nutrient stripping landscaped swales prior to discharge into the PMD.

Additional drainage management measures will be identified through the Local Water Management Strategy and ultimately the design issues identified will be implemented through an Urban Water Management Plan (UWMP). A UWMP will be a Western Australian Planning Commission (WAPC) condition of subdivision as stages are developed.

It is expected that some stormwater drainage collected from Baldivis Road will continue to be conveyed overland based on the current site conditions. Given the subdivision will require significant fill, drainage infrastructure may be required in the Tramway to ensure that any ponding is prevented in isolated areas and to direct stormwater toward an outlet. Connections from the Tramway through to the subdivision drainage network are identified in the Local Water Management Strategy for the project. The nature of

material in the Tramway is sandy and any level differences between the subdivision and the Tramway can therefore be managed through these measures without a detrimental effect. The Urban Water Management Plan will also comprehensively detail the overland flow paths and provide detailed drainage design drawings for verification to address this issue and maintain stormwater flow toward the Freeway culverts and the Peel Main Drain.

6.1 Sub-soil Drainage

A sub-soil drainage network will be provided in the road reserves throughout the development to control groundwater levels. The drains will be set at, or above existing Annual Average Maximum Groundwater Level (AAMGL) and/or the pre-development topographic elevation.

The outflow elevation will be set at least 300mm above the inverts of the drainage culverts under Kwinana Freeway to provide a free outfall. A free outfall to ensure free flowing discharge will be provided and detailed through the Urban Water Management Plan. Subsoil drains will be graded across the site as flat as reasonably possible to maintain a low post-development groundwater elevation. This in turn will assist in minimising imported fill requirements to provide clearance above groundwater which are provided in greater detail in the Local Water Management Strategy.

The main sub-soil drainage lines will grade from west to east toward the culverts, with a north/south network providing connection to the main sub-soil drainage routes. Groundwater will be modelled in view of the clay layer which is known to exist on site also.

Consideration will also be given to the resource enhancement wetland to ensure the measured winter water levels are not manipulated. Sub-soil drains directly adjacent to this area will be set at the current surface level which will become the control groundwater in this location.

Sub-soil modelling and design proposed for the development will be reviewed by Department of Water.

7 WASTEWATER

Currently, Water Corporation has no permanent waste water outlet available to this area as the site falls into the catchment of the East Rockingham Waste Water Treatment Plant (ERWWTP) which is yet to become operational.

Therefore, to allow development to proceed, interim solutions have been investigated. A revised servicing option was presented by David Wills and Associates in their report dated October 2012 to which the Water Corporation reviewed and advised of their general satisfaction.

The David Wills report reviews catchment boundary planning and proposes amendments to Water Corporation's originally nominated waste water pump station locations. The proposal responds to development and timing intent in the area and rationalises head works planning to suit.

Water Corporation advised in November 2012 the revised catchment boundaries and location for proposed waste water pump stations would be adopted. The temporary discharge proposal for limited volumes of waste water has also been agreed to subject to conditions such as necessary upgrades at the existing receiving waste water pump station.

The planning update proposed that landholdings between Mundijong Road and Millar Road would be served via a Type 40 waste water pump station located near the northern boundary of Lot 460 which is generally central to the catchment. This is identified as 'North Baldivis WWPS H' by Water Corporation. Until the outlet at the ERWWTP is available, a temporary pressure main is proposed to be constructed with a DN200 for discharge at the intersection of Wellard Road and Bertram Road. This will include a pressure main of approximately 3 km in length from the WWPS site and will require the pressure main to be constructed along Baldivis Road and Wellard Road. The pressure main will discharge into an existing DN250 waste water pressure main, which in turn discharges to the Kwinana WWPS Number 6 on Bertram Road. This pump station lies in the catchment of the Kwinana Waste Water Treatment Plant.

