Kemerton Strategic Industrial Area

Structure Planning

Civil Servicing and Engineering Report

Prepared for:	Prepared by:
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WOOD & GRIEVE ENGINEERS

Revision

REVISION	DATE	COMMENT	APPROVED BY
Original Issue	11 November 2011		Goran Markovic
A	16 December 2011		Goran Markovic
B	14 November 2014	Draft, new structure plan	Goran Markovic
C	2 December 2014	Final, KIP renamed KSIA	Goran Markovic
D	19 February 2015	Minor amendments to incorporate DSD comments dated 13/01/2015	Goran Markovic
E	25 March 2015	Minor amendments to incorporate DSD comments dated 11/03/2015	Goran Markovic

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Kemerton Strategic Industrial Area

1. Introduction

The Kemerton Strategic Industrial Area (KSIA) was established in 1985 as an area for heavy industry to provide for downstream processing and value-adding to the South West region of Western Australia's extensive primary resources, especially its substantial mineral resources, for both export and domestic markets. The proposed KSIA is the largest industrial area in the South West of Western Australia and is one of the State's designated strategic industrial areas.

In 2007, work commenced on preparation of a Strategy Plan for the KSIA by Thompson McRobert Edgeloe, Coffey Environments and William James Landscape Architect. The completed Kemerton Industrial Park Strategy Plan was published in November 2009 (TME et al ref. 07103P), forming the basis for future amendment of the Shire of Harvey Town Planning Scheme to rezone the northern portion of the KSIA and preparation of a Structure Pan for the Park.

In March 2009, Cabinet approved the allocation of funding to implement the Heavy Use Industrial Land Strategy for Western Australia's industrial estates, including the KSIA. Under this Strategy, the necessary statutory approvals will be sought to develop the Kemerton Strategic Industrial Area.

A Local Structure Plan for the KSIA was prepared by TPG in October 2011. Wood & Grieve Engineers undertook an assessment of the engineering works and civil infrastructure upgrades required to facilitate the future industrial development of the KSIA, based on this Local Structure Plan, and our findings were summarised in our Civil Servicing and Engineering Report dated December 2011.

The Local Structure Plan has since been revised by TPG. A copy of the updated plan entitled Structure Plan – Kemerton Strategic Industrial Area, dated 11 November 2014, is attached at Appendix A. Wood & Grieve Engineers have been engaged by LandCorp to update the Civil Servicing and Engineering Report in response to the current Structure Plan.

Wood & Grieve Engineers have revisited investigations into existing servicing within the KSIA and have also updated a number of the previously prepared preliminary designs to aid in the investigation and reporting of assessment findings. Preliminary designs are based on the revised Structure Plan, some of which have been provided by the respective sub-consultants. It is important to note that the preliminary earthworks plan has not been updated and only pad levels have been revised for the new Structure Plan, as agreed with LandCorp. Plans include but are not limited to the following:

- Existing services plan, refer to Appendix B;
- Preliminary earthworks design plans (pad levels only updated), refer to Appendix C;
- Preliminary service corridor cross-sections, refer to Appendix D;
- Preliminary road cross-sections, intersection treatments and road hierarchy plans, refer to Appendices E, F and G;
- Post development drainage concept plan, based on preliminary roadworks and earthworks designs, refer to Appendix H;
- Preliminary proposed services plans, refer to Appendix I;
- Preliminary water reticulation layout plans, refer to Appendix J;
- Preliminary power layout plans, refer to Appendix K;
- Preliminary gas layout plan, refer to Appendix L.

2. Site Description

2.1 Locality

The Kemerton Strategic Industrial Area is located approximately 160km south of Perth within the Shire of Harvey. It is situated between the South-West Highway and Old Coast Road and is approximately 17 km north-east of Bunbury and 6km inland from the West Australian coastline. The Park is bounded to the west and south-west by Forrest Highway and to the east and south-east by the Wellesley River. Refer to Appendix M for locality details.

The subject site is 7,508 hectares (ha) in total size, comprising the following land areas as identified on TPG's Structure Plan – Kemerton Strategic Industrial Area, as attached at Appendix A:

- 2,024 ha of Strategic Industry Zone;
- 248 ha of Ancillary Industry Zone;
- 4,771 ha as Industry Buffer;
- 234 ha as Public Purpose; and
- 195 ha as Regional Open Space.

The area identified as the Strategic Industry Zone currently supports cleared former grazing land, forestry plantations, semi-rural residential land holdings and areas of native vegetation and wetlands. In addition, a number of existing industries and utilities are located within the Strategic Industry Zone. These include:

South of Marriott Road

- Simcoa Operations Pty Ltd (silicon smelter)
- Cristal(titanium dioxide plant)
- Nufarm Limited (chlorine gas and sodium hydroxide plant)
- BOC Limited (oxygen and nitrogen)
- Cockburn Cement (lime hydration plant)
- Western Power zone substation

North of Marriott Road

- Kemerton Silica Sand (silica sand quarry)
- Tesla Kemerton Pty Ltd (peaking power plant),
- Transfield Services Kemerton Power Station (gas fired peaking power plant),north east corner of the Strategic Industry Zone
- Western Power electricity transmission terminal, northern end of the Strategic Industry Zone

The Ancillary Industry Zone comprises a mix of cleared former grazing land, areas of native vegetation and wetlands, pockets of forestry plantations and several small rural land holdings.

The Kemerton Industry Buffer is generally void of development and largely retained as natural vegetation. Land uses in the buffer area include regional open space, conservation areas, rural uses (including the Goodchild Piggery and other agricultural uses and quarrying), forestry plantations and landfill sites.

There are three areas identified as Public Purpose on the Structure Plan for "Special Uses". The Kemerton Wastewater Treatment Plant (KWWTP) which services the nearby urban areas of Eaton and Australind is located on Water Corporation-owned land to the west of the Strategic Industry Zone, on the northern side of Marriott Road. The State Government owns a rectangular parcel of land opposite the KWWT on the south side of Marriott Road, adjacent to Simcoa Operations. No designated use has been registered for this site. The third area is the City of Bunbury and Shire of Harvey Regional Council Tip Site, located within the Industry Buffer to the south of the Strategic Industry Zone.

Two areas of Regional Open Space (ROS) associated with existing wetland areas are located within the Kemerton Strategic Industrial Area. A large ROS is located on the eastern boundary of the Strategic Industry Zone, adjacent to Treasure Road and west of Wellington Road. A second smaller ROS is located northwest of the Ancillary Industry Zone, spanning across Wellesley Road. Regional Open Space also abuts the eastern boundary of the KSIA along the route of the Wellesley River.

This report is limited to the Strategic Industry Zone and Ancillary Industry Zone only.

2.2 Topography

The topography across the Strategic Industry Zone and Ancillary Industry Zone generally slopes downwards in a south-easterly direction from a dunal ridge in the west to the Wellesley River in the east.

The dunal ridge is situated along the western and northern boundaries of the Strategic Industry Zone, with heights varying from 15.0m to 20.0m AHD between dunes to approximately 45.0 to 50.0m AHD at the crest of dunes. Levels grade down quickly on both sides of the dunal ridge leaving the majority of the Strategic Industry Zone and Ancillary Industry Zone with a relatively level topography of approximately 12.0 to 16.0m AHD, with isolated areas undulating up to approximately 20.0m AHD.

Along the eastern boundary of the site, the central-eastern and north-eastern areas remain fairly level at approximately 14.0m to 16.0m AHD. Along the south-eastern boundary adjacent to the Wellesley River, levels slope rapidly down from approximately 12.0m to 16.0m AHD on the plain to approximately 6.0m to 8.0m AHD at the river's edge.

For further details, refer to the Existing Topography Plan prepared by RPS, attached at Appendix N, and existing contours shown on the Preliminary Earthworks Design Plans, attached at Appendix C.

2.3 Soils and Groundwater

2.3.1 Soils

An overview of the geology and geomorphology within the KSIA is contained within the previously mentioned KIP Strategy Plan (TME et al ref. 07103P). In summary, the underlying geology consists of superficial sands resting on the Leederville Formation which overlies the Yarragadee Formation and/or the Cattamarra Coal Measures.

The profile of the superficial formation generally comprises topsoil overlying sand with sub-surface conditions varying across the site, including Tamala Limestone in the west transitioning to Bassendean Sand, Guildford Formation, Swamp Deposits and Alluvium adjacent to the Wellesley River in the east. There is a noticeable variation in lithology both vertically and laterally, and the thickness ranges from about 20m to 50m.

The Leederville Formation consists of sandstone, siltstone and shale and extends across most of the Coastal Plain. The formation is divided into an upper sandy section and a lower section which is predominantly shale.

The Yarragadee Formation underlies the Leederville formation in the southern part of the site and consists predominantly of sandstone.

The Cattamarra Coal Measure lies unconformably beneath the Leederville formation in the central to northern areas of the KSIA and underlies the Yaragadee Formation in the south. The formation consists of weakly cemented quartz sandstone and weakly consolidated siltstone and shale.

2.3.2 Acid Sulfate Soils (ASS)

The Landgate WA Atlas Acid Sulfate Soils (ASS) Risk Mapping for the Kemerton area indicates that the majority of the site has a "moderate to low risk" of ASS being present in the surface soils. Isolated areas of "high to moderate risk" of ASS associated with Swamp Deposits and Alluvium soils occur across the site. Soils along the western extent of the Industrial Core associated with Tamala Limestone areas are mapped as "no known risk" of ASS.

It is recommended that prior to further development proceeding, further detailed investigation be carried out to better assess the location, extent and severity of potential acid sulfate soils across the site. If the site is found to contain ASS which may be disturbed by the development, an Acid Sulfate Soils and Dewatering Management Plan (ASSDMP) will be required to address the specific management and treatment of potential ASS and resulting dewatered effluent during the construction phase of the project.

Further details and plans of sub-surface soil profiles and ASS risk mapping can be found in Douglas Partners' Report on Preliminary Geotechnical Investigation (DP ref. 76136, dated April 2011), attached at Appendix O.

2.3.3 Groundwater

Groundwater within the KSIA is divided into four distinct groundwater resources as summarised below. Refer to RPS's Local Water Management Strategy – Kemerton Strategic Industrial Area (LWMS) (RPS ref. D1054201 Rev 0, dated December 2014) for further details of the aquifers and their respective salinity levels.

- Superficial aquifer – consisting of clay/sand in the east and sand/limestone in the west with a saturated thickness of around 20m to 40m, recharged by rainfall. Groundwater is fresh to marginal near the Wellesley River, with salinity generally increasing to the west and with depth, although significant local variations are present.
- Leederville aquifer – a confined aquifer system, recharged mainly by downward leakage from the overlying Superficial aquifer and some upward leakage from the Yarragadee aquifer to the south. Salinity levels vary from freshest near the main recharge area to brackish and saline in other areas.
- Yarragadee aquifer – present in the southern part of the KSIA underlying the Leederville aquifer and consisting mainly of sandstone, with salinity varying from fresher in the upper part to brackish and saline in the lower part.
- Cattamarra Coal Measure aquifer – multi-layered aquifer composed of siltstone and shale interbedded with sandstone, divided locally into a fresher quality upper sequence and brackish lower sequence separated by a shale layer.

Groundwater levels have been previously investigated in studies carried out by Aquaterra and details are contained within RPS's LWMS. Annual Average Maximum Groundwater Levels (AAMGL) steadily rise across the site from approximately 9.0m to 10.0m AHD in the west to maximum heights of 12.0m to 13.0m AHD across the eastern extent of the site and up to 14.0m in the north-eastern area of the site. Where the Wellesley River adjoins the south-eastern boundary of the site, AAMGL levels fall rapidly from 12.0m AHD to a minimum height of approximately 6.0m AHD adjacent to the river. In this region, maximum groundwater levels are approximately equal to the natural surface level. Refer to RPS's Annual Average Maximum Groundwater Levels Plan attached at Appendix P for AAMGL contours.

Groundwater is further addressed in commentary regarding AAMGL and effect on earthworks design levels.

Dewatering will be required in service trenches affected by the presence of groundwater.

Along the eastern boundary of the site, the central-eastern and north-eastern areas remain fairly level at approximately 14.0m to 16.0m AHD. Along the south-eastern boundary adjacent to the Wellesley River, levels slope rapidly down from approximately 12.0m to 16.0m AHD on the plain to approximately 6.0m to 8.0m AHD at the river's edge.

For further details, refer to the Existing Topography Plan prepared by RPS attached at Appendix N, and existing contours shown on the Preliminary Earthworks Design Plans attached at Appendix C.

3. Existing Infrastructure

The Kemerton Strategic Industrial Area is serviced by an existing road network and various existing power, telecommunications and gas services, as described in further detail below. A plan showing the indicative location of existing services within the KSIA is attached at Appendix B.

3.1 Road Network

The Kemerton Strategic Industrial Area is situated between two primary distributor roads, Forrest Highway (previously known as the Bunbury Highway and Old Coast Road/Australind Bypass) to the west and South Western Highway to the east, which make it highly accessible to the Perth metropolitan area, the Kwinana heavy industry centre, the nearby Port of Bunbury and the substantial primary industries of the South West region.

Three existing roads link the KSIA to these primary distributors, being Marriott Road, Wellesley Road and Treasure Road.

Marriott Road is a regional distributor linking Forrest Highway in the west with South Western Highway in the east. Marriott Road has significant status as being part of the official high and wide loads corridor from Bunbury Port to locations such as the Worsley Alumina Plant near Collie. It is a two-lane, single carriageway built to rural road standards. Seal width is generally 7.0m.

Wellesley Road is a two lane, single carriageway local distributor built to rural road standards, intersecting with Treasure Road and Marriott Road. It connects to Forrest Highway in the north and Clifton Road in the south. Seal width is 5.0m to the north of Marriott Road and 5.8m to the south of Marriott Road.

Treasure Road is a two-lane, single carriageway access road connecting Forrest Highway in the west to Wellesley Road. It is built to rural road standard with a seal width of 5.1m.

In addition, a number of minor rural standard roads, both sealed and unsealed, exist within the subject site.

Refer to Transcore's Transport Assessment Report (Transcore's ref. t10.209 Revision r02b, dated August 2014) attached at Appendix Q for further details and plans.

3.2 Sewerage

The subject site does not fall within a proposed Water Corporation sewerage catchment area.

The Kemerton Waste Water Treatment Plant (KWWTP) is located to the south west of the site, along Marriott Road. This treatment plant serves the existing residential areas of Australind and Eaton to the south west, and was originally located in the KSIA to facilitate future industrial reuse.

The KWWTP is currently treating 3,900kL per day of wastewater from Eaton and Australind. Flow growth forecasts for the region have required implementation of additional treatment and treated wastewater management strategies to cater for this growth.

Construction of a pipeline that will enable Eaton's wastewater flows to be redirected to the Bunbury Wastewater Treatment Plant is scheduled for completion in mid-2015. Once the pipeline is commissioned, flows to the KWWTP will reduce to 2,000kL per day. Wastewater from Australind will continue to be treated at the KWWTP with flow rates forecast to grow at 5% per annum. The current capacity of the KWWTP of around 4,000kL per day is expected to be sufficient to meet Australind's wastewater treatment needs for the next 16 to 18 years.

The Water Corporation is currently transferring treated effluent from the KWWTP to an existing tree farm near the plant. To ensure nutrient application is sustainable into the future, de-nitrification filters have recently been installed at the plant and commissioning of the filters is currently underway. This tertiary treatment process has the capacity to manage up to 4,000kL per day of treated wastewater flows, which is adequate for both current and forecast flows for the next 16 to 18 years.

The Water Corporation is considering a variety of long-term treated wastewater management options to cater for Australind's continued growth beyond the 16-18 year timeframe.

Current investigations include the purchase of land to expand the existing tree farm and a recycled water supply to an existing industry in the Kemerton Strategic Industrial Area.

Future investigations may include reconsideration of the previously proposed Collie Power Station Ocean Outfall access arrangement. This option may also facilitate future industrial reuse at Kemerton Strategic Industrial Area.

3.3 Saline Water Discharge Pipeline

Cristal currently discharge saline water from their plant located in Marriott Road to the ocean via a privately owned and operated DN300 pressure main. The main is located on the northern side of Marriott Road and extends west to Forrest Highway, then north to Buffalo Road and west to the ocean.

Historically, the average saline discharge rate through the pipeline to the ocean is 130m^3/hr, with flows varying up to 148m^3/hr.

Cristal has advised the absolute maximum discharge capacity of their pipeline is approximately 265m^3/hr. This is currently limited by the discharge capacity of their pumping system which is approximately 160m^3/hr, and strongly dependent on the degree of fouling of the pipeline. The discharge rate is also restricted by the Department of Environment Regulation (DER) which currently limits Cristal's saline flow to the ocean to 150m^3/hr.

Cristal are currently seeking approval from the DER to increase their saline water flow to the ocean from 150m^3/hr to 190m^3/hr to accommodate increases in their plant capacity and the resultant additional saline water flows.

3.4 Saline Water Discharge Pipeline

Currently, no stormwater infrastructure is located within, or services the subject site.

All existing roads within the site are currently un-kerbed, with road crossfalls directing runoff overland to adjacent vegetated areas.

There are a number of natural wetlands located on the subject site which may be able be to be utilised to accommodate future stormwater runoff.

3.5 Water Supply

The subject site does not fall within a proposed Water Corporation water reticulation service area.

The nearest potable water supply is located within Forrest Highway, north of the intersection with Wellesly Road. This supply is conveyed through a DN300 PVC water from the Water Corporation's Integrated Water Supply Scheme (IWSS) and serves the Binningup townsite and surrounding areas. This main would have insufficient capacity to supply the KSIA.

The Water Corporation's recently completed Southern Seawater Desalination Plant (SSDP) is located in Taranto Road, Binningup, to the north-west of the KSIA. The SSDP was constructed in two stages with the second stage having been completed in January 2014, increasing the production capacity of the plant to 100 billion litres (100GL) of drinking water annually. The current production target of the completed plant is 65GL/year.

The Binningup Pipeline, designed to convey potable water from the SSDP to the IWSS in Harvey via a storage facility near Harvey has also been completed.

At the time of construction of the SSDP and Binningup Pipeline, the State Government indicated that this expensive desalinated water was to supply Perth's drinking water needs (as a more acceptable alternative than extracting water from the South West Yarragade for Perth) – not for industry.

Water to Transfield Services Kemerton Power Station is supplied via a Harvey Water DN355 pipeline. This is a non-potable supply originating from Harvey Dam. Harvey Water has advised the pipeline has been designed to supply up to 5GL/Annum, based on Transfield Services's estimate of future water demands. Under an existing agreement, Harvey Water currently supply up to 90ML/Annum to Transfield Services. A portion of the current spare capacity in this pipeline may potentially be utilised as a temporary non-potable supply to the northern area of the KSIA, depending on timing of future increases in Transfield Services' water supply requirements.

Harvey Water also has a number of water supply channels fed from Wellington Dam in the vicinity of the KSIA. With the requisite infrastructure upgrades and extensions, some of these channels could potentially be utilised as a non-potable water supply for industries within the KSIA.

3.6 Power Supply

The subject site is adjacent to Western Power's Kemerton Terminal located in the north of the Strategic Industry Zone, Marriott Road Zone Substation in the south and a major 330kV transmission line running generally north-south to the east of the site. The site is traversed by major 132kV transmission lines running between the Terminal and the Zone Substation and the Zone Substation and Wellesley River, several three phase 22kV distribution lines and several single phase 22kV distribution lines.

The 330kV transmission lines are protected by registered easements in favour of Western Power. The 132kV transmission lines and distribution lines are not currently protected by easements.

The existing power network does not have sufficient capacity to adequately service the expected power requirements of the Kemerton Strategic Industrial Area.

Refer to Western Power's Feasibility Study for the Kemerton Industrial Park (WP ref. SF010041), attached at Appendix R, for further details and plans.

As previously mentioned, there are two private peaking power stations located within the KSIA – Tesla's diesel-fuelled peaking power station and Transfield's gas-fired peaking power station. Whilst these power stations have been designed to provide peak power to meet short duration, high power demands for Western Power's South West Integrated System (SWIS), these plants could potentially supply industries within the KSIA.

Simcoa Operations Pty Ltd's Kemerton plant is one of the largest, single-site users of power in Western Australia. Simcoa has negotiated an interruptible / curtailable power supply with Western Power, an example of how the SWIS can be adapted to meet specific industry requirements without the need for major power network upgrades.

3.7 Telecommunications Services

Telstra has an existing network building located on the Kemerton Wastewater Treatment Plant site in Marriott Road. This site is connected to the main network via optic fibre to the Bunbury - Mandurah link located in Forrest Highway, and the building contains transmission equipment capable of supporting a large volume and range of communications services. Optic fibre cables extend east from this site to service at least five customer sites in the Marriott Road area with wideband and/or data products. Telstra also has a Kemerton mobile phone transmitter located adjacent to the network building which is connected to the Bunbury – Mandurah link via optic fibre cables in Marriott Road.

The remainder of the site has little infrastructure, with no cabled communications to Transfield Services' existing Kemerton Power Station.

3.8 Natural Gas Supply

The Dampier to Bunbury Natural Gas Pipeline (DBNGP), owned and operated by Dampier to Bunbury Pipeline (DBP), is situated in the vicinity of the Kemerton Strategic Industrial Area, as shown on the attached plan at Appendix S. The southern section of the DBNGP Main Line runs roughly south from Pinjarra to the Wellesley Main Line Valve (located approximately 5km north of the Kemerton Power Station) then east to Harvey and south east to Worsley where it currently terminates. The DN323 Kemerton Lateral pipeline is constructed from the Wellesley Main Line Valve, running south past the Kemerton Power Station, through the proposed KSIA, terminating at a point near the corner of Clifton Road and the Australind Bypass.

There are two existing Meter Stations on the Kemerton Lateral – the Kemerton Power Station Meter Station KP 1511.9 (adjacent to and serving the existing Kemerton Power Station) and the Kemerton Meter Station KP 1518.78 (near Devlin Road), as shown on the attached plan in Appendix T.

The Kemerton Meter Station serves three existing industrial customers in Marriott Road via ATCO Gas Australia's gas distribution network.

4. Proposed Development

TPG's updated Structure Plan – Kemerton Strategic Industrial Area, dated 11 November 2014 (included at Appendix A), indicates that the subject site shall be subdivided into the following basic components:

- Developable Industrial Areas comprising the Kemerton Strategic Industry Zone and Kemerton Ancillary Industry Zone, including associated drainage reserves;
- Kemerton Industry Buffer;
- Public Purpose areas – including the Water Corporation-owned Kemerton Wastewater Treatment Plant, State Government owned land and the City of Bunbury and Shire of Harvey Regional Council Tip Site; and
- Regional Open Space.

Investigations into the various types of industries that could be expected to locate to the KSIA have been carried out by Burns and Roe Worley (1998) as referenced by Aquaterra (Kemerton Water Study Phase 2 – Data Volume 2002, Aquaterra ref. 211 R002-c). More recent studies have been undertaken by Parsons Brinckerhoff Australia Pty Limited (Waste Disposal Management Strategy for Expansion of Kemerton Industrial Park 2011, PB ref. WMS RPT 2117168A 004 A JT).

The industries identified as likely to locate to the KSIA are listed below. Further details and information on the various industries can be found in the above reports. Aquaterra have estimated potential water demands based on various growth scenarios (refer to Section 8.5 of this report). In addition, Parsons Brinckerhoff have estimated potential water, power and gas requirements for each industry, as summarised in their Table 5.2 and as attached at Appendix U.

- Urea plant
- Aluminium smelter
- Fuel terminal
- Titanium metal plant
- Ammonium nitrate storage
- Zanthate plant
- Ammonia plant
- Fertiliser plant
- Hydrogen peroxide plant
- Lithium metal facility
- Timber products plant
- Tantalum refining plant
- Pulp and paper mill
- Synthetic rutile plant
- Vanadium refining plant
- Water factory
- Co/tri-generation energy factory

Development within the KSIA, as with other SIAs, is expected to occur over a long term timeframe depending upon the demand for strategic and heavy industry sites. Due to the uncertain nature of the demand for such sites within the KSIA, the subdivision and development of sites is only intended to occur when required by a future proponent or industry operator.

A preliminary staging plan has been prepared and is attached at Appendix V, showing progressive subdivision of lots from within the Strategic Industry Zone and a corresponding stage of lots within the Ancillary Industry Zone. The staging shown on this plan is notional only, intended to demonstrate that as a stage or site is developed, earthworks, roadworks and services will be progressively constructed and implemented to meet the needs of the area being developed. Actual provision of roads and services will be assessed as and when actual industry requirements are known.

5. Geotechnical Investigation

Douglas Partners were commissioned by Landcorp to undertake a Geotechnical Investigation for the Kemerton Strategic Industrial Area in support of the Structure Planning for the project. The investigation was limited to the Strategic Industry Zone and Ancillary Industry Zone and comprised a desktop study combined with a site visit and limited ground breaking investigation to provide preliminary geotechnical comments on:

- Suitability of the site for proposed development;
- Likely site classification;
- Likely site preparation and earthworks requirements;
- Indicative California Bearing Ratio (CBR) for new pavement design;
- Suitability of the site for on-site stormwater disposal;
- Suitable fill level above Average Annual Maximum Groundwater Level (AAMGL); and
- Risk of acid Sulfate soils (ASS) occurring beneath the site.

The key points of Douglas Partners' report are summarised below.

Existing Ground Conditions

The sub-surface conditions beneath the site, based on published geological mapping, consist of Tamala Limestone and sand derived from Tamala limestone in the west transitioning to Bassendean Sand, Guildford Formation, Swamp Deposits and finally Alluvium along the Wellesley River water course on the eastern boundary. Douglas Partners' preliminary site investigations generally concur with this geological mapping.

The soil profile encountered in the boreholes during site investigations generally comprised of topsoil overlying sand. Some exceptions to this profile were encountered including silty sand, peaty sand, clayey sand, coffee rock and fibrous root material.

Groundwater

No free groundwater was observed within any of the 25 boreholes drilled to depths of up to 2.0m below surface levels. A ground water monitoring well located on the west side of Wellesley Road, approximately 1.3km north of the intersection with Treasure Road was dipped and recorded a groundwater level of 3.2m below the surface (11.96m AHD).

Site Classification

The site classification in accordance with AS 2870-2011 for most of the site was found to be Class A, with some areas Class P and Class S. It is likely that some Class M and Class H areas may be found within the Guilford Formation and Alluvium areas. With some minor areas of earthworks remediation, it is likely that the majority of the development should be able to achieve a site classification of 'A'.

Site Preparation and Earthworks

Douglas Partners have provided the following site preparation and earthworks recommendations for all building envelopes and pavement areas:

- Removal of deleterious material including topsoil, vegetation and tree roots;
- Removal of peaty material and replacement with suitable structural fill;
- Proof compaction of exposed subgrade areas including, where necessary, removal of material in areas showing excessive deformation and replacement with suitable compacted structural fill;

- Naturally occurring sand excavated from the site should generally be suitable for re-use as structural fill, and should be compacted in layers of not more that 300mm;
- Areas should be compacted to achieve a dry density ratio of not less than 95% relative to modified compaction;
- Re-compaction of top 300mm using a vibratory plate compactor in all foundation excavations, prior to construction of any footings.

Minimum Fill Levels above AAMGL

A preliminary fill level of 1.5m above AAMGL is considered suitable to meet the geotechnical requirements for an industrial area. This however will be reviewed and the fill level amended accordingly, following further detailed investigations.

Pavement Design

It is suggested that a CBR of 12% should generally be suitable for the design of flexible pavement on the natural sand subgrade encountered at the site, where there is a minimum of 1.0m of sand overlying clay. This will be reviewed following further detailed investigations.

