APPENDIX I INFRASTRUCTURE & SERVICING STRATEGY



#### PEET № 73 PTY LTD

Lots 129 & 302 Zig Zag Road Baldivis

# **Engineering Services**

6<sup>th</sup> February 2015 Project Ref Nº: 7808



# Lots 129 & 302 Zig Zag Road Baldivis

### Engineering Aspects – a preliminary appraisal

6<sup>th</sup> February 2015

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Lots 129 & 302 Zig Zag Road Baldivis

# Table of Contents

1.	General	.4	
2.	Site Description		
3.	Groundwater and acid sulphate soil		
4.	Earthworks	.6	
	4.1 Geotechnical aspects	.6	
	4.2 Concept Design	.6	
	4.3 Tramway Interface	.7	
5.	Stormwater Management		
6.	Roads		
7.	Water Supply		
8.	Wastewater		
9.	Electricity, Gas, Telephone and NBN1	12	
	9.1 Electricity Supply1	12	
	9.2 Gas Services	12	
	9.3 Telephone & NBN	12	
10.	Staging1	13	
11.	Conclusion1	13	

Appendix A	Concept Subdivision Plan	14
Appendix B	Groundwater Level Forecasts	16
Appendix C	Earthworks Concept, Tramway interface & Staging Plan	18
Appendix D	Existing Water Corporation Drain	21
Appendix E	Stormwater Management Features	24

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# 1. General

Peet is to develop the 29 hectare (Ha) Lots 129 and 302 (the Land) into about 419 residential lots. The proposed concept subdivision plan prepared by the Town Planner, Taylor Burrell Barnett, is included as Appendix **A**.

The northern portion of the Land will consist of about 2.79 Ha set aside for part of a high school site and a 4.0 Ha parcel of land set aside as open space. The high school site in the Land forms a portion of the total 9.0 Ha high school site which includes the reclaimed segment of Zig Zag Road along the northern boundary of the site as well as land to be set aside in the development plan for the Perron Group's land north of Zig Zag Road.

A 20 metre wide easement had been provided along the southern and eastern side of the open space for the Water Corporation to accommodate the future installation of large water trunk mains and/or wastewater transfer pipelines for the south metropolitan area. This proposed modified trunk main route replaces the original alignment proposed by the Water Corporation along Zig Zag Road.

This report has been prepared to examine the engineering aspects of the development of the Land and considers the proposed earthworks, roads, wastewater services, stormwater drainage, management of groundwater levels, as well as the provision of water reticulation, electricity supply, gas reticulation and telecommunications services.

# 2. Site Description

The Land is bounded by the tramway reserve adjacent to Baldivis Road on the west, Zig Zag Road to the north, Paparone Road to the east and Australand's subdivision development to the south. The Perron subdivision development is located directly north of Zig Zag Road.

The land is generally low lying with surface levels ranging from about 7 mAHD in the northwestern corner to about 4 mAHD in the south-eastern corner.

A Water Corporation Main Drain (known as the "Urban sub-drain H") enters the Land from near its north-eastern corner and runs along the eastern boundary to about midway along the Land's eastern boundary along Paparone Road and then skews diagonally in a south-westerly direction into the adjoining land to the south.

The majority of the site is predominantly cleared with only some small pockets of vegetation located generally in the north-western corner of the site. The geology of the Land is described by the Rockingham Environmental Geology Sheet as being predominantly underlain by alluvial silt belonging to the Guildford Formation with some areas around the north-western, south-western and south-eastern corners of the site underlain by Bassendean Sand.

Baldivis Road located along the western side of the tramway reserve boundary is currently a rural standard road with bitumen seal and no formal drainage system. As indicated by the City of Rockingham, Baldivis Road will eventually be upgraded to an urban standard boulevard, with a roundabout planned for the main entry into the Land opposite Fifty Road.

### 3. Groundwater and acid sulphate soil

Maximum groundwater levels at the site were reported in the "East Baldivis District Water Management Strategy" by Parsons Brinkerhoff and dated October 2007 and after more recent monitoring of the groundwater level (GWL), the forecast GWL's were updated by Emerge Associates in November 2013. The Emerge plan that details the forecast MGL is included in this report as Appendix **B**.