It is noted the conveyance solution is considered temporary in terms of Water Corporation's planning and funding purposes given the ultimate flows should be directed toward the East Rockingham Waste Water Treatment Plant. The Scoping Report has been prepared and is currently under review by Water Corporation. The temporary outfall arrangement will be confirmed prior to the Engineering Summary Report commencing. Included in Figure 5 is the preliminary catchment plan for 'North Baldivis WWPS H' which has been included in the Scoping Report to date.

It is the developer's expectation the 'North Baldivis WWPS H' would be considered permanent infrastructure in terms of Water Corporation planning and funding agreements, however this remains to be negotiated and confirmed. It may be possible that permanent wet well is constructed with temporary mechanical works for a future upgrade.

It will be necessary for the WWPS to be constructed in the first stage of development, with a deep gravity sewer main from Stage 1, to the WWPS location. This deep gravity main should follow the route of the main north-south road as shown in the concept subdivision plan to provide the most direct route.

Based on the minimum development levels in the project to provide adequate freeboard above the 1 in 100 year flood level, the WWPS and gravity inlet pit may be over 7 metres deep to invert. The David Wills report confirms these depths will be acceptable with Water Corporation which is similarly achieved in the TABEC catchment planning.

The WWPS location is identified as being to the immediate north of the Pug Road reserve in the POS currently identified in the structure plan. Acceptance by Water Corporation is expected to be achieved through the Scoping phase. A standard 30 metre buffer to the lot boundaries will apply around the centre of the wet well and the subdivision plan will need to consider and incorporate this requirement.

The development will be served via a gravity fed network of varying sized sewer pipes designed in accordance with the Water Corporations specifications. The deep sewer 'spine' will be constructed at minimum grade, however development areas feeding into the spine will be designed with drop structures to reduce depths and dewatering requirements as far as possible. Standard Water Corporation headwork's contributions are expected to apply to the project.

8 WATER SUPPLY

Servicing this project requires confirmed development timing due to the non-frontal nature of the site and a variety of options available in providing water mains to the development boundary. Water

Corporation has long term planning to serve ultimate development however the most appropriate interim servicing options are dependent on demand from North Baldivis and other surrounding land users. The Water Corporation's ultimate planning provides 3 major water distribution mains to deliver a system from which reticulation and temporary services can be connected. Works on Water Corporation's 5 year capital works program should be considered also.

Currently, there is a 600mm water main in Baldivis Road near the intersection of Ingram Road which is almost 3km south of the project boundary. Water Corporation is currently planning to extend this water main along Baldivis Road to the intersection of Fifty Road, which would be approximately 740m in length. This project is currently being scoped by Water Corporation and should be commissioned by late 2014.

From the Tamworth Reservoir, Water Corporation ultimate intend to construct a 1400mm diameter steel water main along Eighty Road to Fifty Road. Timing for this project is expected to be completed within 4 to 5 years and it is understood some funding has been allocated on the 5 year capital works program. To complete the connection to Baldivis Road, a 230m long steel main of 1000mm diameter along Fifty Road will be constructed, however timing is not confirmed.

To service initial stages of the North Baldivis project, it is likely that a 300mm diameter water main will be constructed from the Fifty/Baldivis Road intersection the development site. Water Corporation ultimately intend to construct a water main in this location of approximately 900mm diameter however this is affected by confirmed planning on both sides of the freeway and is yet to be confirmed. Therefore, the 300mm water main along Baldivis Road would be about 2km to the development entrance and 3km in total length through to Pug Road.

Significant up-front head works are therefore required for the project which should be considered in relation to ultimate planning and surrounding developments with contributions to be negotiated.

The subdivision will be reticulated with small water mains in each road reserve of nominally 100mm and 150mm diameter size. The reticulation mains will provide water service connections to each lot within the subdivision which will be subject to Water Corporation confirmed approval. It is advised that standard Water Corporation head works contributions are expected to apply.