Soil Permeability Stormwater Disposal

A preliminary soil permeability value of 1 x 10-4 m/s is suggested for the site. Again, this will be reviewed following further detailed investigations.

Acid Sulfate Soil Risk

Based on current published Acid Sulfate Soils (ASS) risk mapping, the risk of ASS expected at the site varies as follows:

- "no known risk of acid sulfate soils occurring within 3.0m of natural soil surface" in areas associated with Tamala Limestone and sand derived from Tamala Limestone (most of western side of Strategic Industry Zone);
- "medium to low risk" in areas associated with Bassendean Sand and Guilford Formation (majority of site);
- "high to medium risk" associated with Alluvium and Swamp Deposits (isolated pockets of wetland areas).

Douglas Partners preliminary site investigations generally support the levels of risk depicted on the published risk mapping. Further detailed investigation is recommended to better assess specific management requirements of potential acid sulfate soils.

A full copy of Douglas Partners' Report on Preliminary Geotechnical Investigation (DP ref. 76136, dated April 2011) is attached at Appendix O.

Due to the small number of boreholes drilled and the desktop nature of investigations, Douglas and Partner's recommendations are limited and preliminary and are subject to further detailed investigations.

6. Earthworks and Retaining Walls

Preliminary earthworks modelling for the proposed site was previously undertaken based on TPG's Structure Plan dated October 2011 and copies of these preliminary earthworks plans (Revision A) are attached within Appendix C.

These preliminary earthworks plans have recently been revised (Revision C) to incorporate TPG's Structure Plan dated November 2014 and are also attached within Appendix C. However, it is important to note that only cadastral information, building envelopes and pad levels have been amended. Earthworks modelling has not been updated and volumes have not been calculated for the Revision C plans, as discussed and agreed with LandCorp.

The general strategy employed for modelling purposes was to fill areas in close proximity to groundwater to 1.5m above the maximum AAMGL, utilising sand mined from areas of the site possessing a large clearance to groundwater, thereby obviating the need to import clean fill to the site. Levels in remaining areas have generally been designed to retain existing natural surface levels. It is noted that KSIAs sand deposits are located mainly along the western ridges of the site, which are environmentally sensitive areas. Mining of sand from these areas would be subject to further environmental review.

Due to the large size of the proposed lots and the general strategy to retaining existing levels, no retaining walls have been incorporated in the preliminary earthworks model. The extents of building envelopes have been graded to match existing natural surface where required.

General parameters for the preliminary earthworks design have been based on the following criteria and/or constraints:

- Earthworks within lots have been restricted to building envelope areas only, as per the Concept Structure Plan.
- Building envelope areas have been based on flat, level building pads.
- Minimum building pad design levels have been assumed as 1.5m above Annual Average Maximum Groundwater Levels (AAMGL). Some building pad design levels are based on road level and/or topography related interfacing requirements, where these are higher than the minimum level required above AAMGL.
- Minimum levels for roadworks have been assumed as 1.0m above AAMGL, with flood routing of roads to proposed basin areas where applicable.
- Proposed road pavement levels within the KSIA tie in with existing pavement levels at the KSIA Strategic Industry Zone and Ancillary Industry Zone boundaries, for interfacing purposes.
- No assessment of road levels external to the Strategic Industry Zone and Ancillary Industry Zone have been undertaken.
- Existing levels for Marriott Road have been retained for the extent of the development due to the presence of existing industries and facilities on the southern side of Marriott Road.
- Existing levels for Mitchell Road have been retained adjacent to Transfield Services' Kemerton Power Station.
- No consideration has been given to Railway layout on design.
- No assessment of retaining wall requirements has been undertaken.
- No consideration has been given to existing power pole levels in Kemerton Road (central major road running north/south), or the existing Dampier to Bunbury Natural Gas Pipeline (DBNGP) levels, as related to future design levels. Physical adjustment of such infrastructure to fit with a re-contoured site can be an extremely costly task.
- No assessment of potential geotechnical remediation has been undertaken as a part of this exercise.
- Cut material has been assumed to be suitable for use as fill material at the site.
- Gravity dependant civil infrastructure has not been considered as a part of this exercise. This will need to be incorporated at detailed design stage.
- No assessment or incorporation of extractive industry areas has been undertaken.
- Basin and/or drainage areas have not been modelled, and therefore do not have any bearing on final earthworks volumes.

Kemerton Strategic Industrial Area

On completion of the preliminary earthworks planning (Revision A plans), the following volumes measured in bank cubic meters (BCM) were extracted from the 12D Modelling package:

Total Cut Volume (BCM):	16,438,000m^3
Total Fill Volume (BCM):	8,338,000m^3
Total Excess of sand post bulk earthworks (BCM):	8,100,000m^3

Preliminary earthworks modelling has been undertaken on a conceptual basis only (based on the Revision A plans). The volumes provided should be considered to be of desk top accuracy only and should not be used for detailed cost analysis and/or financial modelling. We recommend a detailed modelling exercise be undertaken should more accurate volumes be required for planning and/or financial planning purposes.

7. Proposed Servicing

The following sections detail the proposed new infrastructure to be constructed to provide wastewater, roadworks, stormwater, water, power, telecommunications and gas services to the developed site. A preliminary Proposed Services plan has been prepared including water, power, telecommunications and gas services, as attached at Appendix I. Sewer reticulation has been excluded as it is assumed that domestic wastewater will be managed on an individual lot basis in accordance with the LWMS. Industrial wastewater management services are excluded from the plan as they are beyond the scope of WGE's commission and will be investigated by a specialist consultant.

Railway infrastructure has not been considered in this report as this is also beyond the scope of WGE's commission. Investigation, preliminary design and estimating for the proposed rail service to the KSIA is being prepared by a specialist consultant.

A Preliminary Services Corridor Cross Sections plan has also been prepared by WGE showing typical sections through the various proposed corridors within the KSIA Strategic Industry Zone and Ancillary Industry Zone. Refer to Appendix D. The width and configuration of service corridors shown is preliminary only and subject to detailed design and Authority approvals.

7.1 Domestic Wastewater Management

Options for wastewater treatment are discussed in RPS's Local Water Management Strategy - Kemerton Strategic Industrial Area report (LWMS) (RPS ref. D1054201 Rev 0, dated December 2014). Section 6.0 of their report pertaining to industrial and commercial wastewater treatment is attached at Appendix W. Further commentary and details are provided below.

Gravity Sewer Reticulation

The subject site does not fall within a planned Water Corporation sewer reticulation service area.

The Water Corporation has advised they currently do not intend to undertake any formal sewer planning to provide a reticulated sewer system for Kemerton Strategic Industrial Area. They have suggested that there may be some capacity in the Kemerton Wastewater Treatment Plant (KWWTP), subject to future expansion of the KWWTP, however the Water Corporation are not prepared at this stage to confirm if this expansion would accommodate any domestic sewer flows resulting from the Kemerton Strategic Industrial Area.

It has also been advised that should a solution be found involving a Water Corporation reticulated sewer service, the Water Corporation would not enter a prefunding arrangement for Kemerton specific headworks assets. All such works would need to be fully developer funded, including the requisite pump stations, pressure mains and wastewater treatment plant. Additionally a minimum of standard headwork contributions would apply to all lots created and serviced by the reticulated sewer system.

It has since been requested that the Water Corporation provide possible options for a Water Corporation sewer service to the Strategic Industry Zone and Ancillary Industry Zone for the collection and disposal of both domestic wastewater and treated industrial wastewater. The Water Corporation has responded, advising that sewer reticulation services would not be a viable option due to the potential low flows and capital costs involved. However, they have advised accommodation of treated industrial wastewater may be viable, subject to negotiation and detailed analysis (refer to Section 8.2 below).

Preliminary design and estimates for a reticulated sewer system for domestic flows from Stage 1A of the KSIA indicate that the depth of gravity sewers required to serve the proposed lots and the associated infrastructure costs confirm the Water Corporation's position that this option is unlikely to be feasible. This is discussed further below.

Vacuum Sewer System

A viable alternative to gravity sewer reticulation for the KSIA may be a vacuum sewer system. Vacuum sewers use smaller diameter pipes laid with minimal cover in shallow, narrow trenches. A typical vacuum system requires significantly less vacuum stations compared to the number of pump stations that would be necessary in a comparable gravity flow system. As a result, the cost to install a vacuum system is almost always less than a gravity flow system. Another advantage of vacuum systems is that they are air-tight and do not allow infiltration and inflow, thus reducing the volume of wastewater requiring treatment.

Preliminary design and estimates for a vacuum sewer system for Stage 1A of the KSIA has been obtained from WaterCon, the Australian agent for AIRVAC systems. See below for further details.

Aerobic Treatment Units

It is common practice for the relevant authorities to approve the installation of onsite sewer treatment systems, including traditional septic tanks and leach drains and Aerobic Treatment Units (ATUs), in areas where properties cannot be reasonably connected to a reticulated sewer system. Refer to RPS's LWMS for typical details for these systems. The Shire of Harvey has, in principle, accepted the use of such treatment methods for KSIA. Further details and costings for Aerobic Treatment Units (ATUs) have been investigated for this report.

One option for domestic wastewater management is the installation of individual Aerobic Treatment Units (ATUs) to each lot, with the chlorinated effluent from the ATUs being used to surface-irrigate garden areas. The ATUs could be provided by the Developer during subdivision construction based on generic sizing, with installation of additional modules by future lot owners on an as-needed basis to meet any additional treatment capacity requirements they may have. Alternatively, ATUs could be installed by future lot owners to suit their specific requirements.

As ATUs are an onsite effluent disposal system they require approval by the Department of Health WA and quarterly servicing by approved agents, with servicing reports provided to property owners and the Local Government for monitoring purposes to ensure that units are operating effectively and that the quality of final effluent is maintained. Operational costs and ongoing servicing and maintenance costs would be at the individual property owners' expense.

Indicative costs for supply and installation of ATUs to suit small to medium sized offices, as provided by BioMAX (a Department of Health approved supplier), are set out below. Costs are exclusive of internal plumbing within lots, GST, fees and charges. More detailed information on expected land usage will be required in order to determine wastewater flows and ATU capacity requirements so that costs may be more accurately defined.

Capacity Litres/day	No of People (in Office Environment)	Cost $
1,800	24	$26,000
5,400	72	60,000
9,000	120	100,000

Source: BioMAX, Nov 2014

An alternative to individual ATUs, is the construction of a number of central Aerobic Treatment Units suitably located to service sub-catchments within the development. Each sub-catchment would require a piped gravity sewer system to the ATU. The Developer would be required to provide the Local Authority with suitable sites for the ATU's, each with sufficient area for the ATU and irrigation of effluent.

Commercial ATU systems require approval by the Department of Health WA and the Local Government with quarterly servicing reports also provided both parties for monitoring purposes. Indicative costs for supply and installation of commercial ATU systems, as provided by BioMAX, are set out below. Internal plumbing, gravity sewers, pump station and pressure main costs, GST, fees and charges are not included. As noted above, more detailed information on expected land usage will be required in order to determine wastewater flows and ATU capacity requirements so that costs for central ATU systems may be more accurately defined.

Capacity Litres/day	Plan Area of ATU (m x m)	No of People (in Office Environment)	Cost $M
200,000	30 x 45	2,700	$2.3
300,000	30 x 45	4,000	$3.2
500,000	30 x 60	6,700	$3.8

Source: BioMAX, Nov 2014

Private Wastewater Service Provider

Initial discussions have recently been held with Water West, a private water and wastewater service provider, who have expressed an interest in becoming a wastewater service provider for the KSIA. It is recommended that Water West be engaged to investigate to additional and/or more economical wastewater management options for the KSIA.

Summary

In order to assess the feasibility of the various options for domestic wastewater management, a preliminary cost analysis has been carried out for Stage 1A of the development. Costs have been estimated for individual ATU's and vacuum and gravity sewer systems to central ATU's and the KWWTP (subject to Water Corporation approval). The results are summarised in the table below.

Costs are based on flows from the Stage 1A lots only do not take into account upstream flows from future stages. Costs for ATUs are based on unit costs provided by Biomax and Water Corporation design sewer flows for industrial areas, assuming only 10% of building envelope areas would require servicing by sewers. Vacuum sewer systems, gravity sewer systems and central ATU costs do not take into account upstream flows from future stages or the increase in size and/or depth of infrastructure that would be required to accommodate such flows. Vacuum sewer costs incorporate pricing provided by WaterCon. All costs are exclusive of internal plumbing costs, GST, fees and charges.

Wastewater Disposal Method - Stage 1A	Estimated Cost Stage 1A $M
Individual Aerobic Treatment Units (ATUs)	$1.5
Vacuum sewer system to central ATU	$3.7
Vacuum sewer system, pump station & pressure main to KWWTP	$4.0
Gravity sewer reticulation to central ATU	$6.5
Gravity sewer reticulation, pump station & pressure main to KWWTP	$6.9

Source: Wood & Grieve Engineers, October 2011

As shown in the table, the most economically feasible domestic wastewater solution of the options currently considered for the KSIA would be the use of ATUs for individual lots. A vacuum sewer system, either to central ATUs located strategically throughout the site, or to the KWWTP (if approved by the Water Corporation), may be considered feasible options. The cost to construct a reticulated sewer system, either to central ATUs or to the KWWTP is unlikely to be feasible for the low volume of domestic sewer flows that would be generated at the KSIA, depending on the timing of development and rate of uptake of lots. The above costs are indicative only. Further information, detailed design and analysis would be required so that costs for the various options can be more accurately defined.

Further discussions with Water West may reveal additional and/or more economical wastewater management options for the KSIA.

7.2 Industrial Wastewater Management

Hazardous and Industrial Liquid Waste

Preliminary investigations for the management of industrial wastewater have been undertaken by RPS in consultation with the Water Corporation and included in Section 6.0 of their LWMS report (refer Appendix W).

In summary, preferred options to manage industrial wastewater at the KSIA, as outlined by the Water Corporation include:

- Industry to treat effluent to predetermined acceptance criteria and recycle on site or to a neighbouring industry, (this currently occurs on site by some of the existing industries);
- Industrial wastewater to be collected centrally and recycling opportunities sought or disposal considered;
- If a critical mass of industry is reached a combined application for a common outfall could be made, whereby wastewater is treated onsite or centrally within the KSIA to an acceptable standard prior to disposal (subject to required environmental approvals).

The proposed short term strategy is for sites which generate an industrial wastewater, to treat the water at the lot scale to a standard where it is suitable for reuse on site or by a neighbouring industry or for disposal to a nearby existing facility.

The activated sludge treatment plant of the Water Corporation's Kemerton WWTP, and the Bunbury Industrial liquid waste facility operated by Wren Oil, might serve for treating organic and industrial/by-product wastewater respectively in the short term until a suitable facility is developed within the KSIA.

Another potential short-term disposal option for suitably treated industrial wastewater may be via the Water Corporation's proposed Kemerton WWTP outfall to Verve Energy's existing Collie Power Station Ocean Outfall pipeline.

Saline Water Disposal

The KSIA is likely to generate a significant volume of saline water streams from reverse osmosis treatment plants required to desalinate potential water sources and also from some treated industry process water. Previous reports prepared for the KSIA indicate the preferred disposal method for saline water streams would be via a dedicated piped ocean outfall. At present, Cristal dispose of saline water via a private DN300 discharge pressure main extending from their plant in Marriott Road to Forrest Highway and west along Buffalo Road to the ocean.

Potential short-term solutions for the initial stage/s of the KSIA may be to construct an ocean outfall pipeline adjacent to the existing Cristal pipeline, subject to the necessary statutory approvals.

A potential long-term solution may be to utilise a future Kemerton WWTP outfall pipeline, should the Water Corporation resume negotiations with Verve Energy to access the existing Collie Power Station Ocean Outfall Pipeline.

Long Term Solutions

Parsons Brinckerhoff Australia Pty Limited (PB) were commissioned by LandCorp to prepare a Waste Management Strategy (WMS) to address potential key issues and needs related to the waste generated by the expansion of the KSIA, including solid waste, liquid waste and gaseous emissions. Refer to PB's Waste Disposal Management Strategy for Expansion of Kemerton Industrial Park report (PB ref. WMS RPT 2117168A 004 A JT).

The WMS includes investigation of longer term options for management of industrial wastewater from the KSIA. PB has recommended that an expandable and comprehensive water factory be established to process multiple sources of wastewater generated within the KSIA. The treated wastewater would be used to supply water in a variety of qualities, as required by the different potential users that will be part of the industrial park. The water factory would be able to discharge excess volumes treated to an acceptable quality via an ocean outfall, potentially the existing ocean outfall used by Verve Energy.

It is recommended that a specialist consultant be engaged to further investigation options for industrial wastewater management so that preliminary infrastructure planning and cost estimates can be progressed.

7.3 Roadworks Infrastructure

Transcore were commissioned by Landcorp to update their previous Traffic Assessment Report for the Kemerton Strategic Industrial Area in response to revised structure planning for the project, based on TPG's Updated Local Structure dated June 2014. Transcore's updated report is entitled Kemerton Industrial Park Updated Local Structure Plan – Transport Assessment (TPG Ref: t10.209.mr.r02b, dated August 2014) and is attached as Appendix Q.

Transcore has completed detailed modelling of the traffic environment based on projected traffic volumes and usage types in order to assess road design parameters. Their report outlines the following:

- Traffic Modelling for the whole Kemerton Strategic Industrial Area;
- Investigations into proposed road reserve and pavement widths and respective cross sections;
- Advice on existing road infrastructure upgrades, where applicable;
- Investigations into road treatments, including intersection configurations; and
- External site requirements, where applicable.

In summary, Transcore has recommended the following infrastructure treatments and upgrades:

Traffic lights or roundabouts constructed to Forrest Highway at intersections with Marriott Road, Treasure Road and Kemerton Road (formerly Wellesley Road);

No upgrade to the existing intersection of Marriott Road and South West Highway is anticipated;

Roundabout constructed to Treasure Road / North-South Road four-way intersection;

Intersections of Kemerton Road/Marriott Road and Wellesley Road/Marriott Road to be constructed as priority controlled T-intersections with channelised right turn/channelised left turn treatments;

Other key priority controlled T-intersections within the KSIA area to be channelised right turn/basic left turn;

All other internal T-intersection treatments to be basic right turn/basic left turn;

Marriott Road between Forrest Highway and Devlin Road to be upgraded to a 10m carriageway to industrial standard within the existing 60m road/rail reserve; with provision for future upgrade to a dual carriageway within a 50m road reserve;

Marriott Road between Devlin Road and the eastern KSIA boundary to be upgraded to a 10m industrial standard carriageway with a 35m road reserve;

Marriott Road between the eastern KSIA boundary and South West Highway to be upgraded to 7.0m rural standard carriage ways within the existing road reserve.

Treasure Road and Kemerton Road (formerly Wellesley Road) between Forrest Highway and the western boundary of the Strategic Industry Zone to be upgraded to 7.0m rural standard carriageways within the existing road reserves.

Treasure Road between the western boundary of the Strategic Industry Zone and Kemerton Road to be upgraded to a 10m industrial standard carriageway with a 35m road reserve;

Kemerton Road (relocated section of former Wellesley Road) from Marriott Road to approximately 500m north of Treasure Road to be constructed as a 10m industrial standard carriageway with a 35m road reserve;

Kemerton Road (formerly Wellesley Road) from north of Treasure Road to the western boundary of the Strategic Industry Zone to be upgraded to a 10m industrial standard carriageway with a 30m road reserve;

All other internal roads within the industrial core, including existing roads and newly created roads, to be upgraded or constructed to 10m carriageways within 30m road reserves;

For Transcore's full detailed Transport Assessment Report, refer to Appendix Q.

In order to accommodate proposed stormwater drainage swales, it will be necessary to widen some of the road reserve widths proposed by Transcore. Initial indications are that Marriott Road between Forrest Highway and Kemerton Road will require a 60m road reserve width. Any additional changes that may be required will be determined during detailed design.

Attached at Appendix F and G are copies of Transcore's Intersection Treatments and Road Hierarchy Plans, showing the proposed overall road layout, internal and external intersection treatments and pavement/road reserve widths. Preliminary cross-sections for the various proposed road reserve widths have been prepared by WGE and are attached at Appendix E. All proposed road layouts, treatments etc. are preliminary only and are subject to detailed design and formal approval by the Shire of Harvey.

7.4 Stormwater Drainage Strategy

RPS have been commissioned by Landcorp to undertake a Post Development Drainage Study for the Kemerton Strategic Industrial Area in support of the Structure Planning for the project. The results of the study are contained within Section 7.0 of RPS's LWMS report (refer Appendix W).

The key points of RPS's proposed drainage strategy are summarised below.

General

Design of the drainage system focuses on maintaining the pre-development hydrological regime at the site as closely as possible. In order to achieve this RPS has developed an XPSWMM surface water model of the site to determine the pre-development surface water flow rates and the required volumes of stormwater retention needed onsite to maintain the pre-development conditions. To achieve this objective the drainage system incorporates the following design features:

Up to the 1 in 10 year ARI event

Within lots:

- All rainfall outside of the building footprint will infiltrate as close to source as possible as per existing conditions; and
- Rainfall inside the building footprint will infiltrate up to the 1 in10 year ARI event through the use of soakwells. A clay layer shall be incorporated below the building footprint as a means of retaining water quality on site.

Road Drainage:

- Road drainage within the development will incorporate landscaped roadside conveyance swales wherever possible to accommodate the 1 in 10 year ARI event, in accordance with best practice water sensitive design principles and to minimise development costs;

- Where the use of landscaped roadside conveyance swales are not feasible, conventional pit and pipe drainage systems will be required to accommodate the 1 in 10 year ARI event.

Greater than the 1 in 10 year ARI event

For events greater than the 1 in 10 year ARI, stormwater shall be conveyed via overland flow, from the lots, along the road surface to the various drainage areas throughout the industrial site. A number of drainage areas and multiple use wetlands have been included within the Structure Plan in order to manage stormwater within the sub catchments of the site. Each drainage basin shall be designed to detain the 1 in 100 year ARI event and discharge where possible at predevelopment rates. The invert of all drainage structures will be designed to achieve a minimum 0.3m clearance from the MGL levels across the site.

Attached at Appendix H is a copy of RPS's preliminary Post Development Drainage Concept Plan showing preliminary catchment, basin location and sizing information.

7.5 Water Supply – Potable and Process

Investigation into the estimated future water demand for the Kemerton Strategic Industrial Area was carried out by Aquaterra in 2002 and results of their investigations are included in their report entitled "Kemerton Water Study Phase 2 – Data Volume 2002" (Aquaterra ref. 211 R002-c), a copy of which is appended to RPS's LWMS report.

Aquaterra's modelling was based on typical water usage for various industries, sourced from a study by Burns and Roe Worley (1998), and an estimate of the type and number of industries that may locate to the KSIA. From this information, Aquaterra estimated that the future water demand for the KSIA is likely to range between 7 GL/annum and 23 GL/annum, depending on growth within the Park, as per the table below.

Scenario	Demand	Comments
Low Growth	7 GL/Annum	Status quo with demand dictated by the expansion of Cristal and Simcoa operations. Included also is the possibility of titanium sponge production and few small unspecified industries.
Medium Growth	10 GL/Annum	Volume required is higher to meet the demands of a synthetic rutile plant, wool processing, iron briquetting plant and a pulp mill.
High Growth	14 - 18 GL/Annum	High growth scenario view considering the full development of Kemerton with a wide range of industries including an aluminium smelter, power station and other industries.
Maximum	23 GL/Annum	High growth demand plus the introduction of a 'high water demand' industry.

Source: Aquaterra, 2002 Table 3.2

Parsons Brinckerhoff Australia Pty Limited (PB) have also estimated likely water requirements for the KSIA, based on an independent review of industries likely to locate to the Park and water demand figures used in a GHD study for the Oakajee industrial estate. Refer to PB's Wastewater Management Strategy Report dated July 2011 for further details (PB ref. WMS RPT 2117168A 004 A JT).

The total estimated water requirement estimated by PB, based on full development of the KSIA ranges from 30.5 GL/Annum to 52.5 GL/Annum with the inclusion of a pulp and paper mill, as summarised below. Refer to PB's Table 5.2 Potential Water, Power and Gas Requirements attached at Appendix U for further details.

Industry	Total Estimated Water Requirements (GL/yr)			
	Domestic (Potable) (TDS 0-500 mg/L)	High Quality Industry (TDS 100-200 mg/L)	Cooling Water (TDS 800-1000 mg/L)	Total
Existing and Likely Industries (excluding Pulp & Paper Mill)	0.1 GL/A	14.0 GL/A	16.4 GL/A	30.5 GL/A
Pulp and Paper Mill				22.0 GL/A
All Existing and Likely Industries				52.5 GL/A

Source: Parsons Brinckerhoff Pty Limited, July 2011 Table 5.2

Marsden Jacob Associates (MJA) were commissioned by the South West Development Commission to undertake an economic analysis of the likely demand for industrial water supplies and assess the supply options that may be obtained from local water sources. The South West Development Commission is in the process of reviewing MJA's 2011 Study, a copy of which is also appended to RPS's LWMS report.

The key available water sources identified by MJA for the KSIA include:

- Integrated Water Supply Scheme including HIWS Scheme;
- Wellington Dam (Potable and Process);
- Groundwater Abstraction (Potable and Process);
- Recycled water from the Kemerton Wastewater Treatment Plant (Process);
- Recycled water from the Verve Pipeline (Process);
- Recycled water from the Cristal titanium dioxide plant (Process); and
- Recycled water from a new seawater desalination plant constructed within the KSIA.

The above options are discussed in detail in RPS's LWMS report (refer Appendix W). Further commentary on the first four options and additional potential water sources is provided below.

Integrated Water Supply Scheme - Water Corporation (Potable)

The subject site does not fall within a planned Water Corporation water reticulation service area. The Water Corporation has previously advised that they currently do not intend to undertake any formal planning to determine a source option, point of connection or main sizing for Kemerton Strategic Industrial Area.

However the Corporation has indicated that the Binningup Pipeline (from the recently completed Southern Seawater Desalination Plant to Harvey) or the Harvey Integrated Water Supply (HIWS) Scheme may be potential potable water supply sources for KSIA. With the recent completion of the second stage of the Southern Seawater Desalination Plant (SSDP), doubling capacity of the plant to 100 billion litres of water per year, supply from the Binningup Pipeline may now be a viable potable water supply option. It is unlikely that expensively produced drinking water from the Binningup Desalination Plant could be used for industrial purposes e.g. dust suppression and cooling purposes, while metropolitan Perth is on stringent water restrictions.

In order to initiate a Water Corporation Infrastructure Planning Review to determine potable water source options for the KSIA, a written request from the Developer for consideration of servicing options for the proposed development would be required.

Should a solution be found involving a Water Corporation reticulated water supply, the Water Corporation would require the developer to either prefund or fully fund all required headwork assets. Additionally a minimum of standard headworks contributions would apply to all lots created and serviced by the developer-constructed reticulated scheme.

The Water Corporation presumes that any potable supply to the KSIA would be limited to domestic and low usage industry only, with major industrial water use sourced through other means such as groundwater or reuse.

Other Potential Providers (Potable and Process)

Potential water sources from providers Aqwest and Harvey Water have also been investigated.

Aqwest have advised they could not justify such a venture without detailed analysis and business case development. They were not prepared to carry out such an analysis at this time as they considered conducting further investigations to be premature at this early development phase of the Kemerton Strategic Industrial Area.