The groundwater levels within the subject site range between 4 and 5 mAHD and the groundwater appears to flow from the north-west corner towards the Sub Drain H, which acts to control the fluctuations of groundwater levels. The replacement and realignment of the existing Sub Drain H will require the subsoil drainage system to be designed to maintain the minimum 1.2 metres clearance between the average annual maximum groundwater level (AAMGL) and finished lot levels.

To facilitate development, it is desirable to install subsoil drainage at a level within the zone of seasonal groundwater variation to minimise imported fill requirements. The average difference between the AAMGL and the average annual lowest groundwater level is approximately 1 metre and subsoil drains would be installed within this zone of fluctuation. Installing subsoil drains below the AAMGL, but above average annual low groundwater levels will allow for lowering of the peak groundwater levels whilst minimising potential acid sulphate soils issues.

The minimum level that subsoil drains can be installed at is referred to as a controlled groundwater level (CGL). It is important Department of Water criteria that a CGL is shown not to adversely impact any remnant wetlands or areas of conservation significance on a particular site or development. No such sites exist on or near this Land and hence the CGL system that is to be adopted for the Land.

The Land is likely to be affected by acid sulphate soils (ASS) when excavation occurs below the GWL. Management of the ASS is straight forward and will involve lime-dosing any groundwater extracted by dewatering and applying and then mixing lime into the excavated sand prior to its backfill in the trenches. Bearing in mind, the ASS material is unlikely to be found in the upper profile of the surface since annual GWL movement means the material has been aerated, and since there are no wetland areas that can be affected, the GWL will be controlled on the Land to minimise the need for imported fill.

Given that ASS are typically related to particular geological formations, the types and level of soil and groundwater management specified in the ASS and dewatering management plans are also similar and likely to continue to be similar for all stages of development on the Land.

For each subdivision stage, specific and localised ASS and groundwater investigations are to be undertaken. Such investigations can only follow sufficient design (i.e. depth and alignment of the

sewer reticulation in particular) so that the ASS and groundwater management plans are focused on the specific construction works associated with an individual stage of the development.

#### 4. Earthworks

#### 4.1 Geotechnical aspects

A geotechnical investigation of the Land has been completed - refer "*Report on geotechnical investigation Lot 129 Zig Zag Road*", Douglas Partners - 21<sup>st</sup> February 2014.

According to Douglas Partners (DP), the subsurface ground conditions are found to consist mainly of very loose to dense, sand and silty sand from the surface to depth of between 1.5 m and 6 m; with exception of several test locations along the eastern boundary where stiff to very stiff silty clay was found to underlie the sand from depths ranging between 1.5 and about 6.0 metres. Some limestone was also found underlying the sand at test pits near the south-eastern corner of the Land.

The geotechnical report provides recommendations relating to the site preparation which include stripping of topsoil, compaction of the natural soil, importing of fill, its placement, as well as compaction and testing requirements. DP has suggested both "excavation and replacement" and "impact rolling" to be viable and alterative solutions to ensure the loose materials encountered at some of the test locations (and then only a few and in minor areas) are adequately compacted.

On the basis that the recommendations are adopted, DP has suggested that the entire site will achieve Class 'A' classification as defined by the Australian Standard AS2870.

#### 4.2 Concept design

In order to provide adequate flood protection it is intended that the minimum finished development for the proposed residential lots will be 6.1 mAHD as recommended in the *"Serpentine River Floodplain Management Study"* prepared by SKM in February 2010. Roads and open space areas need not be filled to this level. This minimum development level for the lots includes the 0.5 metre buffer added to the forecast flood level. This minimum fill level will also exceed the usual simplistic requirement for 1.2 metres clearance above the controlled groundwater level as detailed below.

As noted the earthworks on the Land will include topsoil stripping, removal of any unsuitable material and then filling with imported clean, free draining and cohesionless well graded sand to the designated levels. It is anticipated that few if any retaining walls will be required as the filled land will be relatively flat. The design of the Land's fill levels will be coordinated with the

design of lot and road levels with the two adjoining land owners, (i.e. Australand and Perron Group, south and north of the Land respectively).