9 POWER SUPPLY

9.1 Existing Power Infrastructure

There are existing Western Power overhead aerials along the western boundary of Baldivis Road which is a 22kV network and this is the known as Brownell Gres feeder. There is another existing network in the area, named the Medina substation feeder which is actually on the opposite side of the Kwinana Freeway and runs along the railway line to the north. Both these feeders are from the Medina zone substation on Thomas Road which is approximately 8km from the site.

Medina is the closest zone substation to the site however the subdivision load may also be served by the Waikiki substation which is on Safety Bay Road to the south west of the site. Future Baldivis and East Rockingham are potential zone substation sites which may be used to supply the latter stages of this development. These will be located south of Safety Bay Road and west of Mandurah Road respectively.

There are several developments in the area currently supplied by the Brownell Gres feeder and Medina substation feeder. According to Western Power's network capacity mapping tool there is still spare network capacity available on the Brownell Gres feeder to supply the initial stages of the proposed subdivision load.

It is anticipated that no high voltage (HV) reinforcements will be required to supply the initial stages of this development, however once the Brownell Gres feeder has reached its maximum capacity a new feeder will be required. Assuming a feeder length of 8 km, this will be at an approximate cost of $2.8 million dollars.

The requirement and timing of this new feeder is dependent on the load growth of this and other surrounding developments in the area. It might also be possible to extend from an alternative future feeder which has spare capacity.

9.2 Proposed Power Infrastructure

Works within the subdivision boundary to service the ultimate approximately load of 3.7MVA will include switchgear and transformers as required by the staging of the development. This is based on 4.7kVA per lot plus the school and commercial areas. The standard HV pool and subdivision policies will apply. Street lights would be required as per the City of Rockingham policy.

There may be a requirement to relocate the existing overhead aerial transmission line underground on the boundary of the site.

The effects of any earth potential rise (EPR) issues have not been investigated, however if any high pressure steel Water Corporation or gas pipelines are in the vicinity extra reporting will be required.

The details in this report are only indicative. Further in-depth study and analysis can only be required to determine the exact requirement of any (if required) reinforcement works once a formal application to Western Power has been lodged.

Western Power will neither reserve capacity nor guarantee supply to this development without a formal request being lodged.

10 TELECOMMUNICATIONS

NBN Co is responsible for the installation of fibre in all broad acre developments of 100 or more premises within the long term optic fibre footprint, to which this project will qualify. A developer agreement will be necessary prior to any construction works commencing.

With the National Broadband Network rollout, the developer is responsible for providing pit and pipe infrastructure throughout the subdivision for the fibre to be installed. NBN Co will cover the costs of installing fibre infrastructure in the development, including backhaul.

The communications design will require the inclusion of Fibre Distribution Hub (FDH) within road reserves which is an unpowered, street side cabinets used to provide an optical connection point between the distribution and local network.

As part of the developer agreement conditions, NBN will take over ownership of the assets upon completion and ensure that fibre is ready 3 months prior to the first occupancy for a new development.

11 GAS SUPPLY

There is an existing 160PE high pressure gas main located approximately 1.9km south of the entry road to the North Baldivis subdivision. This existing gas main is located on the western Baldivis Road reserve boundary near the intersection of Zig Zag Road.

ATCO Gas has confirmed the headworks required to provide services to the subdivision involve the extension of this gas main which requires a significant construction cost. It is also confirmed at this preliminary stage, that under the co-contribution model, ATCO Gas would contribute the vast majority of this cost for these headworks. ATCO Gas however would seek a contribution from the developer to provide the infrastructure from which internal reticulation will be laid.

Internal gas supply will be provided to each lot through common trenching at no additional cost to the project.