Harvey Water is not able to provide a formal proposal for water supply to the KSIA without further information regarding expected maximum daily flows. However they have expressed a keen interest in becoming the water provider for the KSIA and have already undertaken preliminary investigations to identify possible methods of supplying water to the site based on their Harvey Dam and Wellington Dam water sources, as discussed below. Harvey Water has provided an extract from their report regarding project proposals for the Wellington Dam, which details supply options for the KSIA. A copy of the extract, entitled "Water Supply to Kemerton Industrial Park" is attached at Appendix X.

In addition to the above, initial discussions have recently been held with private water and wastewater provider, Water West, who have expressed an interest in becoming a water service provider for the KSIA. It is recommended that further discussions with Water West be held in this regard. Water West may be able to provide alternate and/or more economical potable and non-potable water supply options for the KSIA.

Harvey Dam (Non-Potable)

As outlined in Section 3.5 of this report, there is a Harvey Water DN355 pipeline connected to the Harvey system that supplies water to the Transfield Services Gas-Fired Peaking Power Station. This is a non-potable supply originating from Harvey Dam.

Harvey Water has advised the pipeline is currently underutilised and could be used as a non-potable supply to the northern area of the KSIA, depending on the requirement for and timing of any future upgrades to the power station. This supply option would be subject to discussion and agreement with Harvey Water and Transfield Services.

Waste water from Transfield's power station is currently disposed of via evaporation ponds located immediately adjacent to the plant. It may be possible to recycle this waste water for use by industries within the KSIA. Investigation of this potential source of non-potable water is recommended.

Wellington Dam (Non-Potable)

As detailed in the extract from Harvey Water's report (attached at Appendix X), Harvey Water has a number of water supply channels fed from Wellington Dam in the vicinity of the KSIA. Harvey Water has identified the channels that could potentially be utilised as non-potable water supplies for industries within the KSIA.

Water would be transferred from Wellington Dam into the Collie North Channel, then into the Cactus Channel at Benger. The Cactus Channel travels west along Marriott Road to a point near the intersection of Wellesley Road. At this location, the Cactus Channel crosses the Benger Main Drain. A check structure in the Benger drain near where the Cactus Channel intersects it would capture water in either of the watercourses (through natural events and run-off) and also water purposely released in the Cactus Channel via the Collie North Supply Channel from Wellington Dam.

Flows from these combined channels could then be used to service the KSIA via one of two methods described below.

The first method is to construct a reticulated water main from the Cactus Channel around the KSIA for future connection by individual lot owners. Given the uncertainty around timing of the development and the uptake of lots, and the difficulty in predicting future water demands, it would be very difficult to foresee design requirements for the reticulated system. As such, Harvey Water has not evaluated this option further.

The preferred method would be via construction of a pump station and suitably sized pipeline to a large holding dam (or series of dams) located centrally in the KIP. Several offtake points constructed within the dam/s would allow future lot owners to install their own pumps and infrastructure to supply water to their facility.

This type of system has the capacity to grow over time as water demands increase. Further holding ponds can be constructed in different sectors of the KSIA and the pump station would be a modular type system that could be added to as and when required. This option would also have the capacity to accept water from other sources, such as recycled water from the KWWTP.

Refer to the extract from Harvey Water's report for further details. The above proposals and potential costs for the options presented are subject to further discussion and negotiation with Harvey Water.

Harvey Water has advised the salinity of the Wellington Dam supply varies (currently 1,200 mg/L TDS approx.) and would therefore not be for potable water. The developer or respective lot owners would be responsible for the treatment of a portion of the supplied water to lower salinity levels to less than 500 mg/L TDS so that it would be suitable for potable purposes. Salinity reduction would most likely be required for process purposes, depending on each individual industry's requirements.

Reverse osmosis (RO) treatment would typically be required to reduce salinity of the water supply to within potable standards (or to a specific industry standard) and, in the short term, would best be achieved by installation of individual packaged treatment plants by each lot owner to suit their own specific requirements. It should be noted that the reverse osmosis process produces a highly saline waste stream that would require disposal, as discussed in Section 8.2 of this report.

The volume of water required for potable purposes is expected to be limited to domestic and low use industry only. Delivery of bottled drinking water to site may be a viable alternative to treatment for some industries.

At this stage, investigations suggest that servicing Kemerton via supply from Harvey Water would be a viable option. Using a pipe size of DN355 would be suitable to meet water supply demands for the initial stages of development. A larger pipe or additional pipeline would potentially be required to serve further stages of the development. The requirement for this is not foreseeable at this time.

Groundwater Abstraction (Non-Potable)

According the Local Water Management Strategy (LWMS) prepared by RPS, the total groundwater available for abstraction for the KSIA is 11 GL/Annum. Over 2 GL of this annual allocation is contained in a dispersed superficial aquifer, making extraction for industrial use difficult. Of the remainder, approximately 3 GL is considered readily accessible by industry with the balance being high in salinity and contained in a relatively deep aquifer. An application to abstract 9 GL/Annum and is currently being assessed by the Department of Water.

As noted in the LWMS, the salinity of local groundwater varies greatly across the site and treatment of a portion of the groundwater by reverse osmosis would be required to reduce salinity to potable levels. Depending on salinity levels, treatment may also be required for some process purposes.

Options for groundwater abstraction include:

- Individual bores and, where required, packaged RO treatment plants within lots constructed by each lot owner to suit their specific process and/or potable water requirements.
- Central bores and a reticulated water main system managed by a nominated service provider (Water Corporation or other provider), funded by the developer. Treatment for process and/or potable water by each individual lot owner to suit their specific requirements.

- As above, with central RO treatment plants or a central water factory (as outlined below), constructed and managed by a nominated service provider, to reduce salinity to a level suitable for general use as process water, depending on groundwater quality at each bore. Further treatment for potable requirements would be necessary by individual lot owners to suit their specific needs.

It is understood that site investigations are likely to be required to assess the availability and quality of water at the KSIA prior to the DoW providing a license to take water. Further investigations and supply/demand modelling are recommended to better assess the various options for groundwater abstraction.

Reuse of Kemerton Wastewater Treatment Plant Effluent (Non-Potable)

The KWWTP was originally located adjacent to the KSIA to facilitate future industrial reuse, however there has not been significant uptake of the KSIA by industry to enable effluent disposal by this means. Those industries currently located within the KSIA have been able to meet their water supply requirements with local groundwater, except Transfield which uses water from the Harvey Water Irrigation Scheme.

For some time, the Water Corporation has been investigating a number of alternate options for disposal of effluent from the KWWTP.

Two options previously pursued by the Water Corporation included negotiation with Verve Energy for disposal of effluent via Verve's existing Collie Power Station Kemerton ocean outfall, and discussion with Harvey Water for potential reuse of treated wastewater from the KWWTP. Neither of these effluent disposal solutions has come to fruition and it is our understanding that the Water Corporation is currently not pursuing either of these options.

As previously noted, the current method of disposal of treated effluent from the KWWTP is transfer to an existing woodlot near the plant. The Corporation recently installed de-nitrification filters at the plant to ensure nutrient application to the woodlot is sustainable into the future. The Corporation is also currently investigating purchase of land to establish additional woodlot areas within the KSIA to cater for the increasing flows from the plant as a result of rapid urban growth in the area.

The Water Corporation has previously indicated that they have a long-term interest in developing an industrial reuse scheme in the KSIA, provided that the proponent could guarantee a pre-agreed minimum daily effluent usage rate. In line with this philosophy, the Corporation is currently investigating a recycled water supply to an existing industry in Kemerton as an additional effluent disposal option.

Industrial reuse of treated effluent from the KWWTP may therefore be a viable option for future industries within the KSIA. It is noted that the treated effluent would only be suitable for use as industry process water and a separate potable water source would still be required. Preliminary discussions suggest that the supply will not be adequate to meet expected industry demand and should only be considered as a non-potable source for a defined area of the development or to supplement another water source. The Corporation has also advised that any effluent reuse scheme would most likely require full developer funding.

Expandable Water Factory (Potable and Non-Potable)

Parson Brinckerhoff's WMS report investigates the appropriate management of water within the KSIA to ensure energy resource use efficiency within the KSIA, in line with the concept of industrial ecology. PB recommends that as the estate develops, a comprehensive water factory be established within the KSIA to process multiple sources of water including borewater, seawater, industrial by-product water, sewage and WWTP effluent.

It is envisaged that the water factory would be able to supply a variety of qualities and volumes of water to users in the KSIA. Surplus effluent, treated onsite or centrally within the KSIA to an acceptable quality, could be discharged to the ocean, potentially via Verve Energy's existing Collie Power Station Ocean Outfall, or via a new dedicated ocean outfall pipeline.

The water factory is likely to become more feasible as both the volume of wastewater and industrial demand for quality source water grows. A water factory would assist any industry attraction strategy, so its early development is recommended; making allowance for expandable facilities that can adjust to rising water demand and wastewater volumes as industry uptake increases.

Summary

Based on current investigations, the most logical short-term solution for a reliable water supply for KSIA would be the Wellington Dam, via the Collie North and Cactus Channels to a pump station near the intersection of Marriott and Wellesley Roads, and a pipeline the pump station to a series of holding dams within the KSIA. Individual lot owners would be required to install the necessary infrastructure to convey water from the dam/s to their facility and treat the supplied water and/or purchasing bottled water to suit their specific process and potable water requirements. For lots adjacent to Transfield Services' Kemerton Power Plant, the existing Harvey Water DN355 pipeline may be a potential temporary non-potable water supply.

Continued collaboration and negotiation with the South West Development Commission, DoW, Water Corporation, Harvey Water, Water West and other proponents will be required to determine the most suitable option or combination of options for short term and long term water supply for the development, including the establishment of a comprehensive water factory for the sustainable management of water resources within the KSIA.

7.6 Power Supply

Western Power completed a Feasibility Study for the Kemerton Strategic Industrial Area in February 2011, and a copy of their report is attached at Appendix R. The information provided below is based on this report.

Given the dynamic nature of Western Power's network, it is recommended that an updated feasibility study be requested from Wester Power to determine if there have been any upgrades to the existing network since February 2011 and any changes to the way in which power will be supplied to the development as a result.

Existing Western Power infrastructure in the area includes the Kemerton Terminal in the north east corner of the site, the Marriott Road Substation to the south, a major 330kV transmission line running generally north south to the east of the site, major 132kV transmission lines running between the Terminal and the Substation and from the Substation east to Wellesley River then continuing in a southerly direction, several 3-phase 22kV distribution lines in Forrest Highway, Marriott Road and south of Wellesley Road and several single-phase 22kV distribution lines within the subject site. Refer to WGE's Existing Services Plans and Preliminary Power Layout Plans attached at Appendices B and K for an overview of Western Power's existing network.

Western Power's existing 330kV transmission lines are protected by registered easements in favour of Western Power as shown on the LSP. Western Power has advised that they will request easements for their existing 132kV transmission lines as a condition of the WAPC subdivision process. Preliminary advice indicates a 40m easement will be requested for the line between the Terminal and the Substation, and a 34.5m easement for the line running east from the Substation. Easements may also be requested to protect the existing 22kV distribution lines.

Western Power's feasibility study is based on an assumed nominal design capacity of 200kVA/ha over 100ha per year for ten years, giving a potential horizon load of up to 200MVA, and the assumption that each lot will require a 3+1 RMU switchgear and direct connection to main-line feeder cables.

Initially, distribution connections for newly created lots will be made to the Marriott Road Substation via existing or new feeder circuits, depending on timing and loading. As development progresses, Western Power has advised a minimum of two new zone substations and several new main-line HV distribution feeders will be required. Exact details and the timeframe for this transmission reinforcement will be dependent on the type and timing of the load uptake within the subdivision. Western Power's preliminary investigations based on the assumed ultimate load indicate that two new zone substations will be required, located in the central and northern areas of the site, with four new HV feeders needed to supply the basic electrical requirements of the development. Refer to WGE's Preliminary Power Layout Plans attached at Appendix K.

The developer will be required to provide Western Power with suitable sites for the future zone substations, each a minimum of 1.44ha with the locations to be negotiated between the developer and Western Power to best suit the power requirements of the subdivision. Preliminary investigations by Wood & Grieve Engineers indicate that ideal locations for the two Zone Substations may be at the corner of Kemerton and Wellesley Road and the corner of Kemerton and Treasure Roads, as shown on the Preliminary Power Layout Plans.

Western Power has advised that the design, supply and installation of the zone substations will potentially be undertaken by Western Power at no cost to the developer. Costs for HV feeders and HV equipment to the proposed lots must be met by the developer, however Western Power is unable to provide an estimate of these costs at this time due to the preliminary nature of the feasibility study and uncertainty of zone substation locations and cable routes.

A preliminary design and estimate of power requirements, based on the above assumptions, has been undertaken by Wood & Grieve Engineers. The cost for power supply to the KSIA development is estimated to be in the order of $22.1 Million (exclusive of zone substation costs, GST, fees and charges).

Further investigation by way of formal application to Western Power for a Design Information Package (DIP) is necessary to confirm supply to the development and to determine the exact requirements and costs of the transmission and distribution reinforcement works required to serve the proposed subdivision.

Major heavy industrial plants locating in the KSIA may choose to arrange their own sources of power. There are currently two private peaking power stations located within the KSIA – Tesla's diesel-fuelled peaking power station and Transfield's gas-fired peaking power station. These existing power stations could potentially be a source of supply to other industries within the KSIA.

7.7 Telecommunications Services

Telstra have advised that telecommunications for the first stage of development would potentially be provided via extension of services from their existing network building located on the KWWTP site in Marriott Road, which is connected to Telstra's main network in Forrest Highway via optical fibre cables in Marriott Road. At present there are some spare fibres available on this route, however it is uncertain if these would be sufficient to serve initial stages of the development and infrastructure upgrades or extensions may be required. Telstra have indicated that ADSL/Broadband would not be available to the KSIA as a whole without major equipment upgrades.

As there is little infrastructure throughout the rest of the KSIA area, the most cost effective method of providing telecommunications services would be for staging to proceed in a frontal manner south and/or north from Marriott Road as indicated on the notional preliminary staging plan attached at Appendix V. However, actual requirements for extension of telecommunications infrastructure will need to be assessed on an as-needed basis as and when development occurs.

Telstra has indicated that a capital contribution towards telecommunications infrastructure upgrades and extensions will be required to service the Kemerton Strategic Industrial Area. Further investigations by Telstra are required so that preliminary infrastructure planning and cost estimates can be progressed.

7.8 Natural Gas Supply

The Dampier to Bunbury Natural Gas Pipeline (DBNGP) is a high pressured gas pipeline system supplying gas to industry within Western Australia. A section of the pipeline, the Kemerton Lateral, traverses the KSIA and is protected by an easement of varying width referred to as the DBNGP corridor. Plans showing the location of the DBNGP main line and the Kemerton Lateral pipeline are attached at Appendix S and T. The DBNGP corridor is shown on the Existing Services Plan, attached at Appendix B.

Any future works that are planned in close proximity to or within this corridor need to be considered in terms of risk to the pipeline and if working within the DBNGP corridor, approval under Section 41 of the Dampier to Bunbury Pipeline Act 1997 is necessary. This is applied for with Infrastructure Corridors at the Department for Regional Development and Lands and with the involvement of Dampier Bunbury Pipeline (DBP), the owner and operator of the DBNBP.

There are two existing Meter Stations on the Kemerton Lateral – the Kemerton Power Station Meter Station KP 1511.9 (adjacent to and serving the existing Kemerton Power Station) and the Kemerton Meter Station KP 1518.78 (near Devlin Road, serving three existing industrial customers), as shown on the attached Kemerton Lateral Gas Pipeline Plan in Appendix T.

DBP have advised that supply to industries within the KSIA, with the exception of very high gas users, would most likely come from the Kemerton Meter Station. This would involve construction of a Pressure Reducing Station (PRS) at the Meter Station and provision of gas mains to the subdivision, designed and installed by ATCO Gas Australia (ATCO Gas). Gas mains would either be commissioned by the developer and/or by individual lot owners on an as-needs basis. In the case of very high gas users, gas is generally taken directly from DBP via individual lateral pipelines, thus bypassing ATCO Gas's distribution network. This is discussed in more detail below.

The current capacity of the Kemerton Meter Station is approximately 1,500 TJ/Annum. The three existing industrial customers currently take approximately 550 to 730 TJ/Annum from the existing Kemerton Meter Station. If the total ultimate gas load from the KSIA (ie existing load plus additional load from the proposed development, excluding DBP direct customers) exceeds the current Kemerton Meter Station capacity, then the Meter Station will require upgrading to accommodate the additional capacity. It is our understanding that the full cost of this work would be passed on to the KSIA developer.

Detailed investigations and modelling to determine likely gas demands for the subdivision, together with an engineering study by DBP, would be required to ascertain the timing and scope for such Meter Station upgrade works.

Parsons Brinckerhoff Pty Limited have estimated the total gas requirements for the KSIA based on the ultimate development scenario to be in the order of 105,000 TJ/A (refer PB's WMS Report, 2011). However, this figure includes very high gas demand industries which, as previously mentioned, would typically take gas directly from DBP via dedicated lateral lines with their own meter stations.

In the absence of modelling information, WGE have estimated notional gas demands for the different growth scenarios suggested by Aquaterra in their "Kemerton Water Study Phase 2 – Data Volume 2002" report.

Typical gas usage figures for the various types of industries expected to locate to the KSIA as per Aquaterra's report have been obtained, where possible, from ATCO Gas. These figures are set out in the table below. The various industry groups are sourced from Burns and Roe Worley (1998) as included in Aquaterra's report.

Kemerton Strategic Industrial Area

GROUP No.	INDUSTRY	TYPICAL GAS USAGE TJ/Annum	TYPICAL SUPPLIER
	Alumina Smelter	Very High	DBP
Group 1	Alumina Refinery	Very High	DBP
	Specialised Alumina Products	Very High	DBP
Group 2	Steel Mill	Very High	DBP
	Iron Briquetting	Very High	DBP
Goup 3	Chlor Alkali, Soda Chemicals, Fertiliser / Superphosphate / Chemicals, Ammonium Nitrate Emulsion, Phosphoric Acid	100-460	ATCO Gas
	Sodium Cyanide, Nitric Acid	100-460	ATCO Gas
	Ammonia, Sulphuric Acid	100-460	ATCO Gas
Group 4	Rare Earths, Gallium	100-460	ATCO Gas
	Tantalum, Lithium Metal / Chemicals	100-460	ATCO Gas
	Synthetic Rutile	100-460	ATCO Gas
Group 5	Heavy Mineral Sands Separation, Titanium Slag, Titanium Metal	100-460	ATCO Gas
	Titanium Dioxide (MICL expansion)	100-460	ATCO Gas
Group 6	Timber Mill, Timber Products / Fibreboard, Wool Processing, Agricultural Product Processing	30-100	ATCO Gas
	Pulp & Paper Mill	No information	-
Group 7	Activated Silicas, Fused Silica, Fumed Silica (Simcoa expansion), Silanes & Silicones, Silicon Carbide, High Purity Silica, Silica Sand	100-1600	ATCO Gas
Group 8	Lime, Cement/Lime	100-1600	ATCO Gas
Group 9	Air Separation	No Information	-
Group 10	Hydogen Peroxide, Kaolin Plant, Oxalic Acid, Bentonite, Xanthates / Metham Sodium, Zeolites, Zirconium Chemicals, Zirconium Metal	50-300	ATCO Gas
Group 11	Coal Power Station	500-5000	ATCO Gas/DBP
	Combined Cycle Gas Power Station	500-5000	ATCO Gas/DBP

Source: ATCO Gas, 2011 & Burns and Roe Worley (1998)

Potential gas demands based on the above information and Aquaterra's growth scenarios have been estimated and set out in the table below. It should be noted that these gas demand figures are indicative only. It is recommended that DBP or a specialist consultant be engaged to undertake a detailed engineering study of likely gas demands so that these figures can be more accurately defined.

Growth Scenario (as per Aquaterra Report)	Estimated Gas Demand (TJ per Annum)	Comments (from Aquaterra Report)
Low Growth	1,500-3,000 TJ/A	Status quo with demand dictated by the expansion of Cristal and Simcoa operation. Included also is the possibility of titanium sponge production and few small unspecified industries.
Medium Growth	1,600-3,500 TJ/A	Volume required is higher to meet the demands of a synthetic rutile plant, wool processing, iron briquetting plant and a pulp mill.
High Growth	3,000-15,000 TJ/A	High growth scenario view considering the full development of Kemerton with a wide range of industries including an aluminium smelter, power station and other industries.
Maximum	4,500-17,000 TJ/A	High growth demand plus the introduction of a "high water demand" industry.

Source: Wood & Grieve Engineers, 2011 & Aquaterra, 2011

Based on the above estimated notional gas demands, it is likely that gas demands for the KSIA could potentially exceed the capacity of the existing Kemerton Meter Station under the “Low” or “Medium” growth scenarios.

The cost of Meter Station upgrade works are difficult to estimate without an engineering study, however DBP have advised that to double the capacity of the Meter Station from the existing 1,500 TJ/Annum to approximately 3,000 TJ/Annum, based on replacing the meters with higher capacity ones only, indicative costs may be in the order of $100,000 to $150,000. If additional upgrade works are required (eg to control valves, heaters, filters etc), then costs may be in the order of $500,000 to $1,000,000. Costs would be proportionally higher should a larger increase in Meter Station capacity be required.

ATCO Gas have advised that typically heavy industry areas are not reticulated with gas mains, as any infrastructure that may be installed by a developer would not be fully utilised – some industries do not require gas and others may require more than can be provided by the installed reticulated mains. The common practice in heavy industry areas is for individual industries to arrange extension of gas mains to their site to suit their own specific requirements. Generally, gas is provided via extension or upgrading of ATCO Gas’s distribution network. However, for industries with very high gas demands such as smelters, refineries and power stations, gas is generally taken directly from DBP via a dedicated lateral pipeline, thus bypassing ATCO Gas’s distribution network, as mentioned previously. Typical gas suppliers for various industries are included in the gas usage table above.

If provision of reticulated gas mains was a developer requirement, the most cost effective solution may be to fund the installation of a reticulated medium pressure PE gas network to suit commercial / light industrial development to the Ancillary Industry Zone area only, with industries within the Strategic Industry Zone to fund the extension of larger and/or higher pressure mains to their site to suit their specific needs. Another option may be to provide a suitably sized high pressure steel gas main line from the Kemerton Meter Station along a section of Kemerton Road for industries to connect to, with those industries having higher gas requirements funding their own gas mains.

ATCO Gas have advised typical infrastructure provision in a commercial / light industrial development currently costs in the order of $40/m, based on a medium pressure PE network constructed in a common trench with water reticulation. Using this figure, the estimated cost to provide gas reticulation to the Ancillary Industry Zone is approximately $470,000. In addition to this, the capital cost contribution required for construction of a PRS at the Kemerton Meter Station to suit a medium pressure network would be in the order of $210,000. All estimated costs are exclusive of GST, fees and charges. A preliminary gas reticulation layout plan for the Ancillary Industry Zone is attached at Appendix L.

Kemerton Strategic Industrial Area

ATCO Gas are unable to advise indicative costs to provide reticulated gas mains to a heavy industrial development, or for a high pressure gas main line, without proposed gas loads for the subdivision. However, if there were several major gas users in the development, such as power generation, smelting industries etc, any gas mains would need to be constructed in high pressure steel to accommodate the high load demand. This would have significant cost implications to the development and would also result in much higher connection costs for future small to medium gas users at the KSIA.

In summary, the most logical option would be for industries that require a gas supply to negotiate directly with ATCO Gas for installation of gas mains to suit their own individual requirements, as per common practice in heavy industrial areas. It may be viable to install a medium pressure PE network to the Ancillary Industry Zone area only, however this would be dependent on gas requirements in this area, which cannot be determined at this time.

8. Conclusion

Wood & Grieve Engineers have been commissioned by Landcorp to undertake an assessment of the engineering works and civil infrastructure upgrades required to facilitate the future industrial development of Kemerton Strategic Industrial Area, based on the Structure Plan – Kemerton Strategic Industrial Area prepared by TPG, dated 11 November 2014.

A number of servicing options for the proposed development have been investigated, incorporating advice provided by respective sub-consultants and the relevant service authorities. Services and infrastructure considered in this report are summarised below:

- Geotechnical investigations (Douglas Partners) – The site is generally considered suitable for development. With minor earthworks remediation in some areas, it is likely the majority of the development should be able to achieve a site classification of 'A'. Preliminary investigations indicate a minimum of 1.5m fill above AAMGL within lots and 1.0m within road reserves may be required. It is suggested that a CBR of 12% may be used for flexible pavement design and a soil permeability of 1×10^{-4} may be suitable for stormwater design. ASS risk for the development varies with the majority of the site generally mapped as "medium to low risk". Some areas of "no known risk" occur along the western side of the Strategic Industry Zone there are a number of small "high to medium risk" areas associated with isolated pockets of wetlands across the site.

- Bulk earthworks planning (WGE) – Preliminary earthworks modelling for the site has been undertaken on a conceptual basis, based on the previous Local Structure Plan prepared by TPG, dated 18 October 2011. The resultant preliminary earthworks volumes indicate an excess of material in the order of 8,000,000m^3 (bcm) may be available at the site.

- Domestic wastewater management (RPS, PB & WGE) - Options for management of domestic wastewater include individual ATUs, gravity sewer systems with pump stations and pressure mains or vacuum sewer systems, with outfalls to either commercially sized ATUs or the KWWTP. The most economically viable short-term solution is considered to be individual ATUs for each lot, as outlined in the LWMS.

- Industrial wastewater management (RPS, PB) – The proposed short term strategy for management of hazardous and industrial liquid waste is for treatment at the lot scale to a standard where it is suitable for reuse on site or by a neighbouring industry or for disposal to a nearby existing facility. Saline wastewater may in the short term be disposed of to the ocean via private outfall pipelines, or potentially utilising the Water Corporation's proposed KWWTP outfall to Verve Energy's existing Collie Power Station Ocean Outfall. The recommended long term solution is an expandable and comprehensive water factory to process multiple sources of water (borewater, seawater, industrial by-product water, sewage and WWTP effluent) with effluent reused on site and excess effluent treated onsite to an acceptable standard prior to discharge to the ocean, potentially via Verve Energy's existing outfall.

- Transport Assessment and Roadworks Infrastructure (Transcore) – A number of upgrades and infrastructure treatments are recommended including intersection upgrades on Forrest Highway at intersections with Marriott, Treasure and Kemerton Roads; and upgrade/construction of all internal roads and Marriott Road west to Forrest Highway to 10.0m wide industrial pavements. Marriott Road (east), Treasure, Kemerton and Wellesley Roads external to the Strategic Industry Zone Core and Ancillary Industry Zone are recommended to be upgraded to 7.0m rural standard pavements.

- Stormwater drainage (RPS) – The proposed drainage strategy for the KSIA is based on maintaining the pre-development hydrological regime at the site. Design features include on-site infiltration of the 1 in 10 year ARI event via soakwells within lots and a combination of landscaped roadside conveyance swales and traditional concrete pit and pipe infrastructure within road reserves. For events greater than the 1 in 10 year ARI event, it is proposed to convey flows overland from lots and road reserves along road surfaces to various drainage areas and multiple use wetlands throughout the site, discharging where possible at pre-development rates.

- Water supply (RPS & WGE) – A number of options exist for potable and process water supplies to the KSIA including the Water Corporation IWWS, Harvey IWWS, Wellington Dam, groundwater abstraction, recycled water from KWWTP, recycled water from Cristal's titanium dioxide plant, recycled water from the Transfield power station waste water evaporation ponds, and a new seawater desalination plant constructed within the KSIA. The most logical short-term solution for a reliable supply would be the Wellington Dam via the Collie North and Cactus Channels to a pump station near the intersection of Marriott and Wellesley Roads, and a pipeline the pump station to a series of holding dams within the KSIA, with individual lot owners installing the necessary infrastructure to convey water from the dam/s to their facility and providing the necessary treatment to suit their own potable/process water needs. In the longer term, a combination of water supply options may need to be considered, including the establishment of an expandable and comprehensive water factory as outlined above.