A preliminary or concept design of the likely finished levels and shaping of the Land is provided in Appendix **C**.

#### 4.3 Tramway interface

A detailed engineering drawing showing the extent of the proposed batter has been overlaid on a rectified *nearmaps* aerial photo – refer Appendix C. The plan demonstrates that the battering occurs almost exclusively over the denuded portion of the site and thus the proposal will have a negligible effect in terms of existing remnant vegetation with the Tramway. Rather than undertake a tree survey, the botanist who undertook the initial flora survey of the site reviewed the implications of the batter and identified the only affected vegetation as being one marri tree and some small regenerating marri saplings (all of which are currently in a degraded condition) at the southern end of the reserve. Some localised grading or re-shaping of batters (i.e. steeper) will be undertaken around any trees worthy of retention.

### 5. Stormwater Management

The East Baldivis District Water Management Strategy (DWMS) was approved by the Department of Water (DoW) on the 13<sup>th</sup> November 2007. The DWMS described how the Land and its neighbours can be developed without compromising flood protection and environmental requirements associated with stormwater and groundwater.

The Water Corporation's Peel Rural Sub Drain H that now traverses the Land in a north-south direction and then continues through Australand's land conveys runoff to finally discharge through an existing 1,050mm diameter pipe under Kwinana Freeway.

This rural drain has a severely limited capacity and so will overflow and flood adjacent properties for up to three days. The Water Corporation is only obliged to maintain the drain for these rural needs. The drain has probably been designed for a 40% Annual Exceedance Probability (AEP<sup>1</sup>) storm event.

This rural drain only provides a service to make land viable for rural uses. The relatively poorly graded and low-lying Land with its shallow GWL results in a landform from which water takes quite a long time to drain. This results in localised inundation occurring both seasonally and after storm events. Rural drainage is not designed to provide flood protection to the adjoining land; and therefore some inundation of the land is permitted. The Water Corporation's Operating Licence defines the service levels for rural drainage to maintain rural drains to ensure they are capable of removing water from rural properties in three days.

<sup>&</sup>lt;sup>1</sup> Where *Annual Exceedance Probability* is a measure of the rarity of a rainfall event and is defined as the probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.

The existing drain is located on crown land vested with the City of Rockingham, with an easement granted to the Water Corporation – refer Appendix **D**. An application has already been submitted to close the reserve and then transfer the drain obligations to the City of Rockingham as development proceeds.

The drain will be realigned and/or replaced with a simple arterial drain network and this will used to convey upstream existing flow (at controlled rates) and outflows from the proposed basins as well as direct outflows of the subsoil drainage system within the development. No untreated surface runoff will be connected to the arterial drains. Closure of the existing Water Corporation's Sub Drain H will proceed concurrently with the construction of the proposed arterial drain.

Often groundwater collected by the subsoil drainage network is conveyed to a common treatment basins located near the end of the sub-catchments. Usually it is only legacy nutrients in the groundwater that warrant attention and it has been shown that they decrease over the first three to five years or so after a development is completed. The Civil Group and Department of Water officers have proposed for the Land the pre-treating the groundwater using inline soil media surrounding the subsoil pipes to increase the efficiency of the bio-treatment/retention system, and possibly reducing the bio-retention basin specification requirements. This method supported by the DoW will include adding a bio-filter media material around the coarse sand/gravel surrounds of the perforated subsoil pipes. The bio-retention basins are only then required to treat surface runoff or the so-called first flush event.

The subsoil drainage network illustrated in the concept earthworks design provided in Appendix C has been informed by groundwater modelling carried out using Visual Modflow (as detated in the LWMS. Indicative modelling based on an average 80 metre separation between subsoil drains (the length of 2 properties) with an infiltration rate of 4 m/day results in a maximum mounding of 800 mm at the mid-point between the drains (i.e. back of lots). Fill will be used where necessary to provide a minimum 1.2 m clearance above the subsoil drainage network. This will ensure the minimum clearance from finished floor levels is maintained, as illustrated in Plate 2 in Section 7 of the LWMS.