Figure 1 – Current Concept Subdivision Plan (RPS, October 2015)

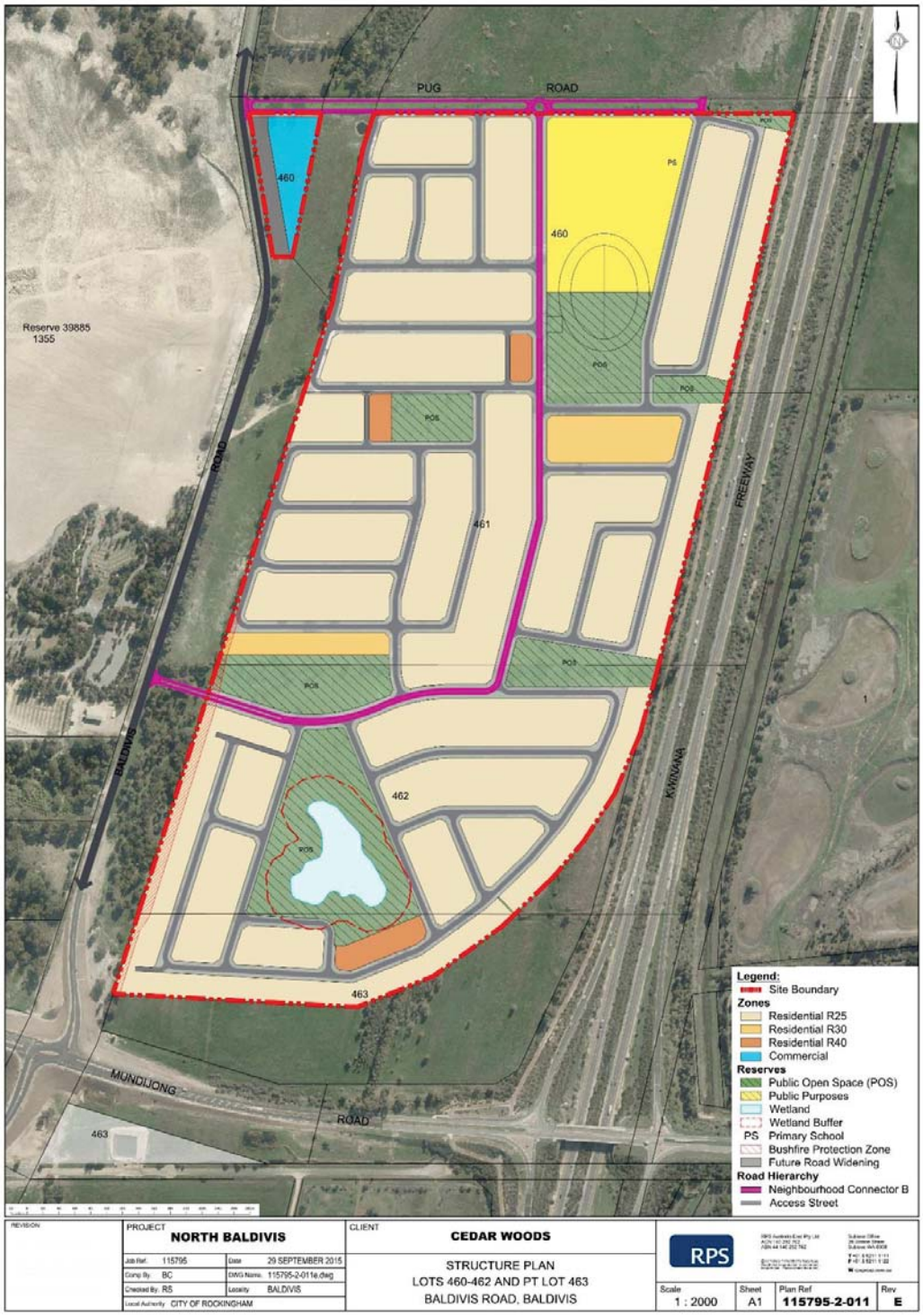

Figure 2 – Site Topography

Figure 3 – Approximate Geological Unit Boundaries (Douglas Partners, June 2008)