- Power supply via Western Power (WGE) – Initially power supply to the development will come from Western Power's existing Marriott Road zone substation via existing or new feeder circuits, depending on timing and loading. As development progresses, a minimum of two new zone substations and several new main-line HV distribution feeders will be required. The developer will be required to provide suitable sites for the future zone substations, each a minimum of 1.44Ha. It is recommended that an updated Feasibility Study be undertaken by Western Power to confirm these requirements.

- Power supply via private sources (WGE) – Major heavy industrial plants locating in the KSIA may arrange their own sources of power. Two existing private peaking power stations located within the KSIA, owned by Tesla and Transfield respectively, could potentially be a source of supply to other industries.

- Telecommunications services (WGE) – Telstra has advised supply to the first stage of development will potentially be provided via extension of services from an existing network building in Marriott Road. Major infrastructure upgrades and extensions may be required to service the KSIA, potentially requiring capital contribution from the developer.

- Natural gas supply (WGE) – The existing Dampier to Bunbury Natural Gas Pipeline (DBNGP) Kemerton Lateral traverses the site and is owned and operated by DBP. Supply to the development would most likely come from the existing Kemerton Meter Station located in Devlin Road via a Pressure Reducing Station and reticulated gas mains designed and installed by ATCO Gas and funded by the developer or individual industries, depending on demand. In the case of high gas users, gas may be taken directly from DBP via individual lateral pipelines. It is likely that the existing capacity of the Kemerton Meter Station may be exceeded as development of the KSIA progresses, requiring the meter station to be upgraded in the future to suit.

Railway infrastructure has been excluded from investigations. Preliminary railway infrastructure planning and design will be addressed by a specialist consultant.

Further detailed investigations, together with discussions and negotiations with the relevant authorities is required to progress infrastructure planning for the development and to better define estimates of development costs. However, based on preliminary civil services investigations undertaken by WGE and the respective sub-consultants, the necessary civil infrastructure upgrades and extensions required to develop the Kemerton Strategic Industrial Area can be provided. The proposed development is capable of proceeding in accordance with the current Structure Plan.

Appendix A

Structure Plan – Kemerton Strategic Industrial Area (TPG, dated 11 November 2014)

Sand Quarry

Kemerton Terminal

Kemerton Power Station

KEMERTON ROAD

TREASURE ROAD

OLD COAST ROAD

ROSAMEL RD

WELLINGTON ROAD

WELLESLEY ROAD

DEVLIN ROAD

MARRIOTT ROAD

BUNBURY HIGHWAY

30m RESERVE

35m RESERVE

95m WIDE SERVICE CORRIDOR

50m RESERVE

20m RESERVE

10m PIPELINE

SU

W.W.T.P

Rail to connect with Southwest main line and Bunbury Port

LEGEND

- Kemerton Strategic Industrial Area Structure Plan Boundary
- Existing lot cadastre
- Conceptual local road and lot layout
- Indicative railway
- EPP 1992 SCP Wetlands
- Conservation/Resource Enhancement Wetlands
- Wetland buffer
- Substation
- Primary Regional Road
- Regional Open Space
- Public Purpose
- Kemerton Strategic Industry Zone
- Kemerton Ancillary Industry Zone
- Kemerton Industry Buffer (Special Control Area No. 2)

Plan 1

Structure Plan

Kemerton Strategic Industrial Area

Date: 11 November 2014

Scale: 1:35,000 @ A3

Project Manager: MR

Checked: MR

Drawn: LC

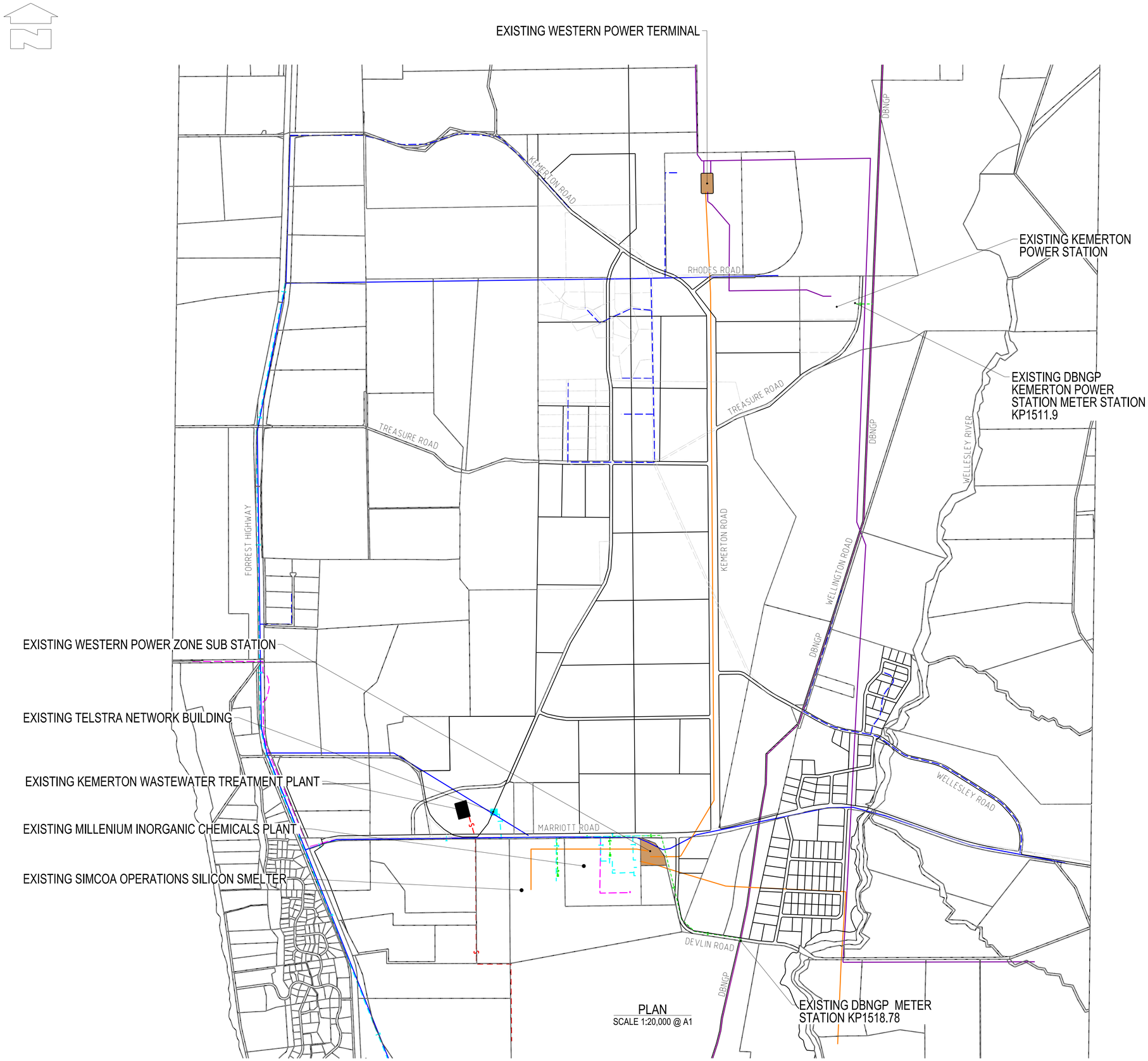
Drawing No. 710-065 ST1A 2014-11-11.dgn

0 1500m

TOWN PLANNING
URBAN DESIGN AND HERITAGE

Appendix B

Existing Services Plan (Wood & Grieve Engineers)



PLAN
SCALE 1:20,000 @ A1

NOTES:

1. THE EXTENT AND LOCATION OF EXISTING SERVICES SHOWN ON THE PLANS ARE INDICATIVE ONLY. DETAILS AND EXACT LOCATIONS OF EXISTING SERVICES SHOULD BE OBTAINED FROM THE RESPECTIVE SERVICE AUTHORITIES.

LEGEND:

- EXISTING GRAVITY SEWER MAINS
- EXISTING ATCO GAS MAINS
- EXISTING DAMPIER TO BUNBURY NATURAL GAS PIPELINE (DBNGP)
- EXISTING DBNGP CORRIDOR
- EXISTING MIC DN300 SALINE OUTFALL PIPELINE
- EXISTING TELSTRA SERVICES
- EXISTING SINGLE PHASE POWER LINES
- EXISTING 22kV DISTRIBUTION POWER LINES
- EXISTING 132kV TRANSMISSION POWER LINES
- EXISTING 330kV TRANSMISSION POWER LINES

REV.	DESCRIPTION	DRAWN	VER	APPROVED
C	PROJECT NAME AMENDED	NJHE		
B	CADASTRAL UPDATED	NJHE		
A	ORIGINAL ISSUE	GAB		

CELEBRATING 50 YEARS
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GOLD COAST
ALBANY
BUSSELTON
SHENZHEN

CLIENT:
LANDCORP

PROJECT:
KEMERTON STRATEGIC INDUSTRIAL AREA - STRUCTURE PLANNING

TITLE:
EXISTING SERVICES PLAN

PRELIMINARY

SECTION: CIVIL SERVICES	VERIFIED :	SCALE : A1	
DESIGNED : GAB	APPROVED FOR TENDER:	DATUM : A.H.D.	
DRAWN : GAB	APPROVED FOR CONSTRUCTION :	WAPC : -	

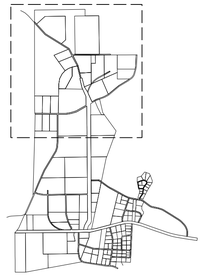
PROJECT No.	DRAWING No.	REVISION
22726-PER-C	ES1	C

P:\22726\CIVIL DRAWINGS\SKETCHES\140722 SKETCHES NEW REPORT\C PLAN EXISTING SERVICES.DGN

A1 @ 1:20,000
A3 @ 1:40,000

Appendix C

Preliminary Earthworks Design Plans (Wood & Grieve Engineers)



LOCALITY PLAN
SCALE 1:100,000

PLAN
SCALE 1:10,000 @ A1

NOTE:

BUILDING ENVELOPES, LOT LAYOUTS AND ROAD CONFIGURATIONS ARE INDICATIVE ONLY. EARTHWORKS PLANNING HAS BEEN UNDERTAKEN AS A DESKTOP CONCEPT BASIS ONLY AND IS SUBJECT TO DETAILED DESIGN AND FORMAL APPROVALS. ACTUAL DESIGN LEVELS MAY VARY CONSIDERABLY TO THOSE SHOWN.

NOTES

GENERAL

1. THE EXISTING CONTOUR INFORMATION HAS BEEN TAKEN FROM LIDAR INFORMATION SOURCED BY MCMULLEN NOLAN AND PARTNERS.
2. DESIGN AREAS MAY EXCLUDE SOME PARTS OF THE KEMERTON INDUSTRIAL PARK NOT SUBJECT TO THIS EXERCISE.

ASSUMPTIONS:

THE PRELIMINARY EARTHWORKS PLANNING HAS BEEN COMPLETED, BASED ON THE FOLLOWING ASSUMED PARAMETERS:

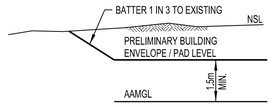
- BUILDING PAD AREAS HAVE BEEN BASED ON A FLAT LEVEL.
- MINIMUM DESIGN LEVELS IN BUILDING PAD AREAS HAVE BEEN TAKEN AS 1.5m ABOVE ANNUAL AVERAGE MAXIMUM GROUNDWATER LEVELS (AAMGL). SOME BUILDING AREAS ARE BASED ON ROAD LEVEL AND/OR TOPOGRAPHY RELATED INTERFACING REQUIREMENTS.
- MINIMUM LEVELS FOR ROADWORKS ABOVE AAMGL ARE AS 1.0m, WITH FLOOD ROUTING OF ROADS TO PROPOSED BASIN AREAS WHERE APPLICABLE.
- ROAD LEVELS TIE IN AT ESTATE BOUNDARIES FOR INTERFACING PURPOSES.
- NO ASSESSMENT OF ROADWORK LEVELS EXTERNAL TO THE CORE WAS UNDERTAKEN.
- MARRIOTT ROAD EXISTING ROAD LEVELS HAVE BEEN RETAINED FOR THE EXTENT OF THE DEVELOPMENT.
- NO CONSIDERATION WAS GIVEN TO RAILWAY LAYOUT OR DESIGN.
- NO ASSESSMENT OF RETAINING WALL REQUIREMENTS WAS UNDERTAKEN.
- NO CONSIDERATION WAS GIVEN TO THE EXISTING POWER POLE LEVELS IN KEMERTON ROAD (CENTRAL MAJOR ROAD RUNNING NORTH /SOUTH), AS RELATED TO FUTURE DESIGN LEVELS.
- NO ASSESSMENT OF POTENTIAL GEOTECHNICAL REMEDIATION WAS UNDERTAKEN AS A PART OF THE EXERCISE.
- GRAVITY DEPENDANT CIVIL INFRASTRUCTURE WAS NOT CONSIDERED AS A PART OF THIS EXERCISE. THIS WILL NEED TO BE INCORPORATED AT DETAILED DESIGN STAGE.

EXISTING EXTRACTION LICENCES:

- EXISTING EXTRACTION LICENCES HAVE NOT BEEN INCLUDED AS A PART OF THE BASE INFORMATION. THIS WILL NEED TO BE INCORPORATED IN A MORE DETAILED EXERCISE.

LEGEND

- DESIGN CONTOURS
- 10 — EXISTING CONTOURS
- 15.80 — PRELIMINARY BUILDING ENVELOPE / PAD LEVEL
- 10.0 — AAMGL LEVELS (PROVIDED BY RPS)
- PROPOSED ROAD
- EXISTING ROAD
- FUTURE PROPOSED DRAINAGE
- BATTER LINE
- BUILDING ENVELOPES
- EARTHWORKS PLANNING BOUNDARY
- KEMERTON INDUSTRIAL PARK BOUNDARY
- 26 — EXISTING LOT NUMBERS



TYPICAL BUILDING ENVELOPE LOT / PAD LEVEL DETAIL
SCALE: INDICATIVE

REV.	DESCRIPTION	DRAWN	VER	APPROVED
A	ORIGINAL ISSUE	GAB		

CELEBRATING 50 YEARS
WOOD & GRIEVE ENGINEERS

Wood & Grieve Engineers Ltd
A.C.N. 137 999 609
Level 3, Hyatt Centre
3 Plain Street, East Perth
Western Australia 6004
Phone: +61 8 6222 7000
Fax: +61 8 6222 7100
Email wge@wge.com.au
Web www.wge.com.au

PERTH
MELBOURNE
SYDNEY
BRISBANE
GOLD COAST
ALBANY
BUSSELTON
SHENZHEN

CLIENT:
LANDCORP

PROJECT:
KEMERTON INDUSTRIAL PARK - STRUCTURE PLANNING

TITLE:
PRELIMINARY EARTHWORKS PLANNING 1 OF 2

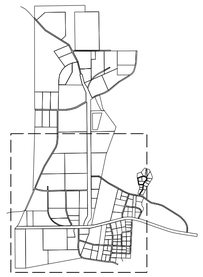
PRELIMINARY

SECTION: CIVIL SERVICES	VERIFIED :	N/A	9/08/2011	SCALE : A1 @ 1:10000
DESIGNED : AJH	APPROVED FOR TENDER:	N/A	9/08/2011	DATUM : A.H.D.
DRAWN : GAB	APPROVED FOR CONSTRUCTION :	N/A	9/08/2011	WAPC : -

PROJECT No.	DRAWING No.	REVISION
22726-PER-C	E1	A

L:\TECH\22700\26\PEP\C PLAN EARTHWORKS.DGN

A1 @ 1:10000



LOCALITY PLAN
SCALE 1:100,000

PLAN
SCALE 1:10,000 @ A1

NOTES

GENERAL

1. THE EXISTING CONTOUR INFORMATION HAS BEEN TAKEN FROM LIDAR INFORMATION SOURCED BY MCMULLEN NOLAN AND PARTNERS.
2. DESIGN AREAS MAY EXCLUDE SOME PARTS OF THE KEMERTON INDUSTRIAL PARK NOT SUBJECT TO THIS EXERCISE.

ASSUMPTIONS:

THE PRELIMINARY EARTHWORKS PLANNING HAS BEEN COMPLETED, BASED ON THE FOLLOWING ASSUMED PARAMETERS:

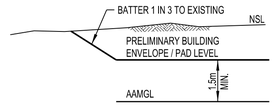
- BUILDING PAD AREAS HAVE BEEN BASED ON A FLAT LEVEL.
- MINIMUM DESIGN LEVELS IN BUILDING PAD AREAS HAVE BEEN TAKEN AS 1.5m ABOVE ANNUAL AVERAGE MAXIMUM GROUNDWATER LEVELS (AAMGL). SOME BUILDING AREAS ARE BASED ON ROAD LEVEL AND/OR TOPOGRAPHY RELATED INTERFACING REQUIREMENTS.
- MINIMUM LEVELS FOR ROADWORKS ABOVE AAMGL ARE AS 1.0m, WITH FLOOD ROUTING OF ROADS TO PROPOSED BASIN AREAS WHERE APPLICABLE.
- ROAD LEVELS TIE IN AT ESTATE BOUNDARIES FOR INTERFACING PURPOSES.
- NO ASSESSMENT OF ROADWORK LEVELS EXTERNAL TO THE CORE WAS UNDERTAKEN.
- MARRIOT ROAD EXISTING ROAD LEVELS HAVE BEEN RETAINED FOR THE EXTENT OF THE DEVELOPMENT.
- NO ASSESSMENT OF RETAINING WALL REQUIREMENTS WAS UNDERTAKEN.
- NO CONSIDERATION WAS GIVEN TO RAILWAY LAYOUT OR DESIGN.
- NO CONSIDERATION WAS GIVEN TO THE EXISTING POWER POLE LEVELS IN KEMERTON ROAD (CENTRAL MAJOR ROAD RUNNING NORTH /SOUTH), AS RELATED TO FUTURE DESIGN LEVELS.
- NO ASSESSMENT OF POTENTIAL GEOTECHNICAL REMEDIATION WAS UNDERTAKEN AS A PART OF THE EXERCISE.
- GRAVITY DEPENDANT CIVIL INFRASTRUCTURE WAS NOT CONSIDERED AS A PART OF THIS EXERCISE. THIS WILL NEED TO BE INCORPORATED AT DETAILED DESIGN STAGE.

EXISTING EXTRACTION LICENCES:

- EXISTING EXTRACTION LICENCES HAVE NOT BEEN INCLUDED AS A PART OF THE BASE INFORMATION. THIS WILL NEED TO BE INCORPORATED IN A MORE DETAILED EXERCISE.

LEGEND

- DESIGN CONTOURS
- EXISTING CONTOURS
- 15.80 — PRELIMINARY BUILDING ENVELOPE / PAD LEVEL
- 10.0 — AAMGL LEVELS (PROVIDED BY RPS)
- PROPOSED ROAD
- EXISTING ROAD
- FUTURE PROPOSED DRAINAGE
- BATTER LINE
- BUILDING ENVELOPES
- EARTHWORKS PLANNING BOUNDARY
- KEMERTON INDUSTRIAL PARK BOUNDARY
- 26 — EXISTING LOT NUMBERS



TYPICAL BUILDING ENVELOPE LOT / PAD LEVEL DETAIL
SCALE: INDICATIVE

NOTE:

BUILDING ENVELOPES, LOT LAYOUTS AND ROAD CONFIGURATIONS ARE INDICATIVE ONLY. EARTHWORKS PLANNING HAS BEEN UNDERTAKEN AS A DESKTOP CONCEPT BASIS ONLY AND IS SUBJECT TO DETAILED DESIGN AND FORMAL APPROVALS. ACTUAL DESIGN LEVELS MAY VARY CONSIDERABLY TO THOSE SHOWN.

REV.	DESCRIPTION	DRAWN	VER	APPROVED
A	ORIGINAL ISSUE	GAB		

CELEBRATING 50 YEARS
WOOD & GRIEVE ENGINEERS

Wood & Grieve Engineers Ltd
A.C.N. 137 959 609
Level 3, Hyatt Centre
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Phone: +61 8 6222 7000
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Web www.wge.com.au

PERTH
MELBOURNE
SYDNEY
BRISBANE
GOLD COAST
ALBANY
BUSSELTON
SHENZHEN

CLIENT:
LANDCORP

PROJECT:
KEMERTON INDUSTRIAL PARK - STRUCTURE PLANNING

TITLE:
PRELIMINARY EARTHWORKS PLANNING 2 OF 2

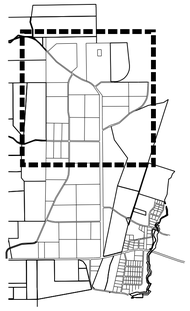
PRELIMINARY

SECTION: CIVIL SERVICES	VERIFIED : N/A	9/08/2011	SCALE : A1 @ 1:10000
DESIGNED : AJH	APPROVED FOR TENDER: N/A	9/08/2011	DATUM : A.H.D.
DRAWN : GAB	APPROVED FOR CONSTRUCTION : N/A	9/08/2011	WAPC : -

PROJECT No.	DRAWING No.	REVISION
22726-PER-C	E2	A

L:\TECH\22700\26\PEP\C PLAN EARTHWORKS.DGN

A1 @ 1:10000
A3 @ 1:20000



LOCALITY PLAN
SCALE 1:100,000

PLAN
SCALE 1:10,000 @ A1

NOTES

GENERAL

1. THE EXISTING CONTOUR INFORMATION HAS BEEN TAKEN FROM LIDAR INFORMATION SOURCED BY MCMULLEN NOLAN AND PARTNERS.
2. DESIGN AREAS MAY EXCLUDE SOME PARTS OF THE KEMERTON STRATEGIC INDUSTRIAL AREA NOT SUBJECT TO THIS EXERCISE.

ASSUMPTIONS:

THE PRELIMINARY EARTHWORKS PLANNING HAS BEEN COMPLETED, BASED ON THE FOLLOWING ASSUMED PARAMETERS:

- BUILDING PAD AREAS HAVE BEEN BASED ON A FLAT LEVEL.
- MINIMUM DESIGN LEVELS IN BUILDING PAD AREAS HAVE BEEN TAKEN AS 1.5m ABOVE ANNUAL AVERAGE MAXIMUM GROUNDWATER LEVELS (AAMGL). SOME BUILDING AREAS ARE BASED ON ROAD LEVEL AND/OR TOPOGRAPHY RELATED INTERFACING REQUIREMENTS.
- MINIMUM LEVELS FOR ROADWORKS ABOVE AAMGL ARE AS 1.0m, WITH FLOOD ROUTING OF ROADS TO PROPOSED BASIN AREAS WHERE APPLICABLE.
- ROAD LEVELS TIE IN AT ESTATE BOUNDARIES FOR INTERFACING PURPOSES.
- NO ASSESSMENT OF ROADWORK LEVELS EXTERNAL TO THE CORE WAS UNDERTAKEN.
- MARRIOTT ROAD EXISTING ROAD LEVELS HAVE BEEN RETAINED FOR THE EXTENT OF THE DEVELOPMENT.
- NO CONSIDERATION WAS GIVEN TO RAILWAY LAYOUT OR DESIGN.
- NO ASSESSMENT OF RETAINING WALL REQUIREMENTS WAS UNDERTAKEN.
- NO CONSIDERATION WAS GIVEN TO THE EXISTING POWER POLE LEVELS IN KEMERTON ROAD (CENTRAL MAJOR ROAD RUNNING NORTH /SOUTH), AS RELATED TO FUTURE DESIGN LEVELS.
- NO ASSESSMENT OF POTENTIAL GEOTECHNICAL REMEDIATION WAS UNDERTAKEN AS A PART OF THE EXERCISE.
- GRAVITY DEPENDANT CIVIL INFRASTRUCTURE WAS NOT CONSIDERED AS A PART OF THIS EXERCISE. THIS WILL NEED TO BE INCORPORATED AT DETAILED DESIGN STAGE.

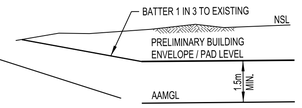
EXISTING EXTRACTION LICENCES:

- EXISTING EXTRACTION LICENCES HAVE NOT BEEN INCLUDED AS A PART OF THE BASE INFORMATION. THIS WILL NEED TO BE INCORPORATED IN A MORE DETAILED EXERCISE.

LEGEND

- DESIGN CONTOURS
- EXISTING CONTOURS
- PRELIMINARY BUILDING ENVELOPE / PAD LEVEL
- AAMGL LEVELS (PROVIDED BY RPS)
- PROPOSED ROAD
- EXISTING ROAD
- FUTURE PROPOSED DRAINAGE (INDICATIVE)
- BATTER LINE
- BUILDING ENVELOPES
- EARTHWORKS PLANNING BOUNDARY
- EXISTING LOT NUMBERS
- NEW BUILDING ENVELOPS
- WETLAND BUFFER

TYPICAL BUILDING ENVELOPE LOT / PAD LEVEL DETAIL 1
SCALE: INDICATIVE



TYPICAL BUILDING ENVELOPE LOT / PAD LEVEL DETAIL 2
SCALE: INDICATIVE

NOTE:

BUILDING ENVELOPES, LOT LAYOUTS AND ROAD CONFIGURATIONS ARE INDICATIVE ONLY. EARTHWORKS PLANNING HAS BEEN UNDERTAKEN AS A DESKTOP CONCEPT BASIS ONLY AND IS SUBJECT TO DETAILED DESIGN AND FORMAL APPROVALS. ACTUAL DESIGN LEVELS MAY VARY CONSIDERABLY TO THOSE SHOWN.

REV.	DESCRIPTION	DRAWN	VER	APPROVED
C	PROJECT NAME AMENDED	NJHE		
B	CADASTRAL AMENDED	NJHE		
A	ORIGINAL ISSUE	GAB		

WOOD & GRIEVE ENGINEERS

Wood & Grieve Engineers Ltd
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Fax: +61 8 6222 7100
Email wge@wge.com.au
Web www.wge.com.au

PERTH
MELBOURNE
SYDNEY
BRISBANE
GOLD COAST
ALBANY
BUSSELTON
SHENZHEN
DARWIN

CLIENT:
LANDCORP

PROJECT:
KEMERTON STRATEGIC INDUSTRIAL AREA - STRUCTURE PLANNING

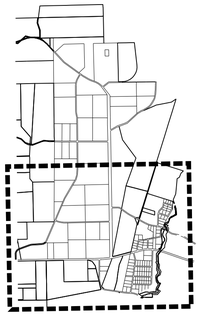
TITLE:
PRELIMINARY EARTHWORKS PLANNING 1 OF 2

PRELIMINARY

SECTION: CIVIL SERVICES	VERIFIED : N/A	9/08/2011	SCALE : A1	
DESIGNED : AJH	APPROVED FOR TENDER: N/A	9/08/2011	DATUM : A.H.D.	
DRAWN : GAB	APPROVED FOR CONSTRUCTION : N/A	9/08/2011	WAPC : -	

PROJECT No.	DRAWING No.	REVISION
22726-PER-C	E1	C

P:\22726-PEP\CIVIL DRAWINGS\C PLAN EARTHWORKS.DGN



LOCALITY PLAN
SCALE 1:100,000

PLAN
SCALE 1:10,000 @ A1

NOTES

GENERAL

1. THE EXISTING CONTOUR INFORMATION HAS BEEN TAKEN FROM LIDAR INFORMATION SOURCED BY MCMULLEN NOLAN AND PARTNERS.
2. DESIGN AREAS MAY EXCLUDE SOME PARTS OF THE KEMERTON STRATEGIC INDUSTRIAL AREA NOT SUBJECT TO THIS EXERCISE.