The maximum allowable outflow rates from the Land are limited to 3 l/s/Ha and 4.5 l/s/Ha for the 10% and  $1\%^2$  AEP storm events respectively as outlined by Water Corporation's '*Mundijong Drainage District*' criteria are adopted as a basic premise for the derivation of storage volumes for attenuation of peak flows on the land in a series of basins.

The Land had been divided into a series of catchments as outline in the drawing by Emerge, included in this report as Appendix **E**. The catchments are determined based on a preliminary earthworks and roadworks design including the preliminary design of the arterial and subsoil drains. The proposed arterial drain mimics the existing Water Corporation's rural drain (sub drain 'H') – albeit along a realigned route – to convey flows from existing inlets along Zig Zag Road and Paparone Road while also acting as the GWL control.

<sup>&</sup>lt;sup>2</sup> 10%-AEP is about the same as a 10-year average recurrence interval (ARI) event and a 1%-AEP is similar to a 100-year event.

All catchments with exception of catchments 2 and 3 have been designed to retain the 100-year storm with a restrained outlet flow in individual basins as shown on Appendix E. Basin outlets will be designed to limit the outflow rates to pre-development rates as outlined by Water Corporation criteria described above. Treatment of surface runoff is provided in form of bio-retention areas designed to treat the first 15mm of rainfall or first flush (previously referred to as the "1-year 1 hour" duration storm event). The bio-retention systems will consist of excavated basins filled with porous media and planted with vegetation. The basins operate by filtering stormwater runoff through the surface vegetation, followed by the stormwater percolating into filter media (typically sandy loam material), where filtration, extended detention treatment, denitrification and some biological uptake occurs. The base of these bio-retention areas is set to be at least 300mm above the CGL.

Due to the level constraints catchments 2 and 3 had been designed to store up to the 1%-AEP storm in full using modular underground stormwater storage units such as *EcoAid*, *StormTech* or similar products in the verge and to replace the concrete pipes connecting the gully pits. Discussions have been initiated, however, with the adjoining developer to ensure that their drainage system is designed to accept outflows restricted to the equivalent of 4.5 l/s/Ha southwards along Paparone Road. Extreme flooding in excess of the 1%-AEP event will temporarily inundate Paparone Road and may overflow into the Australand development located downstream of the Land depending on the final earthworks design of that adjoining development.

Given that the minimum 6.1 mAHD finished lot level for flood protection will result in typically 1.5 to 2.0 metres depth of fill, and bearing in mind that the GWL will be controlled, soakwells will be utilised at each lot to store/manage/dispose of the more frequent (i.e. up to 15mm of rainfall) events prior to discharge into the road drainage system. Depending on their shape and generally where lots are small – usually less than 350 m<sup>2</sup> in area and where the lot frontage is less than ten metres in width and then after considering each site's ability to contain (i.e. attenuate) this initial runoff with some modest on-lot storage - there may be the need to provide lot connection pits to collect all or the excess runoff from the lots so as to allow the discharge of it into the road system. The City of Rockingham rightly has no specific rule about this – it is more a prompt for the civil engineering designer to ensure that soakwells can be accommodated on the lot.

The LSP depicts the agreed alignment of a trunk water main corridor twenty metres wide along the southern and eastern edges of the northern open space. The Water Corporation's long-term planning plan for the metropolitan Interconnected Water Supply System is to build in stages two 1,200mm diameter water trunk mains within this easement. These main will interconnect the ultimate storages at Tamworth Hill with the Stirling Trunk mains and other future tank storages on the scarp above Byford and Mundijong. The corridor will need to be maintained free of any infrastructure (except the inevitable ninety degree crossings) or structures that would affect the ability to install these trunk mains in a timely and efficient way and so minimise the need for any complex or costly reinstatement at the surface.

The surface level of the water main corridor, however, can be shaped for the land to fall gently from the northern edge of the primary east-west road towards the drainage basins depicted on the Emerge Local Water Management Strategy (LWMS) and therefore take some of the 1% AEP peak storm runoff. In other words the southern edge of the basins need not be aligned rigidly with the northern edge of the water main corridor.