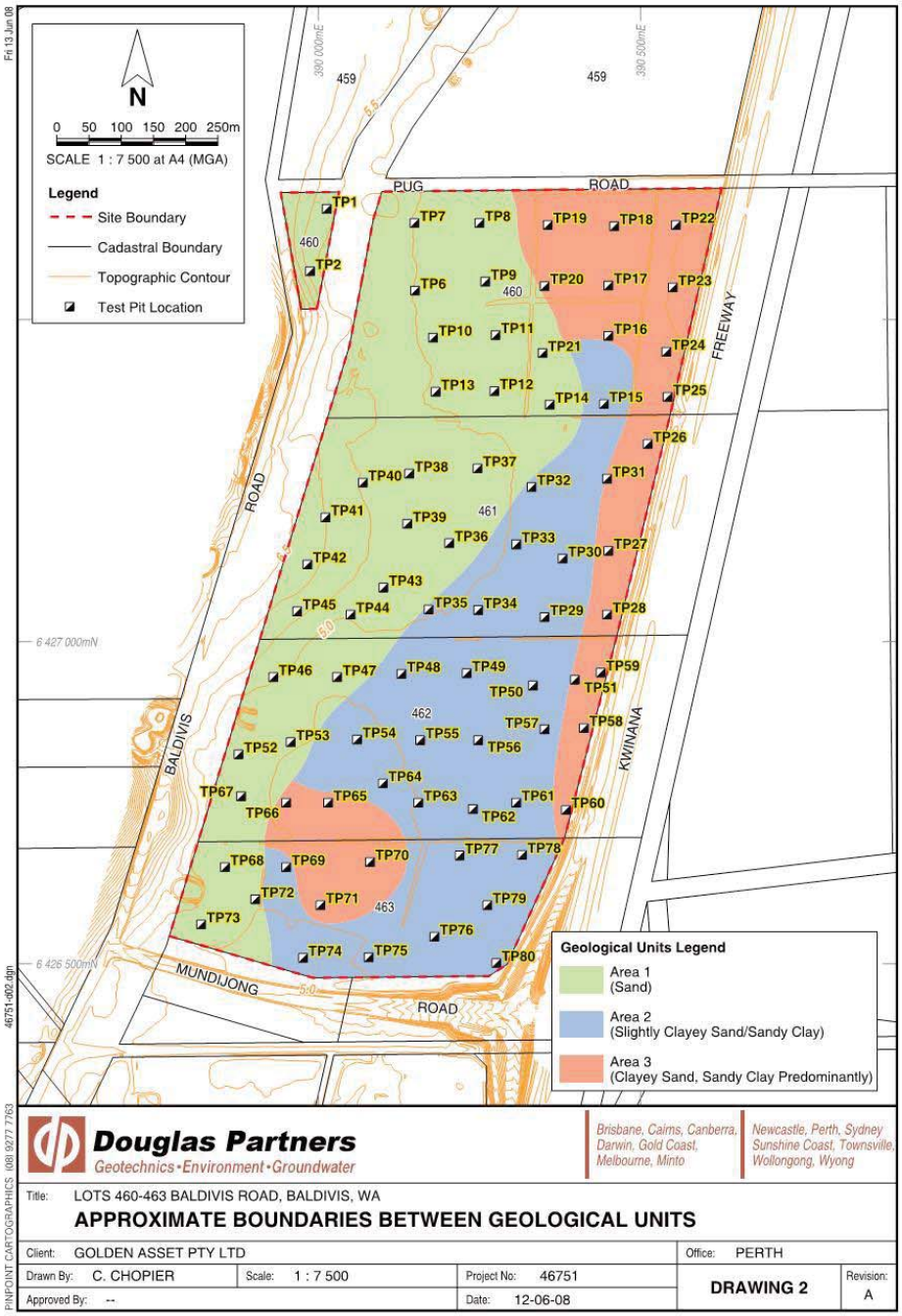

Figure 4 – Concept Earthworks Design (TABEC, November 2015)