ASSUMPTIONS:

THE PRELIMINARY EARTHWORKS PLANNING HAS BEEN COMPLETED, BASED ON THE FOLLOWING ASSUMED PARAMETERS:

- BUILDING PAD AREAS HAVE BEEN BASED ON A FLAT LEVEL.
- MINIMUM DESIGN LEVELS IN BUILDING PAD AREAS HAVE BEEN TAKEN AS 1.5m ABOVE ANNUAL AVERAGE MAXIMUM GROUNDWATER LEVELS (AAMGL). SOME BUILDING AREAS ARE BASED ON ROAD LEVEL AND/OR TOPOGRAPHY RELATED INTERFACING REQUIREMENTS.
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- ROAD LEVELS TIE IN AT ESTATE BOUNDARIES FOR INTERFACING PURPOSES.
- NO ASSESSMENT OF ROADWORK LEVELS EXTERNAL TO THE CORE WAS UNDERTAKEN.
- MARRIOT ROAD EXISTING ROAD LEVELS HAVE BEEN RETAINED FOR THE EXTENT OF THE DEVELOPMENT.
- NO ASSESSMENT OF RETAINING WALL REQUIREMENTS WAS UNDERTAKEN.
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- NO CONSIDERATION WAS GIVEN TO THE EXISTING POWER POLE LEVELS IN KEMERTON ROAD (CENTRAL MAJOR ROAD RUNNING NORTH /SOUTH), AS RELATED TO FUTURE DESIGN LEVELS.
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EXISTING EXTRACTION LICENCES:

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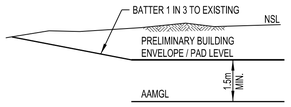
LEGEND

- DESIGN CONTOURS
- EXISTING CONTOURS
- 15.80 — PRELIMINARY BUILDING ENVELOPE / PAD LEVEL
- 10.0 — AAMGL LEVELS (PROVIDED BY RPS)
- PROPOSED ROAD
- EXISTING ROAD
- FUTURE PROPOSED DRAINAGE (INDICATIVE)
- BATTER LINE
- BUILDING ENVELOPES
- EARTHWORKS PLANNING BOUNDARY
- 26 — EXISTING LOT NUMBERS
- NEW BUILDING ENVELOPS

NOTE:

BUILDING ENVELOPES, LOT LAYOUTS AND ROAD CONFIGURATIONS ARE INDICATIVE ONLY. EARTHWORKS PLANNING HAS BEEN UNDERTAKEN AS A DESKTOP CONCEPT BASIS ONLY AND IS SUBJECT TO DETAILED DESIGN AND FORMAL APPROVALS. ACTUAL DESIGN LEVELS MAY VARY CONSIDERABLY TO THOSE SHOWN.

TYPICAL BUILDING ENVELOPE LOT / PAD LEVEL DETAIL 1
SCALE: INDICATIVE



TYPICAL BUILDING ENVELOPE LOT / PAD LEVEL DETAIL 2
SCALE: INDICATIVE

REV.	DESCRIPTION	DRAWN	VER	APPROVED
C	PROJECT NAME AMENDED	NJHE		
B	CADASTRAL AMENDED	NJHE		
A	ORIGINAL ISSUE	GAB		

WOOD & GRIEVE ENGINEERS

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PERTH
MELBOURNE
SYDNEY
BRISBANE
GOLD COAST
ALBANY
BUSSELTON
SHENZHEN
DARWIN

CLIENT:
LANDCORP

PROJECT:
KEMERTON STRATEGIC INDUSTRIAL AREA - STRUCTURE PLANNING

TITLE:
PRELIMINARY EARTHWORKS PLANNING 2 OF 2

PRELIMINARY

SECTION: CIVIL SERVICES	VERIFIED : N/A	9/08/2011	SCALE : A1
DESIGNED : AJH	APPROVED FOR TENDER: N/A	9/08/2011	DATUM : A.H.D.
DRAWN : GAB	APPROVED FOR CONSTRUCTION : N/A	9/08/2011	WAPC : -

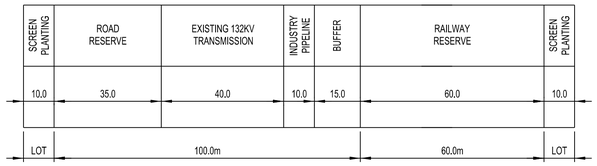
PROJECT No.	DRAWING No.	REVISION
22726-PER-C	E2	C

P:\22726-PEP\CIVIL DRAWINGS\C PLAN EARTHWORKS.DGN

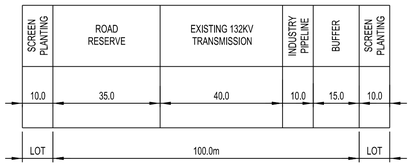
Appendix D

Preliminary Services Corridor Cross Sections (Wood & Grieve Engineers)

SERVICE CORRIDOR CROSS-SECTIONS



SECTION A



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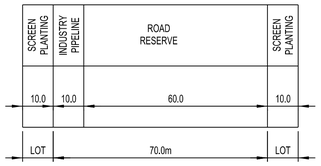

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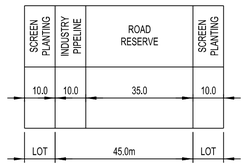
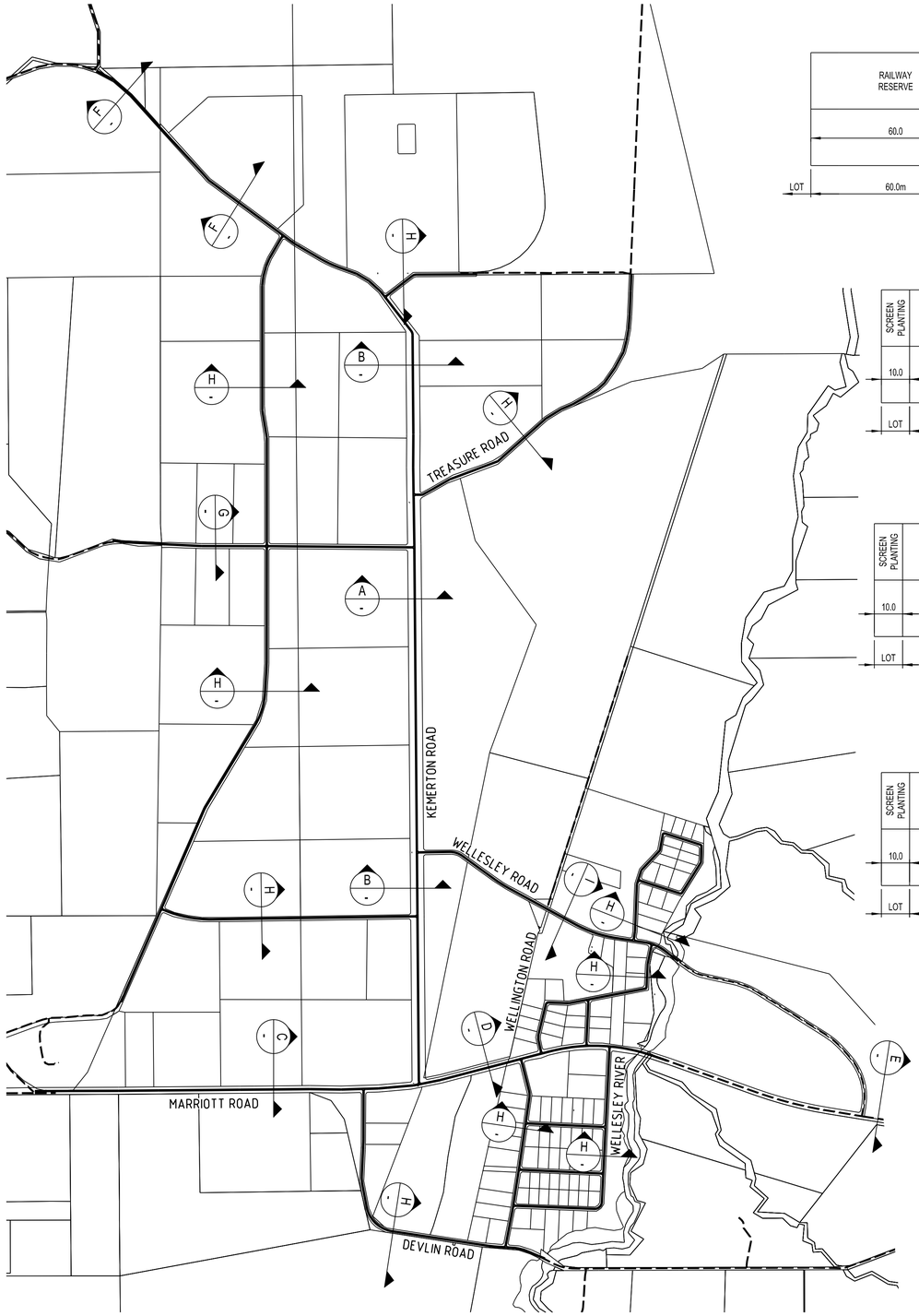
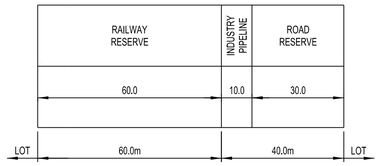


SECTION D

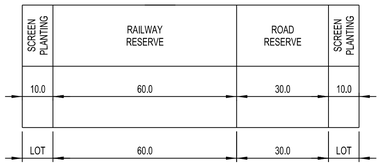


PLAN
SCALE 1:20,000 @ A1

SERVICE CORRIDOR CROSS-SECTIONS (CONT.)



SECTION E



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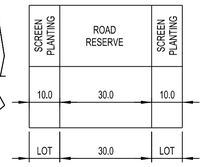
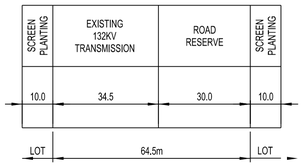
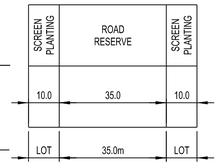


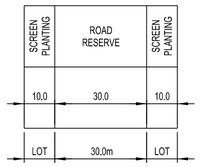
SECTION F



SECTION J



SECTION G



SECTION H

REV.	DESCRIPTION	DRAWN	VER	APPROVED
C	PROJECT NAME AMENDED	NJHE		
B	CADASTRAL REVISED, ROAD CROSS SECTIONS UPDATED TO SUIT	NJHE		
A	ORIGINAL ISSUE	GAB		

CELEBRATING 50 YEARS
WOOD & GRIEVE ENGINEERS

Wood & Grieve Engineers Ltd
A.C.N. 137 069 609
Level 3, Hyatt Centre
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Web www.wge.com.au

PERTH
MELBOURNE
SYDNEY
BRISBANE
GOLD COAST
ALBANY
BUSSELTON
SHENZHEN

CLIENT:
LANDCORP

PROJECT:
KEMERTON STRATEGIC INDUSTRIAL AREA - STRUCTURE PLANNING

TITLE:
PRELIMINARY SERVICE CORRIDOR CROSS SECTIONS

PRELIMINARY

SECTION: CIVIL SERVICES	VERIFIED :	SCALE : A1
DESIGNED : BC	APPROVED FOR TENDER:	DATUM : A.H.D.
DRAWN : GAB	APPROVED FOR CONSTRUCTION :	WAPC : -

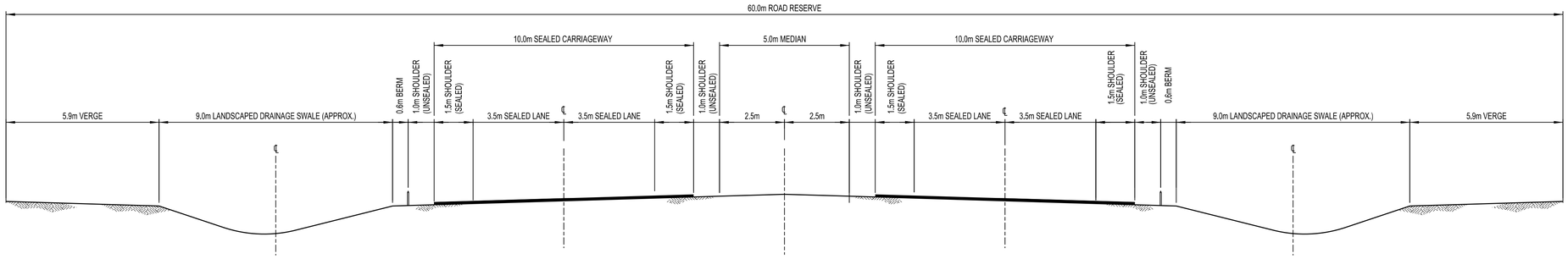
PROJECT No.	DRAWING No.	REVISION
22726-PER-C	XS1	C

P:\22726\Civil Drawings\Sketches\140722 Sketches new report\c del service corridor xs.dgn

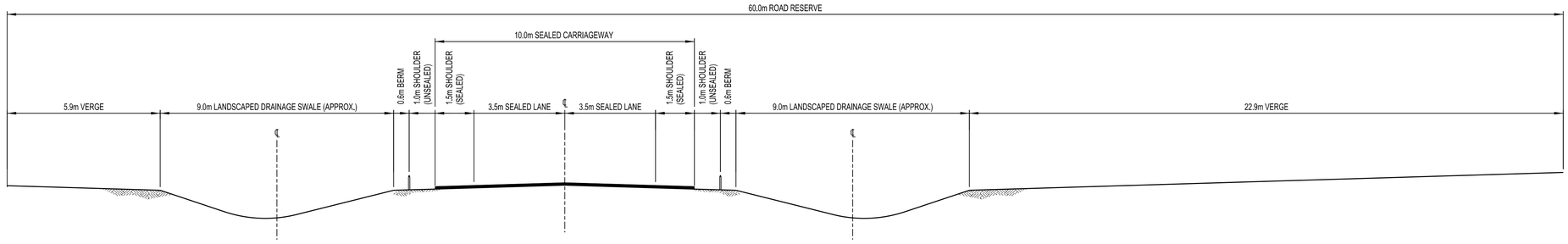
A1 @ 1:20,000
A3 @ 1:40,000

Appendix E

Preliminary Road Reserve Cross-Sections (Wood & Grieve Engineers)



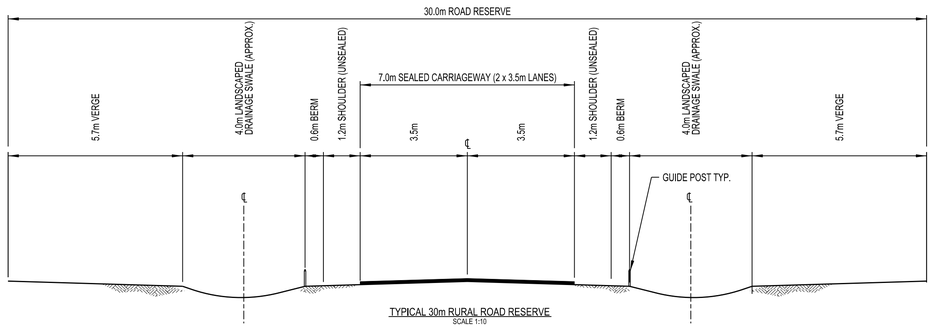
TYPICAL 60m INDUSTRIAL ROAD RESERVE
ULTIMATE DUAL CARRIAGEWAY LAYOUT
SCALE 1:10



TYPICAL 60m INDUSTRIAL ROAD RESERVE
INTERIM SINGLE CARRIAGEWAY LAYOUT
SCALE 1:10

TYPICAL 35m INDUSTRIAL ROAD RESERVE
SCALE 1:10

TYPICAL 30m INDUSTRIAL ROAD RESERVE
SCALE 1:10



TYPICAL 30m RURAL ROAD RESERVE
SCALE 1:10

REV.	DESCRIPTION	DRAWN	VER	APPROVED
C	PROJECT NAME AMENDED	NJHE		
B	CROSS SECTIONS AMENDED	NJHE		
A	ORIGINAL ISSUE	GAB		

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CLIENT:
LANDCORP

PROJECT:
KEMERTON STRATEGIC INDUSTRIAL AREA - STRUCTURE PLANNING

TITLE:
PRELIMINARY ROAD RESERVE CROSS SECTIONS

PRELIMINARY

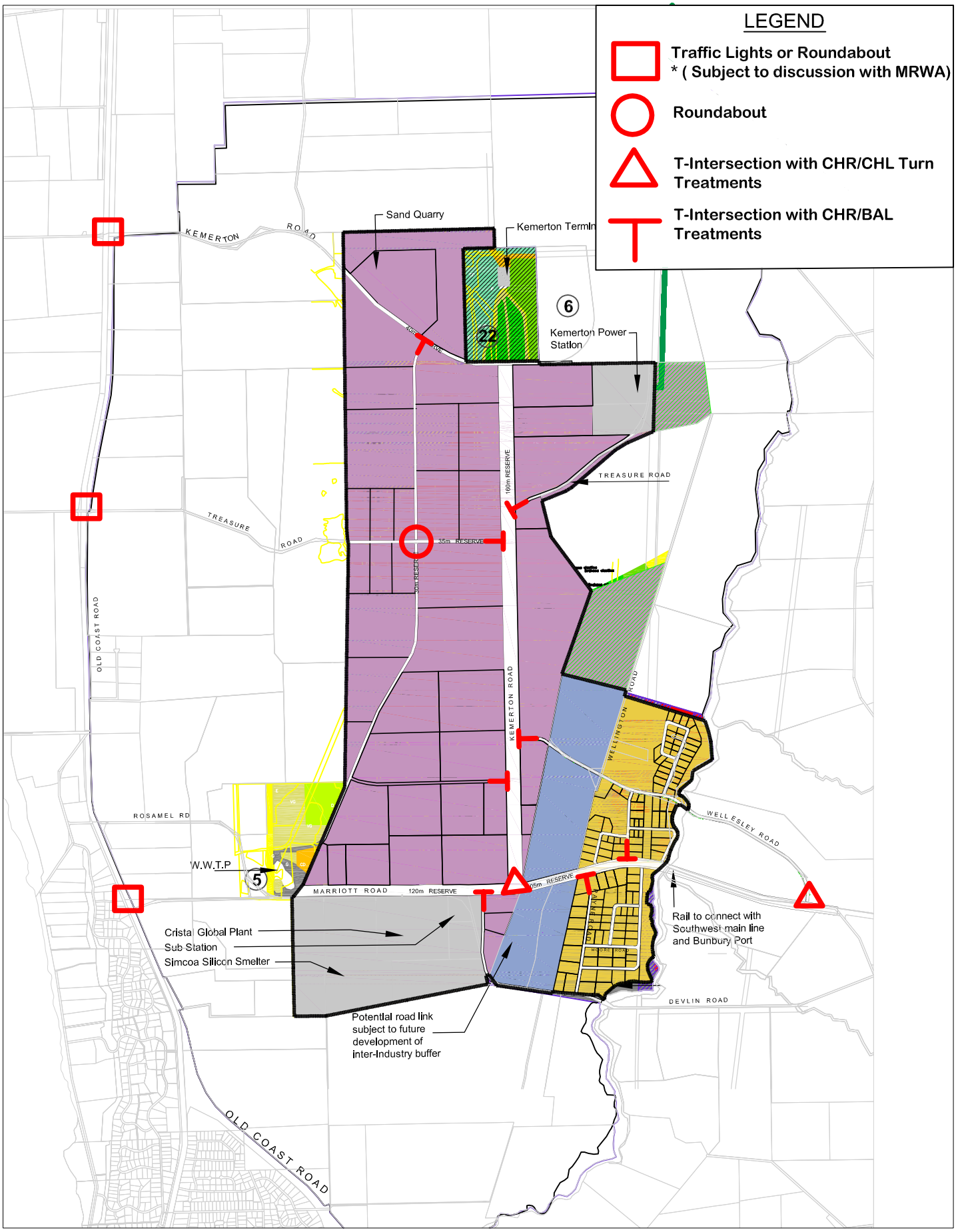
SECTION: CIVIL SERVICES	VERIFIED :	SCALE : A1
DESIGNED : BC	APPROVED FOR TENDER:	DATUM : A.H.D.
DRAWN : GAB	APPROVED FOR CONSTRUCTION :	WAPC : -

PROJECT No.	DRAWING No.	REVISION
22726-PER-C	XS2	C

P:\22726\Civil Drawings\Sketches\140722 Sketches new report\c det road xs.dgn

Appendix F

Intersection Treatments Plan (Transcore)



Kemerton Industrial Park

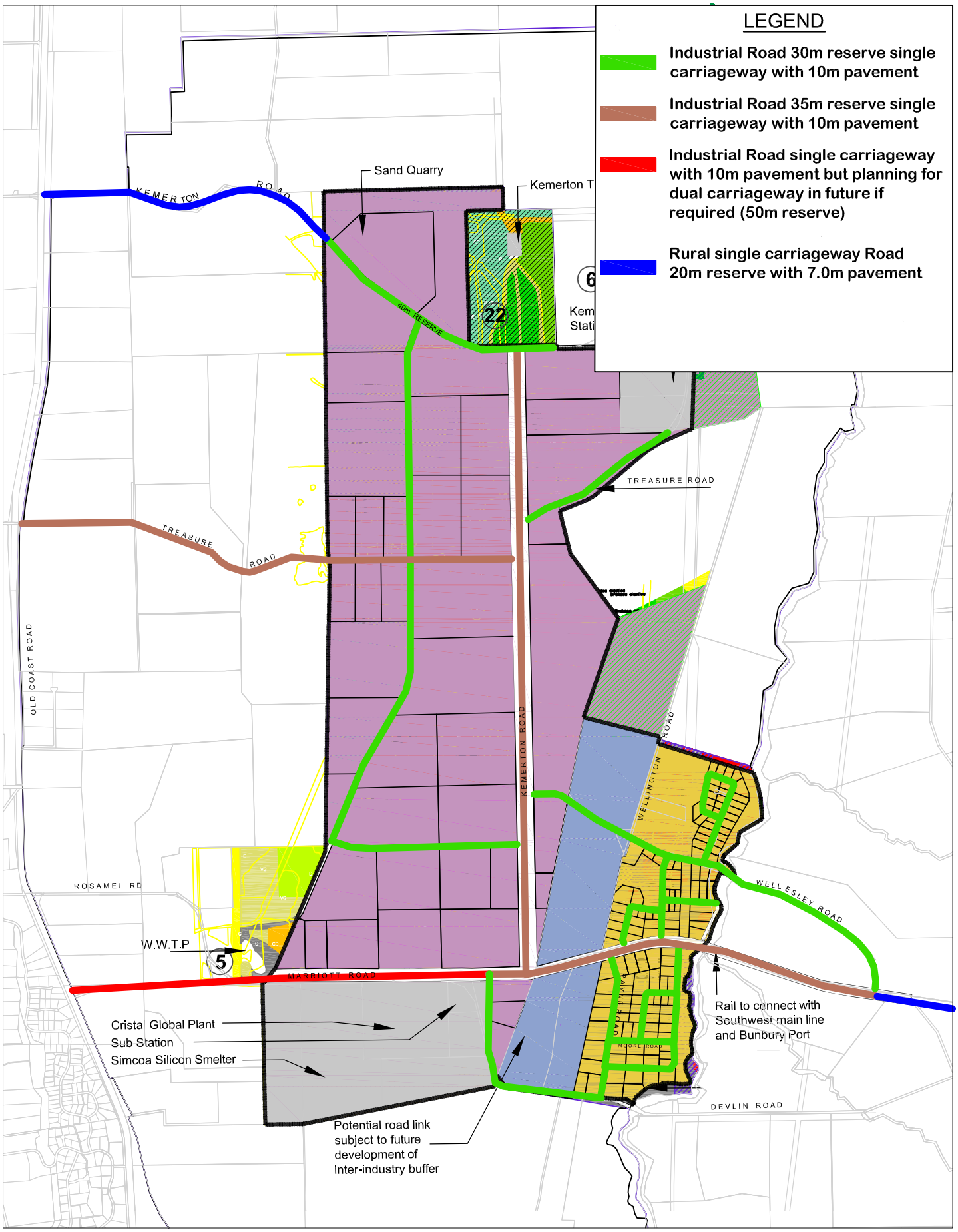
Proposed Road Hierarchy Plan

t10.209.Sk02

transcore

Appendix G

Road Hierarchy Plan (Transcore)



Kemerton Industrial Park

Proposed Road Hierarchy Plan

t10.209.Sk02

transcore

Appendix H

Post Development Drainage Concept Plan (RPS)

38 Station Steet, Subiaco | T +61 8 92111111 | F +61 8 92111122 | www.rpsgroup.com.au

LEGEND

- Site Boundary
- Services Railway
- 100 Year Inundated Boundary
- Proposed Road
- Road Direction of Flow
- Lot Direction of Flow

Post Development Catchment Boundary

- Catchment 1
- Catchment 2
- Catchment 3
- Catchment 4
- Catchment 5
- Catchment 6
- Catchment 7
- Catchment 8
- Catchment 9
- Catchment 10

Draft Basin Volume Estimates for Kemerton

	Catch 1	Catch 2	Catch 3	Catch 4	Catch 5	Catch 6	Catch 7	Catch 8	Catch 9	Catch 10
Contributing Catchment Area (ha)	196	235	440	126	390	114	23	37	42	134
Basin Invert (mAHD)	16.5	13.8	12.8	12.8	12.5	11.3	11.8	10	12.5	7.5
Basin Floor Area (ha)	4.0	4.0	6.0	1.8	3.0	1.5	0.25	0.5	0.15	2
Basin Depth (m)	1	1	1	1	1	1	1	1	1	1
Basin Batters	1 in 6	1 in 6	1 in 6	1 in 6	1 in 6	1 in 6	1 in 6	1 in 6	1 in 6	1 in 6
Basin Top Area (ha)	4.5	4.5	6.6	2.1	3.4	1.8	0.4	0.7	0.3	2.4
1 Year ARI Results										
TWL (mAHD)	16.5	13.8	12.8	12.8	12.5	11.3	11.8	10.19	12.71	7.68
Water Depth (m)	0	0	0	0	0	0	0	0.19	0.21	0.18
Top Wetted Area (ha)	4.0	4.0	6.0	1.8	3.0	1.5	0.25	0.5	0.2	2.1
Storage Volume (m3)	0	0	0	0	0	0	0	980	340	3600
10 Year ARI Results										
TWL (mAHD)	16.6	13.9	12.9	12.8	12.6	11.4	12.0	10.3	12.8	7.8
Water Depth (m)	0.06	0.06	0.05	0.00	0.05	0.08	0.22	0.28	0.28	0.26
Top Wetted Area (ha)	4.1	4.1	6	1.8	3	1.5	0.3	0.6	0.2	2.1
Storage Volume (m3)	4000	4000	3000	0	1500	1200	600	1500	460	5300
100 Year ARI Results										
TWL (mAHD)	17.3	14.5	13.7	13.7	13.3	12.1	12.6	10.8	13.2	8.3
Water Depth (m)	0.8	0.7	0.9	0.9	0.8	0.8	0.8	0.8	0.7	0.8
Top Wetted Area (ha)	4.4	4.34	6.53	2.1	3.35	1.75	0.35	0.65	0.22	2.3
Storage Volume (m3)	33500	29200	53900	17100	25400	13000	2200	4600	1300	16700
% of Catchment Area	2.2	1.8	1.5	1.6	0.9	1.5	1.5	1.8	0.5	1.7
Discharge Flow Rates (m3/s)										
Pre-Development Peak 10 yr flowrate	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.3	1.0	1.4
Post-Development Restricted Outflow	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.3	1.0	1.4

Notes and Assumptions:

All basins provided minimum 0.3m clearance to MGL

Drainage swales for temporary storage and conveyance of stormwater to basins have been included along all road reserves.