The LWMS prepared by Emerge Associates (and supported with more specific engineering matters provided by The Civil Group) details the stormwater management concepts in greater detail.

### 6. Roads

The traffic engineer Riley Consulting prepared the "Structure Plan Traffic Report (dated February 2015) (the 'Riley Report') and it is a reference document to this section of the engineering report. The site abuts Baldivis Road to its west, Paparone Road to its east and Zig Zag Road to its north. A roundabout is proposed for the main entry intersection between Baldivis Road and Fifty Road.

All roads within the subject site will be constructed to City of Rockingham standards. The existing Paparone Road along the eastern site boundary is to provide the main north–south connections and will be extended southward and connect to the Australand development, northward to the Perron Group's development, and this ultimately allows a connection to Kerosene Lane. The subdivision connect plan included in Appendix A depicts special treatments of some roads as follows:

Entrance road from Baldivis Road along southern edge of POS - Road 'A'

Boulevard treatment for reserve made up as follows - 4.5 metre verge south side plus a 3.2 metre pavement plus a 1.3 metre cycle lane with 3.1 metre wide flush-median plus second a 3.2 + 1.3 metre wide pavement with a 2.3 parking embayment and then a 2.5 metre wide shared path in the POS on the north side. Refer Figure 5 in the Riley Report

Main north-south Road and Paparone Road – Road 'B'

Reserves made up as follows - 4.5 metre verge south side plus a 4.5 metre pavement with a 2.8 metre wide flush-median plus second a 4.5 metre pavement with a 4.5 metre verge. Refer Figure 6 in Riley Report

Where the north-south road is adjacent to the central POS, the cross section will be modified to be made up with a 4.5 metre verge on the western side plus a 4.5 metre pavement with 4.6 metre wide flush-median plus a second 4.5 metre pavement with a 2.3 parking embayment and a 2.5 metre wide shared path in the POS on the eastern side of reserve. Refer Figure 7 in the Riley Report

Baldivis Road will be upgraded to an urban standard, dual single lane boulevard style which will include kerbing, drainage, footpath and other underground services as required for the development.

Specific details of the road treatments, forecast traffic volumes and management options are detailed in the Riley Report.

The segment of existing Zig Zag Road abutting the northern site boundary will be closed as part of the plan to locate the proposed high school in the East Baldivis District Structure Plan.

### 7. Water Supply

Access to scheme water will be facilitated by extension of distribution mains from the nearby Tamworth Hill Reservoir system. The Water Corporation has recently revised its water distribution planning for the Tamworth Gravity Scheme and has scheduled some major water distribution main projects to the east of the Tamworth Reservoir in order to provide for the anticipated developments in East Baldivis.

The water distribution main extensions planned relating to the Land include a 720m section of 600mm diameter water distribution main along Baldivis Road between Ingram Road and Fifty Road (to be constructed in the 2014/15 financial year). The completed extension will enable water supply connection to the site.

#### 8. Wastewater

The subject site is situated within the Water Corporation's Baldivis North Sewer District, which is planned to ultimately discharge its wastewater to the proposed East Rockingham Wastewater Treatment Plant (ERWWTP).

The adopted wastewater conveyance planning for this area divides the East Baldivis urban land into four distinct pump station catchments.

There is already a wastewater pumping station (WWPS) located on the south west corner of the subject land – it is known as the 'Baldivis Road North Pump Station PS1' (BR-WWPS) – and it serves the land south of Zig Zag Road. The BR- WWPS has a temporary pressure main that conveys wastewater north along Baldivis Road to another WWPS in Johnson Road, Wellard. Although the capacity of this outlet is limited, the BR-WWPS arguably already serves part of the subject land. That it also serves the Australand development south of the Peet and Perron land was used as a basis for the MRS rezoning of that land. The pressure main from the BR-WWPS will eventually be redirected westwards along Fifty Road and be connected into the 450mm pressure main to the ERWWTP.