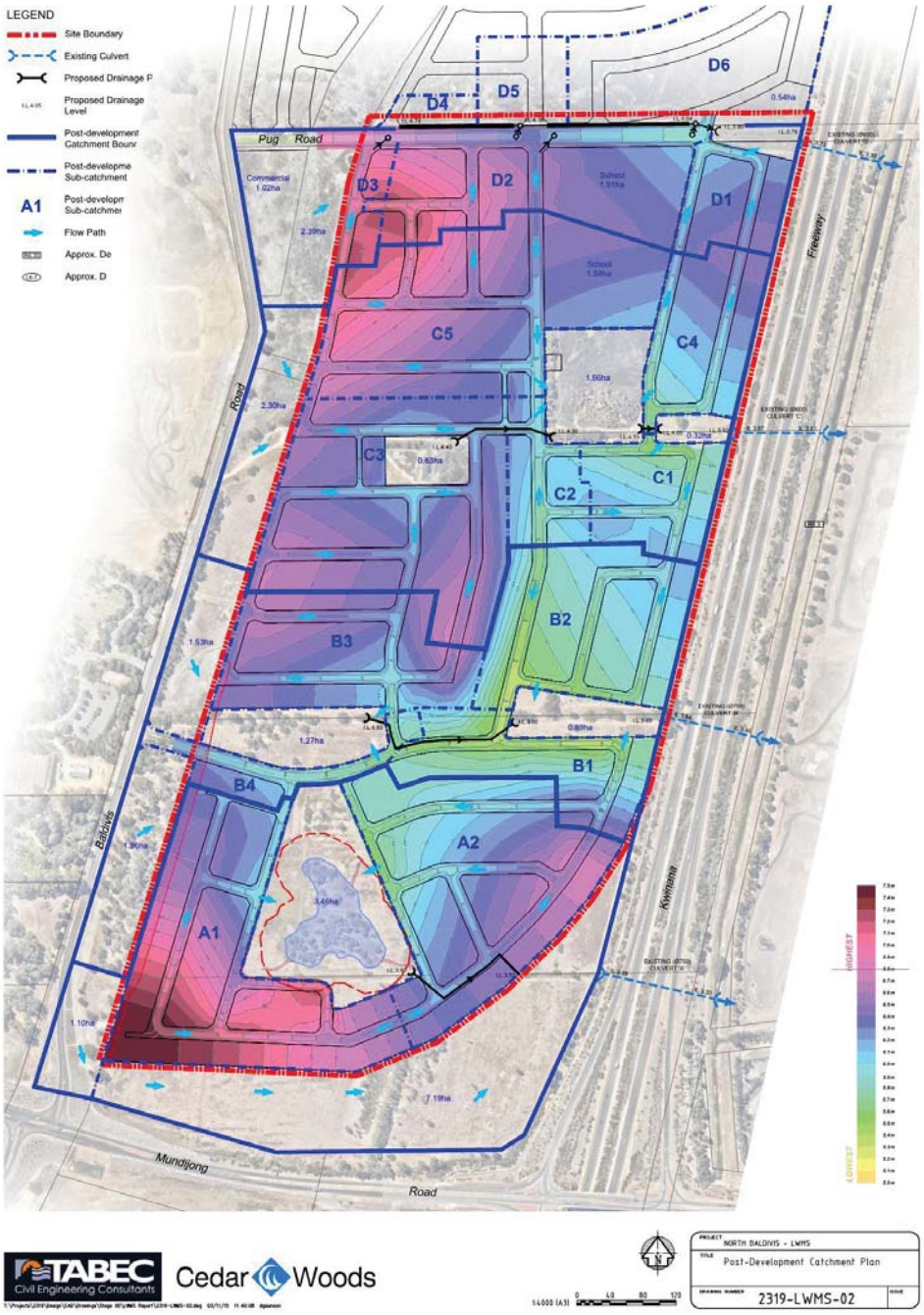

Figure 5 – Preliminary waste water catchment plan (TABEC, October 2015)