- Kemerton Road: assumed 40m wide reserve with 2 x 9m wide / 0.6m deep swales with 1:6 batters
- All other roads: assumed 30m wide reserve with 2 x 3.6m wide / 0.6m deep swales with 1:3 batters

Runoff Coefficient 0.8 applied to total building envelope area. Runoff Coefficient 0.2 applied to surrounding undeveloped lot area

Runoff Coefficient 0.8 applied to total road reserve area (considers pervious and impervious surfaces)

Some modelled road elevations require minor modifications to proposed lot levels. Road elevations were modelled with suitable grade for drainage

Areas subject to change at UWMP

RPS

Job Number: D1054201
Date: 19.11.14
Scale: 1:25000 @ A3
Version: A
Drafted by: MR
Source: Orthophoto - Landgate, 2008 Cadastre - Landgate, 2011

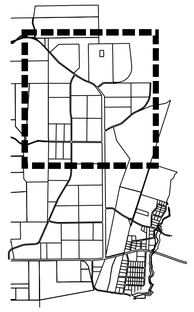
0 125 250 500 750 1,000 metres

Figure 12

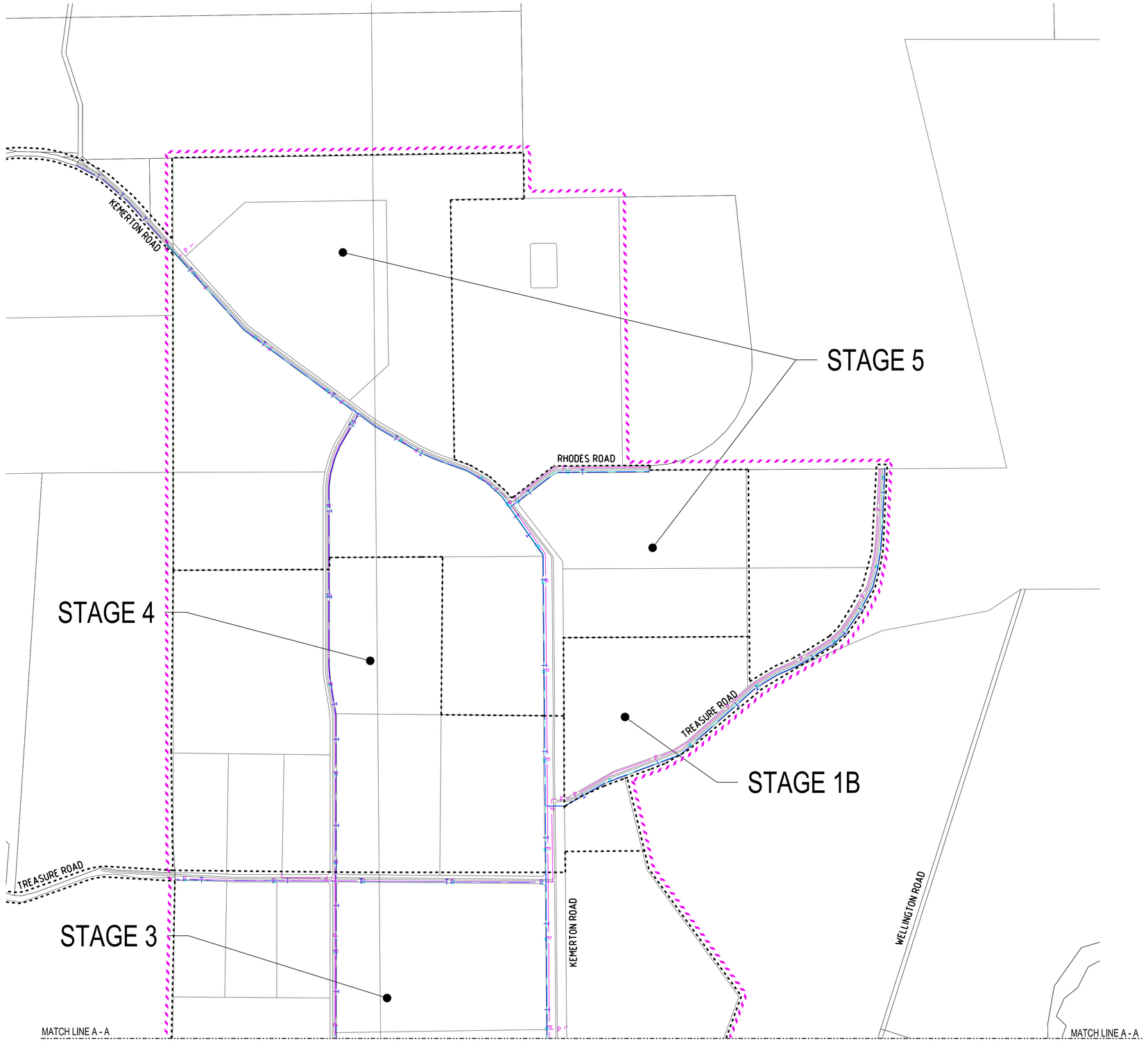
Post Development Drainage Concept

Appendix I

Preliminary Proposed Services Plans (Wood & Grieve Engineers)



LOCALITY PLAN
SCALE 1:100,000



PLAN
SCALE 1:10,000 @ A1

NOTES:

1. THE EXTENT AND LOCATION OF EXISTING SERVICES SHOWN ON THE PLANS ARE INDICATIVE ONLY. DETAILS AND EXACT LOCATIONS OF EXISTING SERVICES SHOULD BE OBTAINED FROM THE RESPECTIVE SERVICE AUTHORITIES.
2. PROPOSED SERVICE LOCATIONS SHOWN ON THE PLANS ARE INDICATIVE ONLY AND ARE BASED ON PRELIMINARY, NOTIONAL DESIGNS WHICH MAY BE SUBJECT TO CHANGE FOLLOWING DETAILED DESIGN AND AUTHORITY APPROVALS.
3. IN ACCORDANCE WITH THE LOCAL WATER MANAGEMENT STRATEGY (LWMS), IT IS ASSUMED THAT DOMESTIC WASTE WATER WILL BE MANAGED ON SITE VIA INDIVIDUAL AEROBIC TREATMENT UNITES (ATU'S) SUPPLIED AND INSTALLED BY FUTURE LOT OWNERS.

LEGEND:

- PROPOSED WATER SUPPLY MAINS
- PROPOSED WATER RETICULATION MAINS
- PROPOSED GAS MAINS
- PROPOSED POWER
- PROPOSED TELSTRA SERVICES
- PROPOSED ROAD PAVEMENT
- STRATEGIC INDUSTRY ZONE BOUNDARY
- PROPOSED STAGE BOUNDARY

REV.	DESCRIPTION	DRAWN	VER	APPROVED
C	PROJECT NAME AMENDED	NJHE		
B	CADASTRAL UPDATED	NJHE		
A	ORIGINAL ISSUE	GAB		

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CLIENT:
LANDCORP

PROJECT:
KEMERTON STRATEGIC INDUSTRIAL AREA - STRUCTURE PLANNING

TITLE:
PRELIMINARY PROPOSED SERVICES PLAN - SHEET 1 OF 2

PRELIMINARY

SECTION: CIVIL SERVICES	VERIFIED :	SCALE : A1 @ 1:10,000
DESIGNED : GAB	APPROVED FOR TENDER:	DATUM : A.H.D.
DRAWN : GAB	APPROVED FOR CONSTRUCTION :	WAPC : -

PROJECT No.	DRAWING No.	REVISION
22726-PER-C	PS1	C

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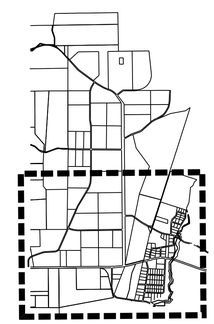
A3 @ 1:20000



LOCALITY PLAN
SCALE 1:100,000

MATCH LINE A - A

MATCH LINE A - A

STAGE 3

STAGE 2

STAGE 1A

STAGE 2A

STAGE 3A

STAGE 4A

STAGE 5A

KEMERTON ROAD

WELLINGTON ROAD

WELLESLEY ROAD

MARRIOTT ROAD

DEVLIN ROAD

EXISTING DBNGP METER
STATION KP 151878

PLAN
SCALE 1:10,000 @ A1

NOTES:

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- PROPOSED TELSTRA SERVICES
- PROPOSED ROAD PAVEMENT
- STRATEGIC INDUSTRY ZONE BOUNDARY
- ANCILLARY INDUSTRY ZONE BOUNDARY
- PROPOSED STAGE BOUNDARY

REV.	DESCRIPTION	DRAWN	VER	APPROVED
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B	CADASTRAL UPDATED	NJHE		
A	ORIGINAL ISSUE	GAB		

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PROJECT:
KEMERTON STRATEGIC INDUSTRIAL AREA - STRUCTURE PLANNING

TITLE:
PRELIMINARY PROPOSED SERVICES PLAN - SHEET 2 OF 2

PRELIMINARY

SECTION: CIVIL SERVICES	VERIFIED :	SCALE : A1 @ 1:10,000
DESIGNED : GAB	APPROVED FOR TENDER:	DATUM : A.H.D.
DRAWN : GAB	APPROVED FOR CONSTRUCTION :	WAPC : -

PROJECT No.	DRAWING No.	REVISION
22726-PER-C	PS2	C

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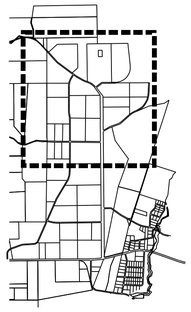
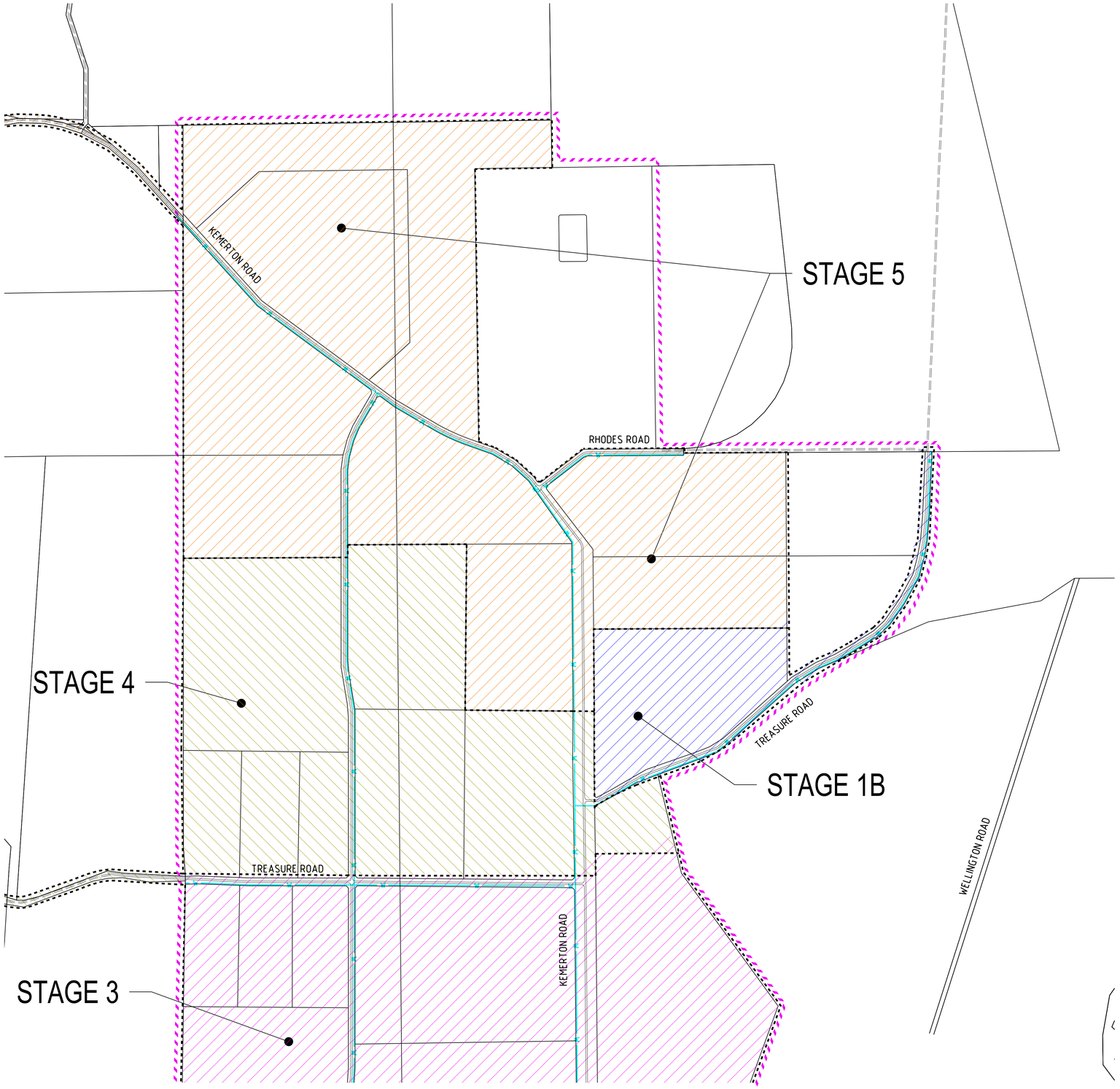
A1 @ 1:10000
A2 @ 1:20000

Appendix J

Preliminary Water Reticulation Layout Plans (Wood & Grieve Engineers)



LOCALITY PLAN
SCALE 1:100,000



PLAN
SCALE 1:10,000 @ A1

NOTES:

1. THE EXTENT AND LOCATION OF EXISTING SERVICES SHOWN ON THE PLANS ARE INDICATIVE ONLY. DETAILS AND EXACT LOCATIONS OF EXISTING SERVICES SHOULD BE OBTAINED FROM THE RESPECTIVE SERVICE AUTHORITIES.
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LEGEND:

- PROPOSED HARVEY WATER SUPPLY MAIN
- PROPOSED RETICULATION WATER MAINS
- PROPOSED ROAD PAVEMENT
- EXISTING ROAD PAVEMENT
- STRATEGIC INDUSTRY ZONE BOUNDARY
- PROPOSED STAGE BOUNDARY
- STAGE 1
- STAGE 2
- STAGE 3
- STAGE 4
- STAGE 5

REV.	DESCRIPTION	DRAWN	VER	APPROVED
D	PROJECT NAME AMENDED	NJHE		
C	CAD AMENDED	NJHE		
B	REVISED CADASTRAL	GAB		
A	ORIGINAL ISSUE	GAB		

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CLIENT:
LANDCORP

PROJECT:
KEMERTON STRATEGIC INDUSTRIAL AREA - STRUCTURE PLANNING

TITLE:
PRELIMINARY WATER RETIC LAYOUT PLAN - SHEET 1 OF 2

PRELIMINARY

SECTION: CIVIL SERVICES	VERIFIED :	SCALE : A1 @ 1:10,000
DESIGNED : GAB	APPROVED FOR TENDER:	DATUM : A.H.D.
DRAWN : GAB	APPROVED FOR CONSTRUCTION :	WAPC : -

PROJECT No.	DRAWING No.	REVISION
22726-PER-C	W1	D

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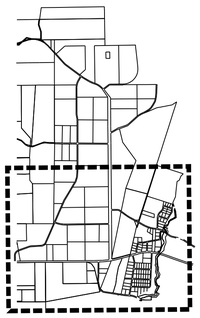
A3 @ 1:20000



LOCALITY PLAN
SCALE 1:100,000

STAGE 3

STAGE 2

KEMERTON ROAD

WELLESLEY ROAD

WELLINGTON ROAD

INDICATIVE LOCATION OF
HARVEY WATER 2ML
HOLDING DAM

STAGE 5A

STAGE 4A

MARRIOTT ROAD

HARVEY WATER DN355 WATER SUPPLY MAIN EXTENSION
FROM EXISTING CACTUS MAIN CHANNEL

STAGE 1A

STAGE 2A

STAGE 3A

DEVLIN ROAD

PLAN
SCALE 1:10,000 @ A1

NOTES:

1. THE EXTENT AND LOCATION OF EXISTING SERVICES SHOWN ON THE PLANS ARE INDICATIVE ONLY. DETAILS AND EXACT LOCATIONS OF EXISTING SERVICES SHOULD BE OBTAINED FROM THE RESPECTIVE SERVICE AUTHORITIES.
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- PROPOSED RETICULATION WATER MAINS
- PROPOSED ROAD PAVEMENT
- EXISTING ROAD PAVEMENT
- STRATEGIC INDUSTRY ZONE BOUNDARY
- ANCILLARY INDUSTRY ZONE BOUNDARY
- PROPOSED STAGE BOUNDARY
- STAGE 1
- STAGE 2
- STAGE 3
- STAGE 4
- STAGE 5

REV.	DESCRIPTION	DRAWN	VER	APPROVED
D	PROJECT NAME & WATER SUPPLY DETAILS AMENDED	NJHE		
C	CADASTRAL UPDATED	NJHE		
B	REVISED CADASTRAL	GAB		
A	ORGINAL ISSUE	GAB		

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CLIENT:
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PROJECT:
KEMERTON STRATEGIC INDUSTRIAL AREA - STRUCTURE PLANNING

TITLE:
PRELIMINARY WATER RETIC LAYOUT PLAN - SHEET 2 OF 2

PRELIMINARY

SECTION: CIVIL SERVICES	VERIFIED :	SCALE : A1 @ 1:10,000
DESIGNED : GAB	APPROVED FOR TENDER:	DATUM : A.H.D.
DRAWN : GAB	APPROVED FOR CONSTRUCTION :	WAPC : -

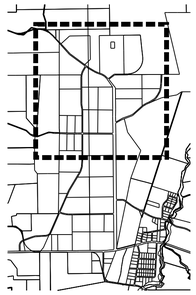
PROJECT No.	DRAWING No.	REVISION
22726-PER-C	W2	D

P:\22726\Civil Drawings\Sketches\140722 Sketches new report\c plan water.dgn

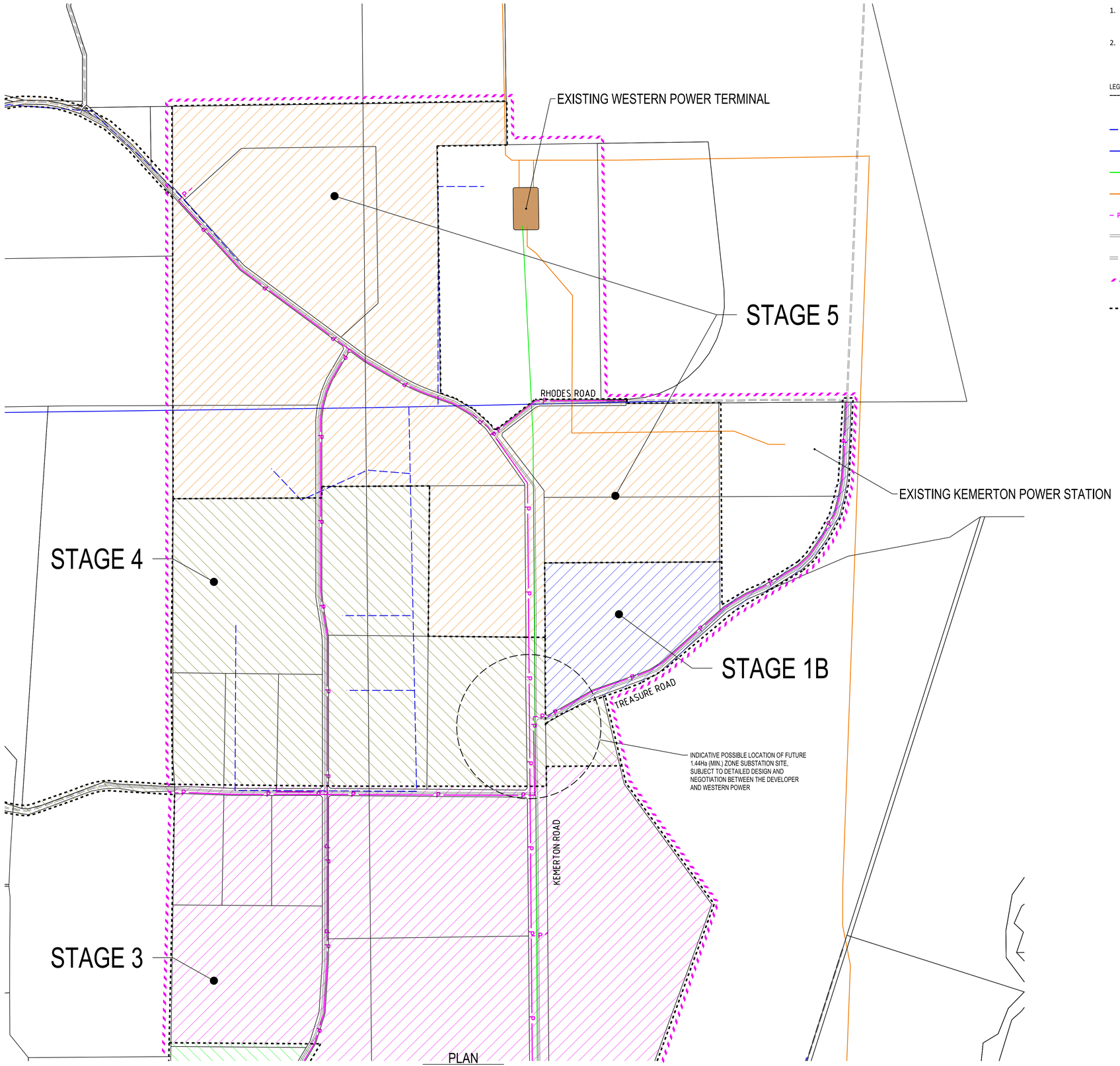
A1 @ 1:10000
A3 @ 1:20000

Appendix K

Preliminary Power Layout Plans (Wood & Grieve Engineers)



LOCALITY PLAN
SCALE 1:100,000 @ A1



PLAN
SCALE 1:10,000 @ A1

NOTES:

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LEGEND

- EXISTING SINGLE PHASE LINES
- EXISTING 22kV DISTRIBUTION LINES
- EXISTING 132kV TRANSMISSION LINES
- EXISTING 330kV TRANSMISSION LINES
- PROPOSED POWER
- PROPOSED ROAD PAVEMENT
- EXISTING ROAD PAVEMENT
- STRATEGIC INDUSTRY ZONE BOUNDARY
- PROPOSED STAGE BOUNDARY
- STAGE 1
- STAGE 2
- STAGE 3
- STAGE 4
- STAGE 5

REV.	DESCRIPTION	DRAWN	VER	APPROVED
C	PROJECT NAME AMENDED	NJHE		
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CLIENT:
LANDCORP

PROJECT:
KEMERTON STRATEGIC INDUSTRIAL AREA - STRUCTURE PLANNING

TITLE:
PRELIMINARY POWER LAYOUT PLAN - SHEET 1 OF 2

PRELIMINARY

SECTION: CIVIL SERVICES	VERIFIED :	SCALE : A1 @ 1:10,000
DESIGNED : AJH	APPROVED FOR TENDER:	DATUM : A.H.D.
DRAWN : GAB	APPROVED FOR CONSTRUCTION :	WAPC : -

PROJECT No.	DRAWING No.	REVISION
22726-PER-C	PO1	C

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A1 @ 1:10000 0 100 200 300 400 500 600 700 800 900 1000

LOCALITY PLAN
SCALE 1:100,000 @ A1

PLAN
SCALE 1:10,000 @ A1

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- EXISTING 22kV DISTRIBUTION LINES
- EXISTING 132kV TRANSMISSION LINES
- EXISTING 330kV TRANSMISSION LINES
- PROPOSED POWER
- PROPOSED ROAD PAVEMENT
- EXISTING ROAD PAVEMENT
- STRATEGIC INDUSTRY ZONE BOUNDARY
- ANCILLARY INDUSTRY ZONE BOUNDARY
- PROPOSED STAGE BOUNDARY
- STAGE 1
- STAGE 2
- STAGE 3
- STAGE 4
- STAGE 5

REV.	DESCRIPTION	DRAWN	VER	APPROVED
C	PROJECT NAME AMENDED	NJHE		
B	CADASTRAL UPDATED	NJHE		
A	ORGINAL ISSUE	GAB		

CELEBRATING 50 YEARS
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PERTH
MELBOURNE
SYDNEY
BRISBANE
GOLD COAST
ALBANY
BUSSELTON
SHENZHEN

CLIENT:
LANDCORP

PROJECT:
KEMERTON STRATEGIC INDUSTRIAL AREA - STRUCTURE PLANNING

TITLE:
PRELIMINARY POWER LAYOUT PLAN - SHEET 2 OF 2

PRELIMINARY

SECTION: CIVIL SERVICES	VERIFIED :	SCALE : A1 @ 1:10,000
DESIGNED : GAB	APPROVED FOR TENDER:	DATUM : A.H.D.
DRAWN : GAB	APPROVED FOR CONSTRUCTION :	WAPC : -

PROJECT No.	DRAWING No.	REVISION
22726-PER-C	PO2	C

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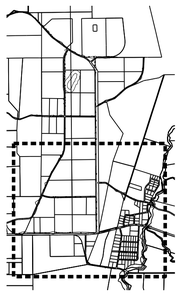
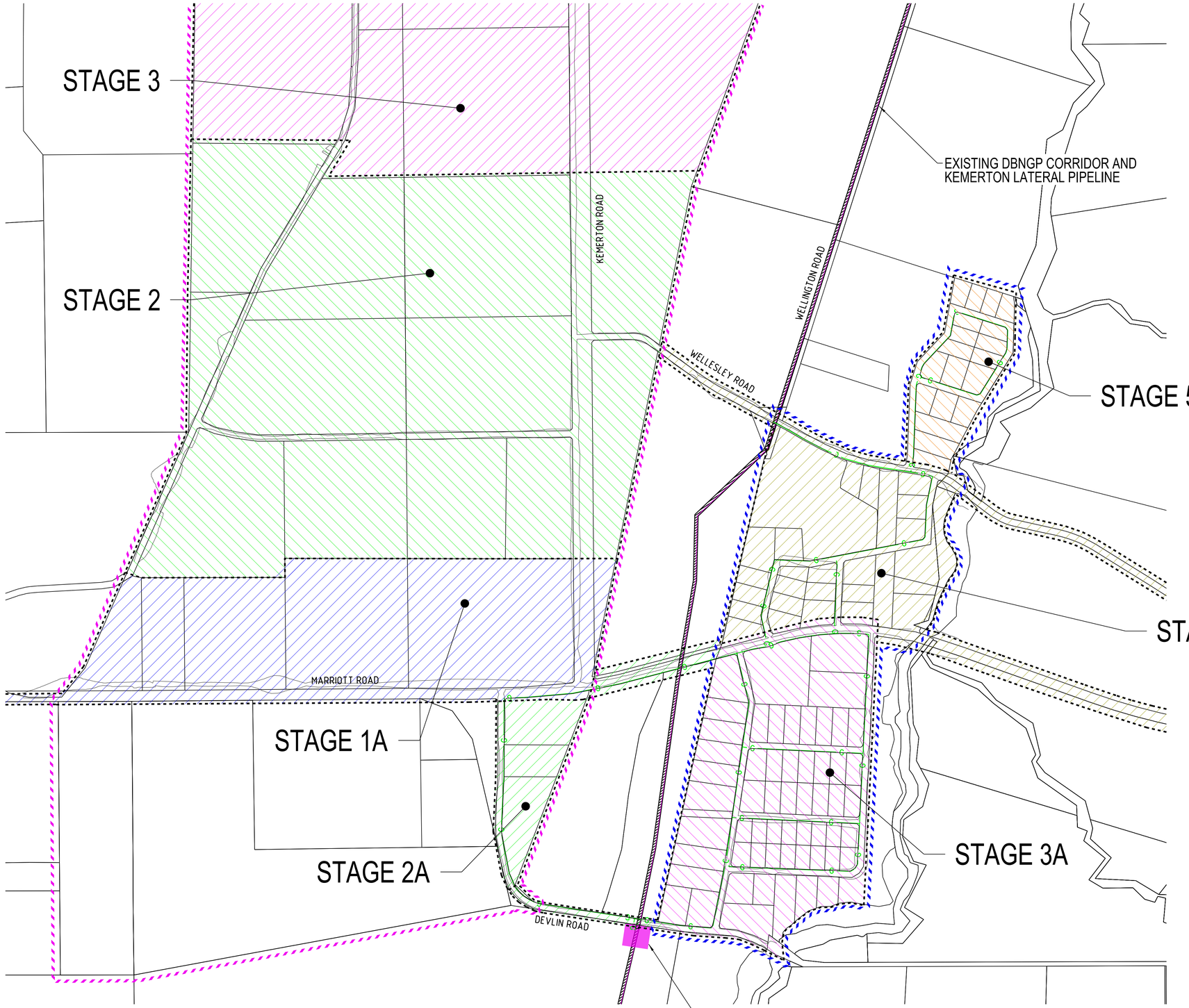
A1 @ 1:10000
A3 @ 1:20000

Appendix L

Preliminary Gas Layout Plan (Wood & Grieve Engineers)



LOCALITY PLAN
SCALE 1:100,000 @ A1



PLAN
SCALE 1:10,000 @ A1

NOTES:

1. THE EXTENT AND LOCATION OF EXISTING SERVICES SHOWN ON THE PLANS ARE INDICATIVE ONLY. DETAILS AND EXACT LOCATIONS OF EXISTING SERVICES SHOULD BE OBTAINED FROM THE RESPECTIVE SERVICE AUTHORITIES.
2. PROPOSED SERVICE LOCATIONS SHOWN ON THE PLANS ARE INDICATIVE ONLY AND ARE BASED ON PRELIMINARY, NOTIONAL DESIGNS WHICH MAY BE SUBJECT TO CHANGE FOLLOWING DETAILED DESIGN AND AUTHORITY APPROVALS.