The Corporation's long term planning indicates that the BR-WWPS will ultimately be upgraded from a Type 40 to Type 90 facility by the Water Corporation when the demands warrant, estimated to be at some point after 2050, depending on the ultimate number of services and flows from its catchment. The buffer standard used by the Water Corporation and the DER indicates that a 30m radius buffer is required around a type 90 pump station to limit the impact of possible fugitive odours, noise and light spill on nearby sensitive uses. It is likely that any new civil structure for the ultimate BR-WWPS will need to be built in the available space immediately to the north of the existing structure to allow adequate provision for POS around the future/ultimate BR-WWPS which will accommodate a 30 metre radius buffer surrounding the wet well of the WWPS.

# 9. Electricity, Gas, Telephone and NBN

#### 9.1 Electricity Supply

After analysing Western Power's DFIS<sup>3</sup> records and the surrounding subdivisions, it was noted that there is currently existing high voltage (HV) overhead aerials along Baldivis Road to the western side of the proposed subdivision along with HV overhead aerials to the north of the subdivision along Zig Zag Road.

The proposed development will consist of about 419 single dwelling residential lots and 1 High School site, requiring approximately 2.8 MVA of power. Six transformers and 3 switchgear installations would be required to distribute the necessary power. Low voltage (LV) cables will then be extended to mini pillars and uni-pillars to supply the individual lots, along with LV cables to interconnect into the surrounding subdivisions.

Further investigation with Western Power is required to determine the HV connection point which is expected will come from the existing overhead cables along Baldivis Road. Since the existing aerial cables appear to front the subdivision along Baldivis Road, the WAPC conditions will require these to be undergrounded. The Western Power network mapping tool indicated there is sufficient capacity if construction was to occur before 2016. Noting we are unable to demonstrate available capacity at a feeder level.

Existing low voltage overhead lines along Zig Zag Road service the land east of Paparone Road. These existing lines will eventually be removed as part of the Zig Zag Road closure for the proposed school site.

#### 9.2 Gas Services

There is currently a 160mm diameter high pressure gas main located on the western verge of Baldivis Road across the frontage of the site.

The adjacent "Baldivis Central" and "Spires" development sites are each connected to the ATCO gas reticulation system and the system can be extended through the Land.

#### 9.3 Telephone & NBN

Telstra, NBN Co, and Nextgen Networks broadband services exist in the area along the west verge of Baldivis Road and each could probably be easily extended to service the proposed development.

The development is expected, however, to be serviced with fibre optic as a greenfields site

<sup>&</sup>lt;sup>3</sup> DFIS - *Distributed Facilities Information System* which is Western Power's as-constructed details of the electricity network.

under the National Broadband Network Company (NBN Co). NBN Co is the wholesale service provider of last resort, which means that NBN Co is required to provide communications services to properties that have not been serviced by another communications provider.

Under current criteria, NBN Co will provide fibre to new greenfields developments of over 100 lots that are located within the NBN fibre footprint while the developer is required to install "pipe and pit" for future NBN installation.

#### 10. Staging

The Land will probably be constructed in five stages of about 60 to 90 lots each commencing from Baldivis Road in the north-west portion of the Land. Subsequent stages will probably then create lots along the western edges of the Land to its southern boundary and then eastwards to Paparone road. The staging plan – refer Append C presents the initial views as to the likely staging. A final plan will be prepared nearer the time of detailed design of all engineering services to allow the creation of a mix of lot sizes. The staging plan will, however, be subject to further detailed review depending on market demand for the mixes or combinations of lot sizes so as to cater for that demand.

# **11. Conclusion**

In terms of servicing issues this report had shown that no impediment exists on the development of the Land.

### **APPENDIX A**

**Concept Development Plan** 

**Taylor Burrell Barnett** 

23<sup>rd</sup> January 2015



Lots 129 & 302 Zig Zag Road Baldivis

### **APPENDIX B**

**Groundwater Level Forecasts** 

**Emerge Associates** 

April 2014



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page 17

# **APPENDIX C**

Earthworks concept, Tramway interface, and, Staging plan

**The Civil Group** 

October 2014







## **APPENDIX D**

**Existing Water Corporation Drain** 



# **APPENDIX E**

**Stormwater Management Features** 

**Emerge Associates** 

February 2015

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Lots 129 & 302 Zig Zag Road Baldivis

page 25