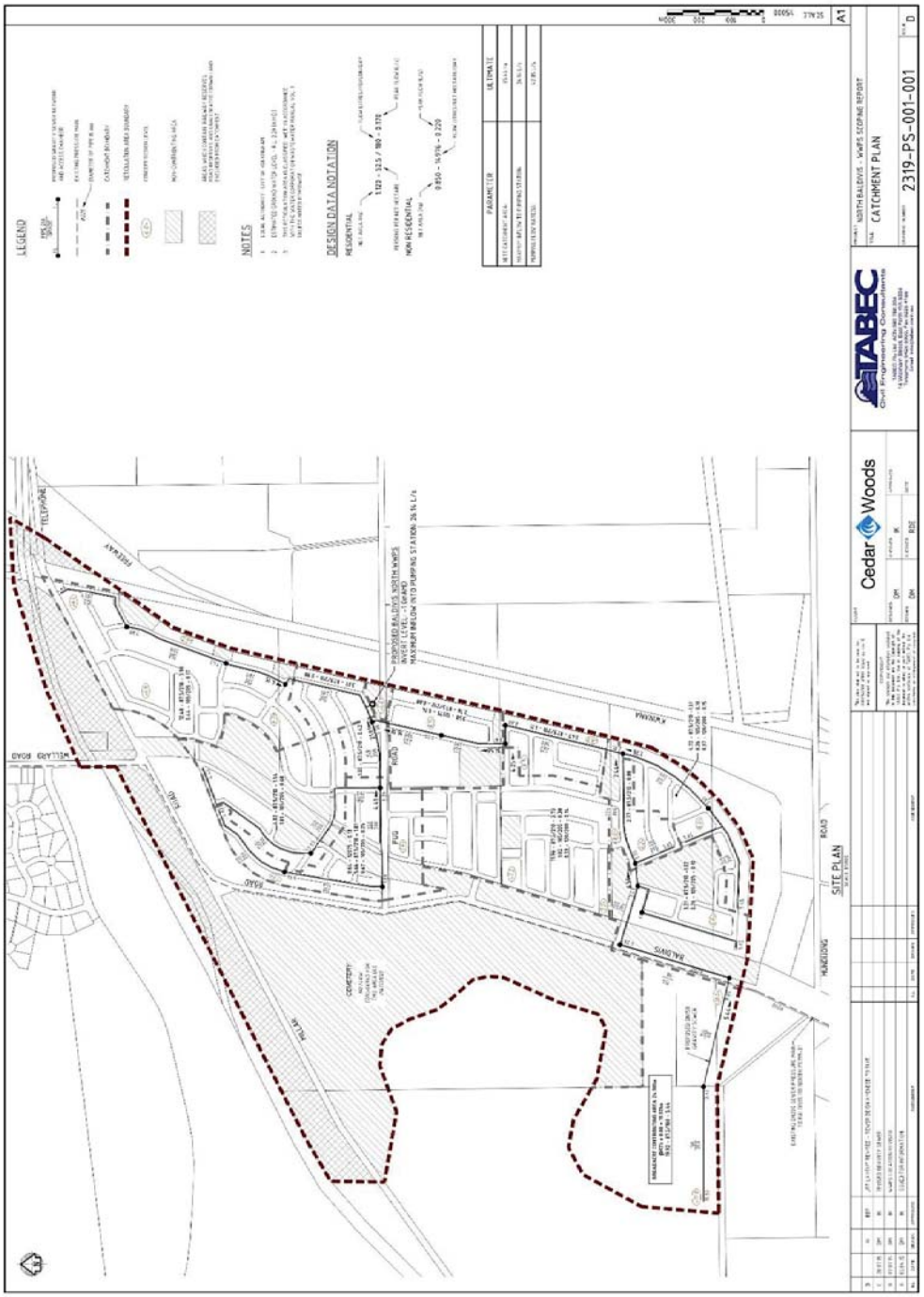

Figure 6 – Preliminary gas headworks planning (ATCO Gas, November 2013)