LEGEND

- EXISTING DAMPIER TO BUNBURY NATURAL GAS PIPELINE (DBNGP)
- DBNGP CORRIDOR
- PROPOSED GAS PIPELINE
- PROPOSED ROAD PAVEMENT
- EXISTING ROAD PAVEMENT
- STRATEGIC INDUSTRY ZONE BOUNDARY
- ANCILLARY INDUSTRY ZONE BOUNDARY
- PROPOSED STAGE BOUNDARY
- STAGE 1
- STAGE 2
- STAGE 3
- STAGE 4
- STAGE 5

REV.	DESCRIPTION	DRAWN	VER	APPROVED
D	PROJECT NAME AMENDED	NJHE		
C	CADASTRAL UPDATED	NJHE		
B	CADASTRAL REVISED	GAB		
A	ORIGINAL ISSUE	GAB		

CELEBRATING 50 YEARS
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PERTH
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SHENZHEN

CLIENT:
LANDCORP

PROJECT:
KEMERTON STRATEGIC INDUSTRIAL AREA - STRUCTURE PLANNING

TITLE:
PRELIMINARY GAS LAYOUT PLAN

PRELIMINARY

SECTION: CIVIL SERVICES	VERIFIED :	SCALE : A1 @ 1:10,000
DESIGNED : GAB	APPROVED FOR TENDER:	DATUM : A.H.D.
DRAWN : GAB	APPROVED FOR CONSTRUCTION :	WAPC : -

PROJECT No.	DRAWING No.	REVISION
22726-PER-C	GA1	D

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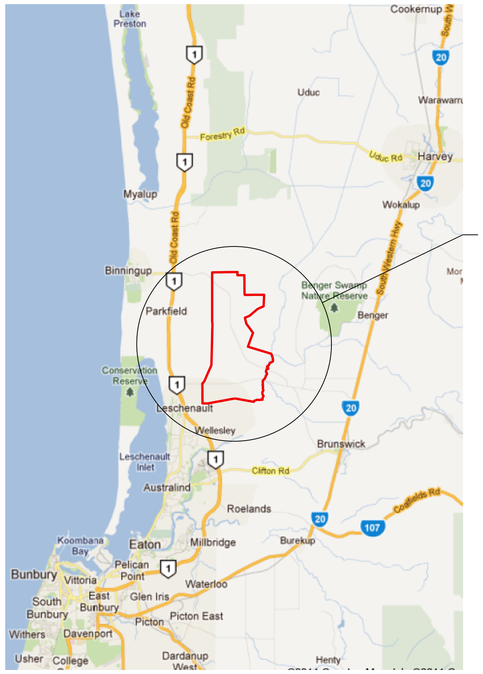
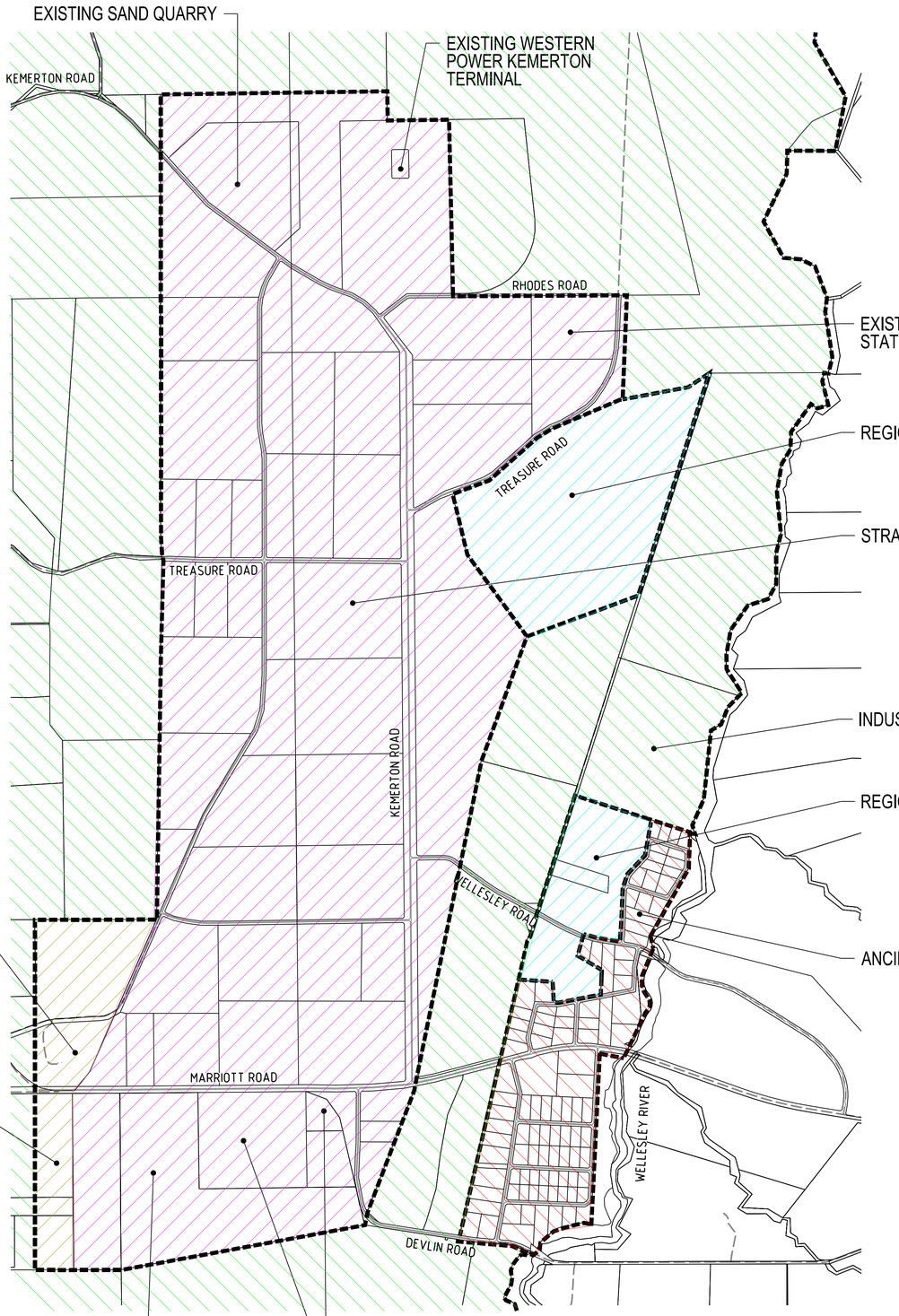
A1 @ 1:10000
A2 @ 1:20000

Appendix M

Locality Plan (Wood & Grieve Engineers)



SITE LOCATION



PLAN
SCALE 1:10,000 @ A1

LEGEND:

- SITE BOUNDARY
- STRATEGIC INDUSTRY ZONE
- ANCILLARY INDUSTRY ZONE
- INDUSTRY BUFFER
- PUBLIC PURPOSE
- REGIONAL OPEN SPACE
- PROPOSED ROAD PAVEMENT
- EXISTING ROAD PAVEMENT

REV.	DESCRIPTION	DRAWN	VER	APPROVED
D	PROJECT NAME AMENDED	NJHE		
C	CADASTRAL UPDATED	NJHE		
B	REVISED CADASTRAL	GAB		
A	ORIGINAL ISSUE	GAB		21/10/11

CELEBRATING 50 YEARS
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PERTH
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ALBANY
BUSSELTON
SHENZHEN

CLIENT:
LANDCORP

PROJECT:
KEMERTON STRATEGIC INDUSTRIAL AREA - STRUCTURE PLANNING

TITLE:
LOCALITY PLAN

PRELIMINARY

SECTION: CIVIL SERVICES	VERIFIED :	SCALE : A1 @ 1:10,000
DESIGNED : GAB	APPROVED FOR TENDER:	DATUM : A.H.D.
DRAWN : GAB	APPROVED FOR CONSTRUCTION :	WAPC : -

PROJECT No.	DRAWING No.	REVISION
22726-PER-C	LP	D

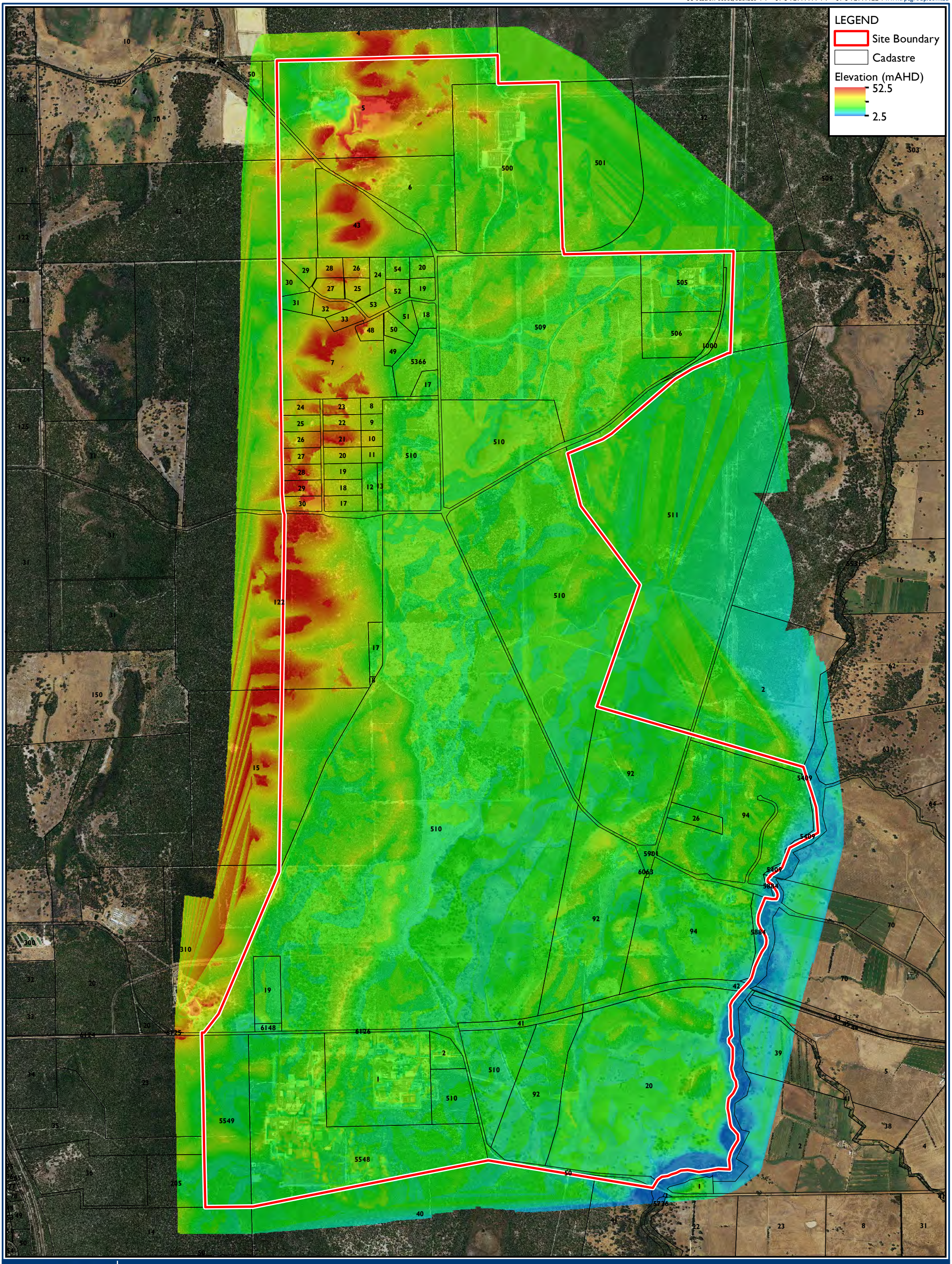
P:\22726\Civil Drawings\Sketches\140722 Sketches new report\c plan locality.dgn

A1 @ 1:10000
A3 @ 1:20000

Appendix N

Existing Topography Plan (RPS)

38 Station Steet, Subiaco | T +61 8 92111111 | F +61 8 92111122 | www.rpsgroup.com.au



RPS

Job Number: D1054201
Date: 17.11.14
Scale: 1:25000 @ A3
Version: A
Drafted by: SC
Source: Orthophoto - Landgate, 2008 Cadastre - Landgate, 2011 LIDAR - DoW, 2011

0 125 250 500 750 1,000 metres

Figure 4

Topography

Appendix O

Report on Preliminary Geotechnical Investigation, by Douglas Partners

(DP ref. 76136, dated April 2011)

Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Preliminary Geotechnical Investigation

Kemerton Industrial Park

Prepared for
LandCorp

Project 76136
April 2011

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

Document details

Project No.	76136	Document No.	1
Document title	Report on Preliminary Geotechnical Investigation		
Site address	Kemerton Industrial Park		
Report prepared for	LandCorp		
File name	P:\76136 Kemerton Industrial Park\Docs\76136 Report Preliminary Geotechnical Investigation for Kemerton Industrial Park, Kemerton.doc		

Document status and review

Revision	Prepared by	Reviewed by	Date issued
0	D Reaveley	F Verheyde	6 April 2011

Distribution of copies

Revision	Electronic	Paper	Issued to
0	1	1	G. Markovic, Wood and Grieve Engineers

The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
Author		6-4-2011
Reviewer	pp. F. L-J	6-4-2011

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Table of Contents

Report on Preliminary Geotechnical Investigation
Kemerton Industrial Park, WA

1. Introduction

This report presents the results of a preliminary geotechnical investigation undertaken at the site of the proposed Kemerton Industrial Park, WA. It is understood that the investigation is required to assist in the structure planning process. The investigation was commissioned in an email dated 14 January 2011 from Jonathan Roach of LandCorp and was undertaken in accordance with Douglas Partners' proposal dated 23 November 2010 and in consultation with Wood and Grieve Engineers, consulting engineers for the project.

The aim of the investigation was to undertake a desktop study combined with a site visit and limited ground breaking investigation to provide preliminary geotechnical comments on:

- The suitability of the site for the proposed development.
- The likely site classification in accordance with the requirements of AS 2870-2011.
- The likely site preparation and earthworks requirements to develop the site.
- An indicative California bearing ratio (CBR) for the design of new pavements, based on field observations.
- The suitability of the site for on site stormwater disposal using soakwells and sumps, including the assessment of the soil permeability based on field observations and laboratory testing.
- A suitable fill level above the average annual maximum groundwater level (AAMGL).
- The risk of acid sulphate soils occurring beneath the site based upon published information and the findings of the preliminary geotechnical investigation.

The investigation included a review of available geological information, a walkover survey, the drilling of 25 boreholes and laboratory testing of selected samples. The details of the investigation are presented in this report, together with comments and recommendations on the issues listed above.

2. Site Description

The proposed Kemerton Industrial Park covers a total area of approximately 7543 ha, and is located approximately 160 km south of Perth and 17 km northeast of Bunbury (refer to Drawing 1 in Appendix A). Of the total area, 2019 ha had been designated as a core industry area, 293 ha as support industry area and the remaining 5231 ha as a buffer zone. This investigation is limited to the core industry and support industry areas.

The site can be characterised by several land uses, including cleared grazing land, forestry plantations, native bushland and swamps, semi-rural residential land holdings, existing industry and sand quarrying.

The majority of the northern portion of the site is predominantly covered by either bushland or cleared grassy paddocks. Some heavy industry is located to the south of Marriot Road.

The topography across the site generally slopes downwards in a south-easterly direction, with the highest part of the site situated along the western and northern boundaries at approximately 30 m AHD and falling towards the Wellesley River on the eastern boundary at less than 10 m AHD.

3. Review of Published Geological Information

The Geological Survey of WA 1:50 000 Harvey - Lake Preston Sheet indicates that shallow sub surface conditions beneath the site consist of the following geological units, generally listed in the order as mapped across the site from west to east:

- **Tamala Limestone –** A lithified eolian and marine calcarenite, which generally underlies a thin cover of orange-brown sand containing boulders of limestone, leached white near the surface. The rock varies in hardness from friable (very low strength) to completely lithified (high strength) and mainly consists of calcium carbonate and quartz.
- **Sand associated with Tamala Limestone** – This unit forms the Spearwood dunes which are generally high dunes with steep slopes occurring in continuous ridges of fine to medium grained subangular to subrounded sand grains. The sand is derived from the calcarenite by decalcification through weathering.
- **Bassendean Sand** – Forming the easternmost and oldest dune system. The dunes are generally irregular and rounded consisting of subrounded to subangular fine to medium grained quartz grains.
- **Thin Bassendean over Guildford Formation –** A sub-unit of the Bassendean Sand where the sand is thin, rarely over 5 m in thickness and overlies the Guildford Formation. It is considered an eroded remnant of a formerly more-extensive dune cover.
- **Guildford Formation** – This unit generally comprises alluvial sandy or silty clays, clayey sand and small areas of semi-lithified laterised clay.
- **Swamp Deposits** – These deposits mainly consist of dark grey or dark brown fine grained sands or silts with varied but significant amounts of peat which have formed in depressions within the Spearwood and Bassendean Sand dunes.
- **Alluvium –** Generally a highly variable lithology occurring along watercourses such as streams and rivers. Predominantly consisting of fine to coarse grained sands, silt and clay.

The spatial distribution of the geological units across the site are depicted on Drawing 3, Appendix A.

4. Field Work Methods

The field work was carried out on 17 February 2011 and comprised a survey visit of the site and the drilling of 25 boreholes (BH1 to BH25) and Perth sand penetrometer (PSP) tests. The boreholes were generally undertaken across the range of geological units within the site, to confirm the soil types and thus verify the published mapping.

The survey visit consisted of a drive-over and walk-over across the site by an experienced geotechnical engineer in order to identify features of geotechnical significance.

The boreholes were drilled to a maximum depth of 2.0 m using a 110 mm hand auger. Each borehole was logged, in general accordance with AS 1726-1993, by a suitably experienced representative from Douglas Partners. Representative soil samples were recovered from selected locations for subsequent laboratory testing.

Perth sand penetrometer (PSP) testing was carried out adjacent to the boreholes in accordance with AS 1289.6.3.3 to assess the density of the shallow soils.

Test locations were determined using a hand held GPS and are shown on Drawing 2. Surface elevations at each test location were interpolated from a survey provided by Wood and Grieve Engineers and are quoted in metres above AHD.

5. Field Work Results

5.1 Ground Conditions

Detailed boreholes of the ground conditions are presented in Appendix A, together with notes defining descriptive terms and classification methods used.

The ground conditions encountered at the boreholes generally comprised topsoil overlying sand. A summary of the conditions encountered is:

- **Topsoil –** dark grey and dark brown, silty sandy topsoil to depths of between 0.05 m to 0.30 m.
- **Sand –** loose to medium dense, light grey, grey and brown fine to medium grained sand to borehole termination depths up to 2.0 m.

The following exceptions to the above-mentioned profile were encountered:

- **Silty Sand** – loose, dark grey, silty sand from 0.15 m to 0.75 m at BH07.
- **Peaty Sand** – medium dense, dark brown, peaty sand from 0.05 m to 0.85 m at BH15.
- **Clayey Sand** – medium dense, grey brown, clayey sand from 0.5 m to borehole termination depth of 1.2 m at BH17.
- **Coffee Rock** - weakly and moderately cemented brown sand below depths of 1.6 m and 0.85 m within BH6 and BH15 respectively.
- Fibrous root material was noted from 0.3 m to 0.6 m depth at BH04.

5.2 Groundwater

No free groundwater was observed within any of the boreholes drilled on 17 February 2011 to depths of up to 2.0 m below surface level (RL 10.5 at BH20). The boreholes were immediately backfilled following the investigation, which precluded longer-term monitoring of groundwater levels.

A groundwater monitoring well located on the west side of Wellesley Road, approximately 1.3 km north of intersection with Treasure Road, was dipped on 17 February 2011. The groundwater level in the well was 3.2 m below the surface (11.96 m AHD).

6. Geotechnical Laboratory Testing

A geotechnical laboratory testing programme was carried out by a NATA registered laboratory and comprised the determination of:

- The particle size distribution of eight samples.
- The Atterberg limits and linear shrinkage of one sample.
- The organic content of two samples.

The detailed test certificates are given in Appendix B, with the results summarised in Table 1 (following page).

Table 1: Results of Laboratory Testing

Test	Depth (m)	Fines (%)	d_{10} (mm)	d_{60} (mm)	LL (%)	PL (%)	PI	LS (%)	OC	Material
BH03	1.5	3	0.17	0.39	-	-	-	-	-	Sand, trace silt, grey
BH04	0.4	4	0.16	0.41	-	-	-	-	3.3	Sand, trace silt and fibrous root, dark grey-brown
BH09	1.2	4	0.16	0.39	-	-	-	-	-	Sand, trace silt, grey
BH12	1.5	2	0.17	0.39	-	-	-	-	-	Sand, trace silt, yellow brown
BH15	0.4	4	0.16	0.38	-	-	-	-	3.1	Peaty Sand, trace silt, dark brown
BH17	0.7	25	<0.0135	0.29	38	15	23	8	-	Clayey Sand, grey-brown mottled orange
BH20	1.0	4	0.15	0.38	-	-	-	-	-	Sand, trace silt, light grey-brown
BH23	1.5	1	0.18	0.42	-	-	-	-	-	Sand, grey

Notes on Table 1:

-The % fines is the amount of particles smaller than 75 µm.
-A d_{10} of 0.17 mm means that 10% of the sample particles are finer than 0.17 mm.
-A d_{60} of 0.23 mm means that 60% of the sample particles are finer than 0.23 mm.
- LL: liquid limit.
- PL: plastic limit.
- PI: plasticity Index.
- LS: linear shrinkage.
- OC: organic content.

7. Proposed Development

It is understood that the site will form a large industrial subdivision for heavy industry with arterial road and rail link to Bunbury Port.

8. Comments

It is emphasised that comments within this report are of a preliminary nature and are based on limited ground investigation across a large site. It is recommended that detailed geotechnical investigations are undertaken during the design phase of the development.

8.1 Discussion on Ground Conditions

The ground conditions encountered to shallow depths within the boreholes generally concurs with the published geological mapping information of the site. However the following comments:

- Limestone was not encountered to depths of up to 2.0 m at BH12.
- Clayey materials were not encountered at surface level at BH17, in the area depicted as being underlain by the Guildford Formation. Bassendean Sand to a depth of 0.5 m overlies the clayey material at this location.
- Peaty materials were not encountered at test locations BH4, BH5, BH8 and BH24.

It is assumed that the geological conditions depicted on the Geological Survey of WA 1:50 000 Harvey - Lake Preston Sheet generally reflects the ground conditions within the Kemerton Industrial Park.

8.2 Site Classification

The site classification in accordance with AS 2870-2011 of the ground conditions encountered at the test locations was assessed using the method presented in Kay (1990) and based on a design depth of suction change of 1.8 m. The results of this assessment indicate that the test locations should be classified as either 'Class A', 'Class S' or 'Class P' as detailed below in Table 2.

Table 2: Site Classification at Test Locations

Test Location	Current Site Classification
BH01 to BH14, BH16, BH28 to BH25	A
BH15	P
BH17	S

Given the variability of the soil conditions across the site and the scale of the project area, it is considered that site classification for individual lot sites should be established at a later stage during the detailed design phase of the development. However, based on the correlation between the geological mapping, the results of the site visit and the limited intrusive investigation, the following comments relating to site classification can be made:

- It is likely that the bulk of the development should be able to achieve a site classification 'A'.
- The existing classification of areas shown on the mapping as being underlain by the Guildford Formation and Alluvium are likely to be class 'S' to 'M', although areas of class 'H' should not be precluded at this stage of the study.
- Some of the areas shown on the mapping to be underlain by Swamp Deposits will possibly to be classified as 'P', although the limited data available indicates that minor earthworks may allow these areas to be reclassified to 'A'.

8.3 Preliminary Comments on Site Preparation and Earthworks

Prior to any cutting and filling or construction of structures, all deleterious material, including topsoil, vegetation and tree roots, and any particles larger than 150 mm should be removed from the site. In particular, the peaty materials, such as those encountered within BH15 and likely to be elsewhere across the site, should be removed and the excavation backfilled with suitable structural filling.

Following removal of topsoil and prior to any filling, it is recommended that the exposed subgrade beneath all building envelopes and pavement areas be compacted using a minimum 12 tonne vibrating smooth drum roller. Any areas that show signs of excessive deformation during compaction should be compacted until deformation ceases or, alternatively, the poor quality material should be excavated and replaced with suitable structural filling compacted to achieve a dry density ratio of not less than 95% relative to modified compaction. Care should be taken not to operate heavy plant immediately adjacent to existing buildings and services.

Naturally occurring sand excavated from the site should be suitable for re-use as structural filling, provided it is free from organic material and particles greater than 150 mm in size. It is recommended that naturally occurring sand at this site, if used for structural filling, be placed in loose lift thickness of not more than 300 mm, within 2% of its optimum moisture content with each layer compacted to achieve a dry density ratio of not less than 95% relative to modified compaction. Compaction control of the sand at the site could be carried out using a Perth sand penetrometer in accordance with test method AS 1289.6.3.3.

All areas within building envelope and road reserve areas should be compacted to achieve a minimum blow count of 8 blows per 300 mm penetration to a depth of 1 m below finished lot level when tested in accordance with the above test method.

During construction, some loosening of the surface sands in foundation excavations is expected. Therefore the top 300 mm in the base of any excavation should be re-compacted using a vibratory plate compactor prior to construction of any footings.

8.4 Minimum Fill Levels above AAMGL

Shallow groundwater can impact construction, soil bearing capacity, stormwater infiltration and slope stability. For standard industrial warehouses without unusually high loading conditions, construction and soil bearing capacity limitations can generally be managed if groundwater is more than 0.5 m below foundation levels and thus on site stormwater infiltration generally governs the clearance between finished levels and groundwater. Several local authorities in Perth require a clearance of at least 1.2 m between AAMGL and finished levels for residential and industrial developments.

At this stage of the study, we have no information regarding likely founding details of the structures or drainage systems which will be constructed at the site. Based on information provided by Wood and Grieve Engineers, it is understood that a preliminary fill level of 1.5 m above AAMGL has been suggested. Douglas Partners considers that this level is suitable to meet the geotechnical requirements for an industrial area. However if information is available regarding any proposed structures or drainage systems for the site, then the above clearances should be taken into consideration

8.5 Pavement Design

The shallow soils conditions across the site generally comprise sand. Based on the results of the investigation, it is suggested that a CBR of 12% should be suitable for the design of flexible pavement on the natural sand subgrade encountered at the site, provided the subgrade includes a minimum thickness of 1 m of sand over any clayey material, and provided the sand is compacted to achieve a dry density ratio of not less than 95% relative to modified compaction. Specific testing should be undertaken during detailed geotechnical investigations for the development areas to confirm suitable CBR values for pavement design, in particular, areas underlain by clayey materials at shallow depths are likely to have a CBR value of less than 5%, and peaty materials will not consistent suitable subgrade material.

8.6 Soil Permeability and Stormwater Disposal

As discussed in Section 4.1, the shallow ground conditions beneath the site generally comprise sand, therefore on-site stormwater disposal using soak wells and sumps should be feasible at the site.

A permeability value was derived using grading results of soil samples and the Hazen's formula, which applies for sand in a loose state. Results of the permeability analysis are summarised in Table 3.

Table 3: Summary of the Derived Permeability Values

Location	Depth (m)	Derived Permeability (m/s)	Material
BH03	1.5	2.9×10^{-4}	Sand
BH04	0.4	2.6×10^{-4}	Sand
BH09	1.2	2.6×10^{-4}	Sand
BH12	1.5	2.9×10^{-4}	Sand
BH20	1.0	2.3×10^{-4}	Sand
BH23	1.5	3.2×10^{-4}	Sand

Results of the analysis indicate a permeability value of between 2×10^{-4} m/s and 3×10^{-4} m/s for the sand encountered beneath the site. Given that the sand encountered at the borehole locations is generally loose to medium dense, a design permeability value of 1×10^{-4} m/s is suggested for the site. It is emphasised that a lower permeability value than that indicated may be appropriate for a long-term design value which takes into account long term bio-build up and/or siltation of the infiltration surface.

8.7 Acid Sulphate Soil Risk

The Western Australian Planning Commission (WAPC) in conjunction with the Department of Environment and Conservation (DEC) have prepared a series of acid sulphate soil risk maps targeting high development areas across Western Australia. These risk maps has been prepared on the basis

of geological origin, depth to groundwater and partial ground truthing. The acid sulphate soil risk map categories across the site are displayed on Drawing 4, Appendix A.

Acid sulphate soil risk map (Figure 23 – Greater Bunbury Region Scheme Acid Sulphate Soils) indicates that the site is located within the following areas of risk:

- "no known risk of acid sulphate soils occurring within 3 m of natural soil surface." Areas of no known risk generally correlate with the areas of sand derived from Tamala Limestone and Tamala limestone as depicted by the geological mapping.
- "medium to low risk of acid sulphate soils within 3 m of natural soil surface", which generally correlate with areas of Bassendean Sand and the Guildford Formation as depicted by the geological mapping.
- "high to medium risk of acid sulphate soils within 3 m of natural soil surface", which generally correlate with areas of swamp deposits and alluvium as depicted by the geological mapping.

The ground conditions encountered during the investigation are generally consistent with the published geology and thus support the levels of risk depicted on the published risk mapping. Based on the mapping indicating a high to moderate risk of acid sulphate soils at the site, it is considered likely that a WAPC condition requiring a preliminary acid sulphate soil investigation be undertaken at the site will be placed on a development application.

It is recommended that in order to better assess specific management requirements of potential acid sulphate soils, further detailed investigations, targeted to proposed excavations, be undertaken prior to the commencement of works.

9. References

1. Australian Standard AS 1289-2000, Methods of Testing Soils for Engineering Purposes
2. Australian Standard AS 1289.6.3.3-1999, Soil Strength and Consolidation Tests-Determination of the Penetration Resistance of a Soil – Perth Sand Penetrometer Test.
3. Australian Standard AS 1726-1996, Geotechnical Site Investigation.
4. Australian Standard AS 2870-2011, Residential Slabs and Footings.
5. Geological Survey of WA 1:50 000 Harvey - Lake Preston Sheet

10. Limitations

Douglas Partners (DP) has prepared this report for this project at Kemerton Industrial Park in Kemerton, WA in accordance with DP's proposal dated 23 November 2010 and acceptance received from LandCorp on 14 January 2011. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of the LandCorp for this project only and for the purposes described in the report. It should not be used by or relied upon for other projects or purposes on the

same or other site or by a third party. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions only at the specific sampling or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of anthropogenic influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be limited by undetected variations in ground conditions between sampling locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached notes and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

Douglas Partners Pty Ltd

Appendix A

Notes Relating to this Report
Drawings 1 to 4
Field Work Results

About this Report

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Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Soil Descriptions

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Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	vs	<12
Soft	s	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

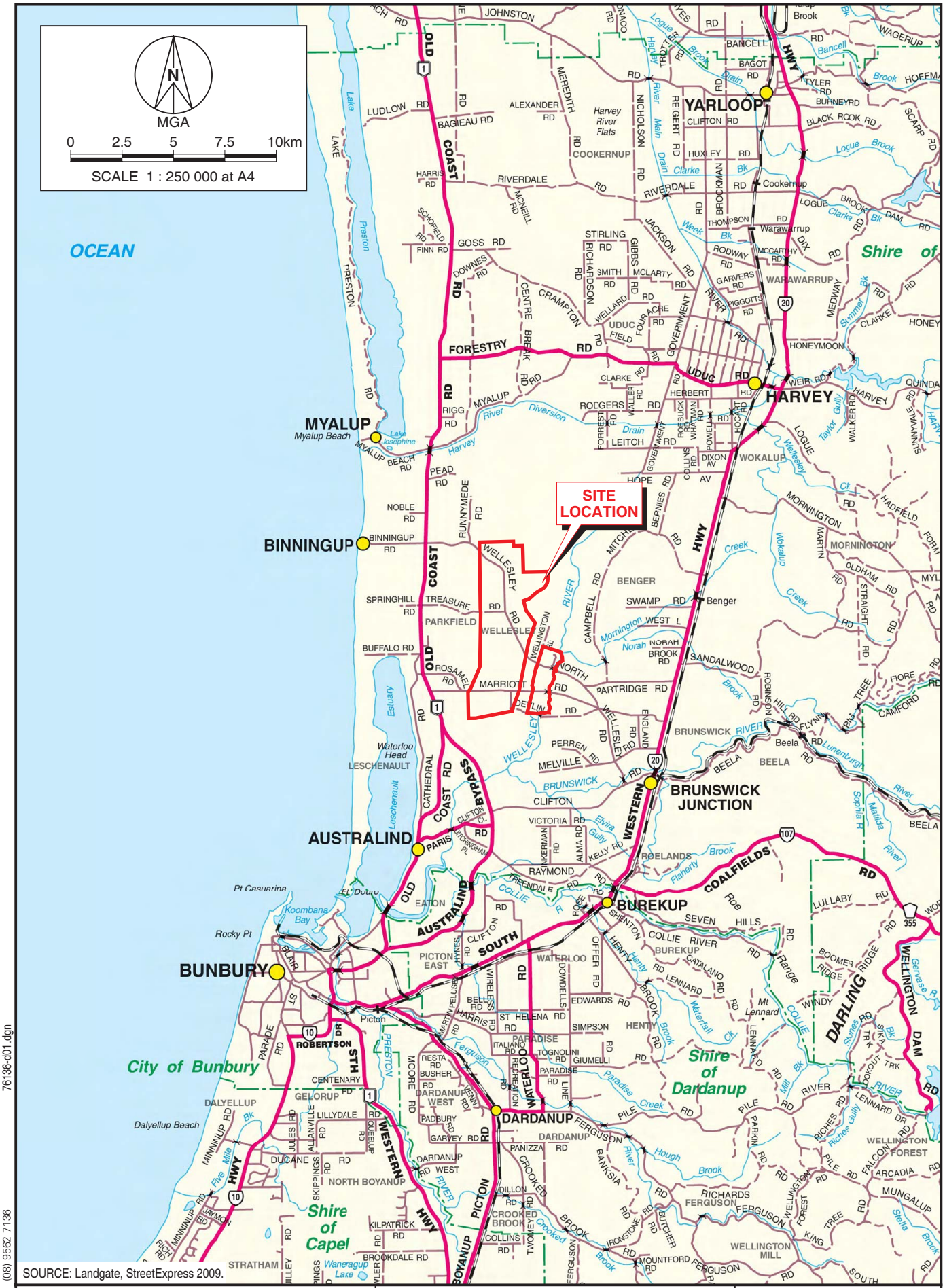
Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.



SOURCE: Landgate, StreetExpress 2009.

PINPOINT CARTOGRAPHICS (08) 9562 7136 76136-d01.dgn

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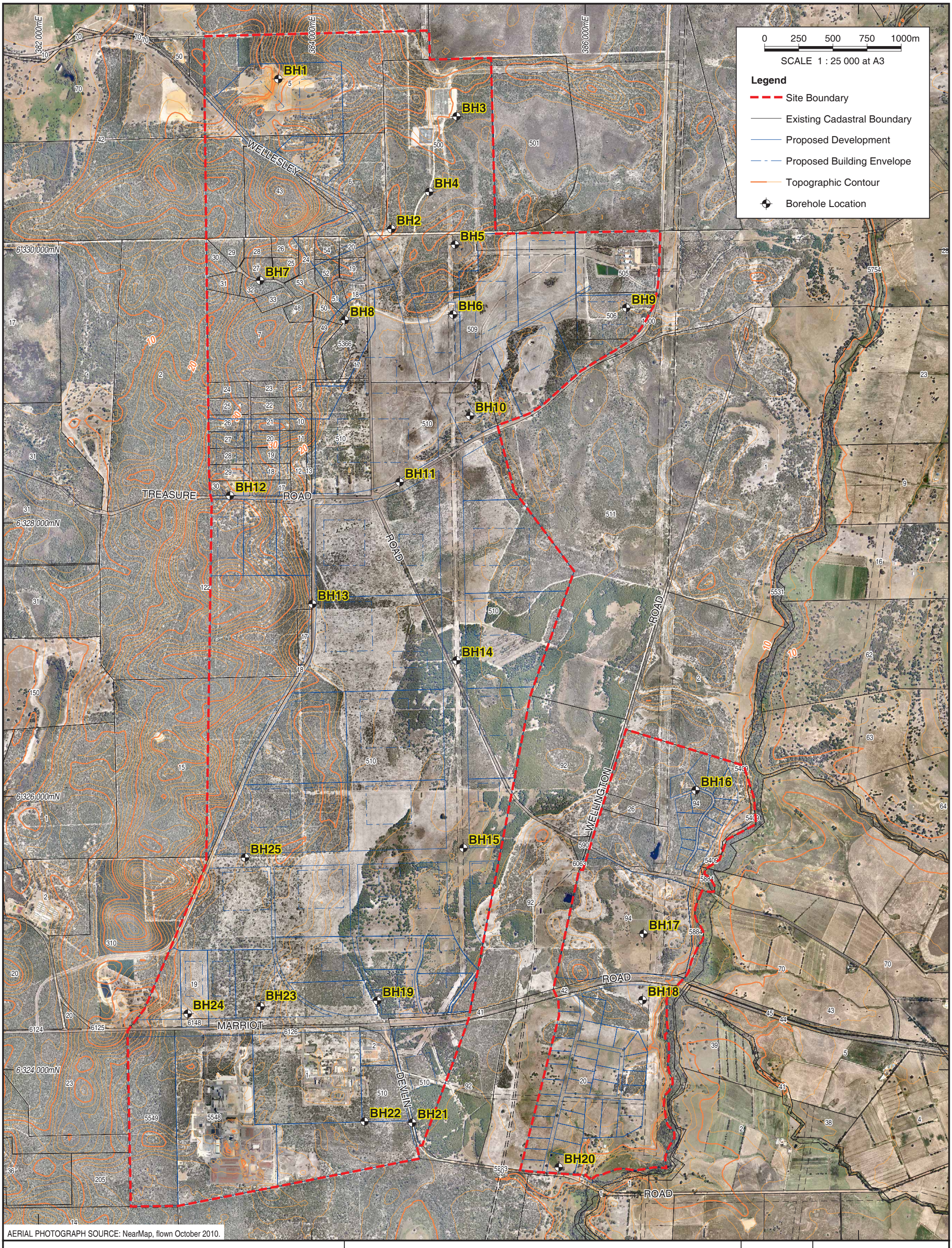
Site Locality Plan
Preliminary Geotechnical Investigation
Kemerton Industrial Park

CLIENT: LandCorp

PROJECT No.: 76136
DRAWING No.: 1
REVISION: A
DATE: 21 Mar 2011



AERIAL PHOTOGRAPH SOURCE: NearMap, flown October 2010.

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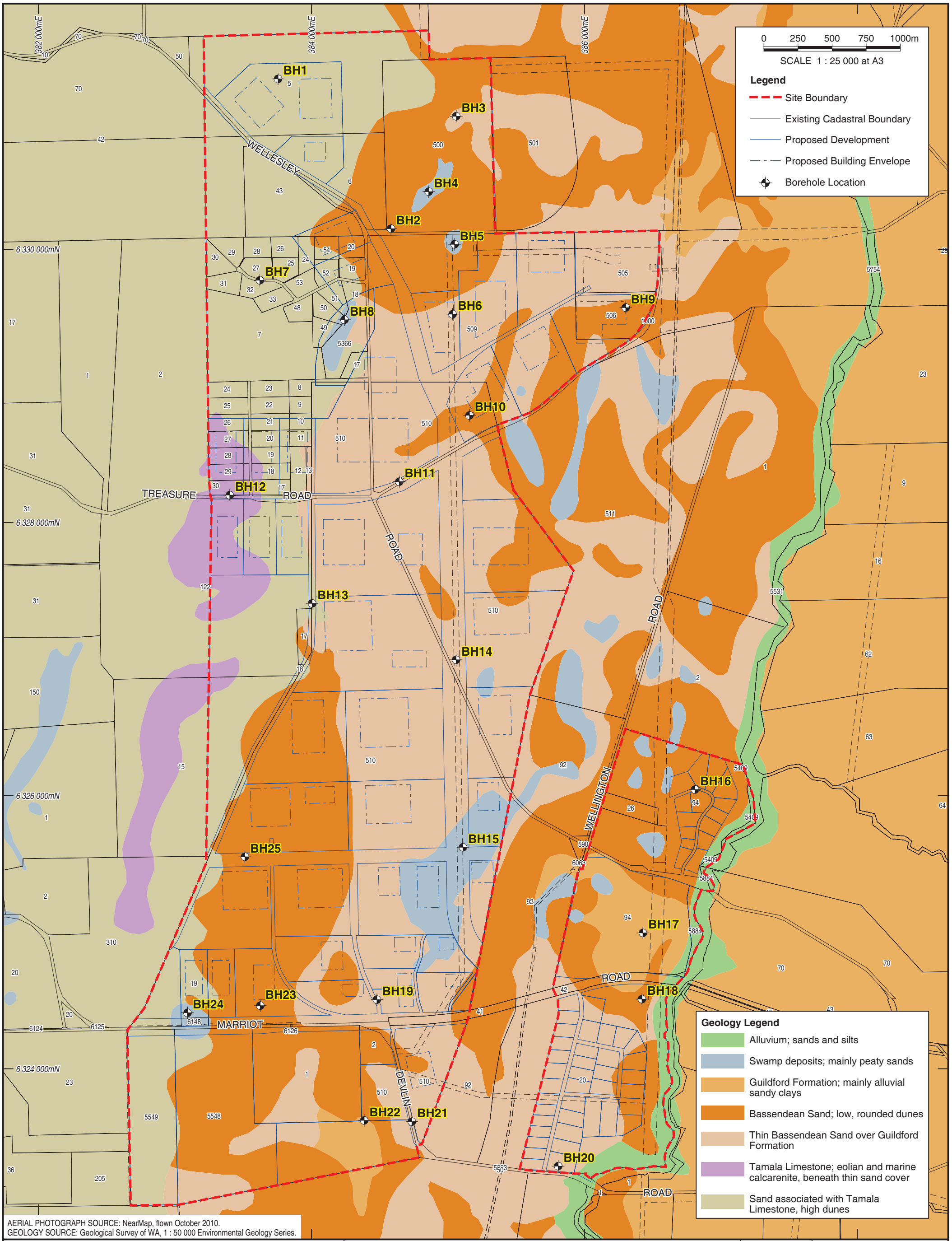
TITLE: **Test Location Plan**
Preliminary Geotechnical Investigation
Kemerton Industrial Park

MGA

CLIENT: LandCorp	PROJECT No.: 76136	DRAWING No.: 2	REVISION: A	SCALE: 1 : 25 000

OFFICE: Perth
DRAWN BY: C. Engel
DATE: 21 Mar 2011



AERIAL PHOTOGRAPH SOURCE: NearMap, flown October 2010.
GEOLOGY SOURCE: Geological Survey of WA, 1 : 50 000 Environmental Geology Series.

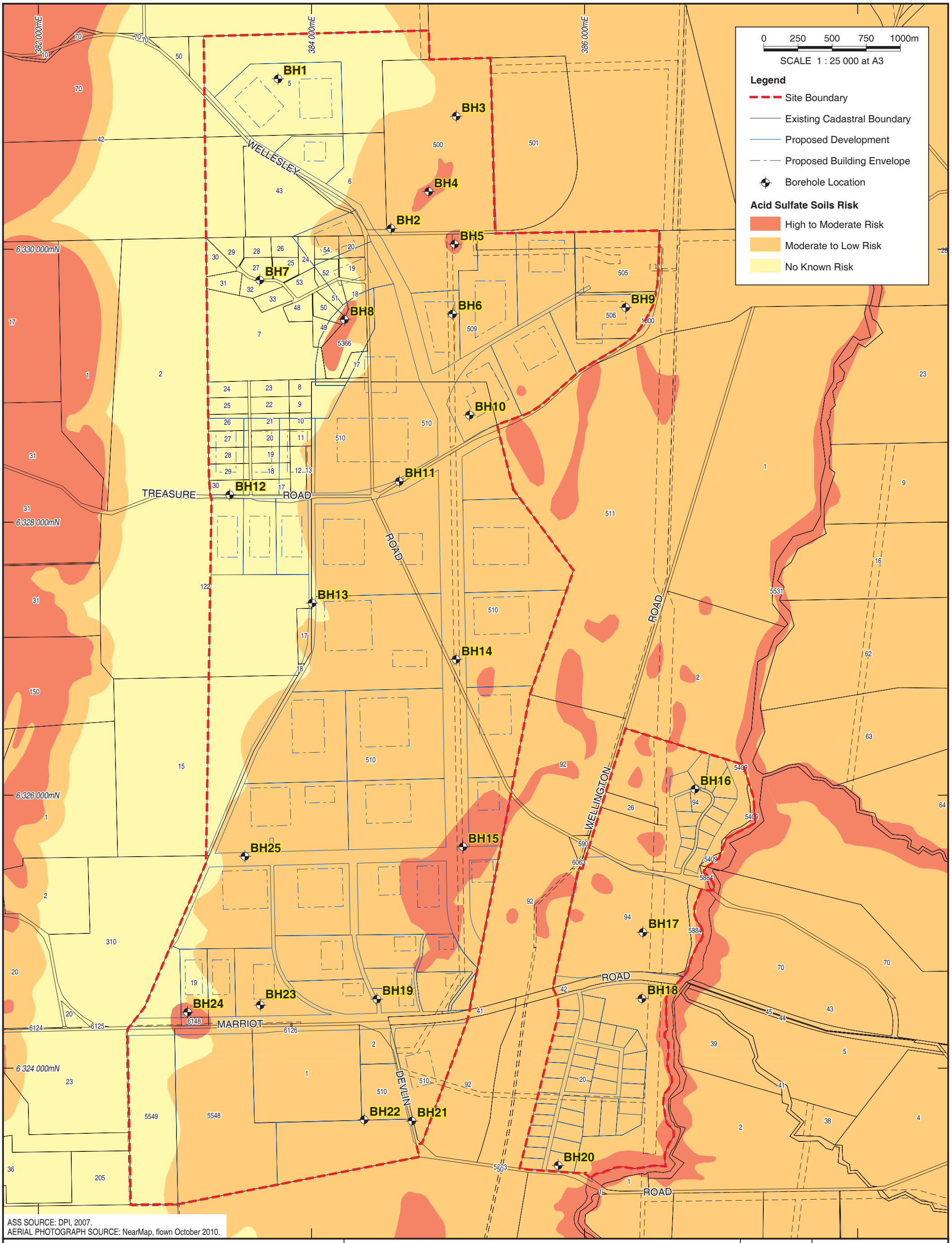
Douglas Partners
Geotechnics / Environment / Groundwater

TITLE: **Test Location Plan and Geology**
Preliminary Geotechnical Investigation
Kemerton Industrial Park

N
MGA

CLIENT: LandCorp	PROJECT No.: 76136	DRAWING No.: 3	REVISION: A

OFFICE: Perth
DRAWN BY: C. Engel
DATE: 21 Mar 2011
SCALE: 1 : 25 000



ASS SOURCE: DPI, 2007.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown October 2010.

Douglas Partners
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TITLE: **Test Location Plan and ASS Risk Mapping**
Preliminary Geotechnical Investigation
Kemerton Industrial Park

MGA

OFFICE:	Perth
DRAWN BY:	C. Engel
DATE:	21 Mar 2011

CLIENT: LandCorp	PROJECT No.: 76136	DRAWING No.: 4	REVISION: A	SCALE: 1 : 25 000

BOREHOLE LOG

CLIENT: LandCorp
PROJECT: Kemerton Industrial Park
LOCATION: Kemerton, WA

SURFACE LEVEL: 32.0 mAHD*
EASTING: 383755
NORTHING: 6331249
DIP/AZIMUTH: 90°/--

BORE No: BH01
PROJECT No: 76136
DATE: 17/2/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
32		TOPSOIL - grey, silty sandy topsoil, dry.							
	0.1	SAND - medium dense, light grey, fine to medium grained sand with a trace of silt, dry.							
31	1			D	1.0				1
		- becoming light brown from 1.2 m.							
	2								2
	2.0	Bore discontinued at 2.0m (Target)							

5 10 15 20

RIG: 110 mm Hand Auger **DRILLER:** D Reaveley **LOGGED:** D Reaveley **SURVEY DATUM:**
TYPE OF BORING: Hand Auger **CASING:**
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface level interpolated from survey provided by Wood and Grieve Engineers

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo Ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: LandCorp
PROJECT: Kemerton Industrial Park
LOCATION: Kemerton, WA

SURFACE LEVEL: 21.5 mAHD*
EASTING: 374582
NORTHING: 6330152
DIP/AZIMUTH: 90°/--

BORE No: BH02
PROJECT No: 76136
DATE: 17/2/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm) 5 10 15 20
22		TOPSOIL - dark grey, silty sandy topsoil with some rootlets, dry.							
	0.2	SAND - medium dense, light grey, fine to medium grained sand with a trace of silt, dry.							
	1								1
23									
	2	2.0 Bore discontinued at 2.0m (Target)							2

RIG: 110 mm Hand Auger **DRILLER:** D Reaveley **LOGGED:** D Reaveley **SURVEY DATUM:**
TYPE OF BORING: Hand Auger **CASING:**
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface level interpolated from survey provided by Wood and Grieve Engineers

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo Ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: LandCorp
PROJECT: Kemerton Industrial Park
LOCATION: Kemerton, WA

SURFACE LEVEL: 18.0 mAHD*
EASTING: 385060
NORTHING: 6330975
DIP/AZIMUTH: 90°/--

BORE No: BH03
PROJECT No: 76136
DATE: 17/2/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
18		SAND - medium dense, grey, fine to medium grained sand with a trace of silt, dry.		D	1.5				5 10 15 20
17	1								1
	2 2.0	Bore discontinued at 2.0m (Target)							2

RIG: 110 mm Hand Auger **DRILLER:** D Reaveley **LOGGED:** D Reaveley **SURVEY DATUM:**
TYPE OF BORING: Hand Auger **CASING:**
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface level interpolated from survey provided by Wood and Grieve Engineers

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: LandCorp
PROJECT: Kemerton Industrial Park
LOCATION: Kemerton, WA

SURFACE LEVEL: 16.3 mAHD*
EASTING: 384891
NORTHING: 6330346
DIP/AZIMUTH: 90°/--

BORE No: BH04
PROJECT No: 76136
DATE: 17/2/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm) 5 10 15 20
17	0.0	TOPSOIL - dark grey-brown, silty organic sand with fibrous root material, dry.							
	0.3	SAND - medium dense, dark grey-brown, fine to medium grained, sand with trace of silt and some fibrous root material, dry.		D	0.4				
	0.6	SAND - medium dense, grey-brown sand with a trace of silt, dry.							
1									1
2	2.0	Bore discontinued at 2.0m (Target)							2

RIG: 110 mm Hand Auger **DRILLER:** D Reaveley **LOGGED:** D Reaveley **SURVEY DATUM:**
TYPE OF BORING: Hand Auger **CASING:**
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface level interpolated from survey provided by Wood and Grieve Engineers

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: LandCorp
PROJECT: Kemerton Industrial Park
LOCATION: Kemerton, WA

SURFACE LEVEL: 16.0 mAHD*
EASTING: 385072
NORTHING: 6329964
DIP/AZIMUTH: 90°/--

BORE No: BH05
PROJECT No: 76136
DATE: 17/2/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm) 5 10 15 20
16		TOPSOIL - dark grey, silty sandy topsoil, dry.							
	0.25	SAND - medium dense, grey-brown, fine to medium grained sand with a trace of silt, dry.							
17	1								1
	2	2.0 Bore discontinued at 2.0m (Target)							2

RIG: 110 mm Hand Auger **DRILLER:** D Reaveley **LOGGED:** D Reaveley **SURVEY DATUM:**
TYPE OF BORING: Hand Auger **CASING:**
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface level interpolated from survey provided by Wood and Grieve Engineers

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: LandCorp
PROJECT: Kemerton Industrial Park
LOCATION: Kemerton, WA

SURFACE LEVEL: 16.0 mAHD*
EASTING: 385033
NORTHING: 6329526
DIP/AZIMUTH: 90°/--

BORE No: BH06
PROJECT No: 76136
DATE: 17/2/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm) 5 10 15 20
16		SAND - dark grey, fine to medium grained sand with some silt, dry.							
	0.2	SAND - medium dense, brown, fine to medium grained sand, dry.							
		- becoming dark brown/brown from 0.6 m.							
17	1			D	1.2				1
		- becoming moist from 1.5 m.							
		- dark brown and weakly cemented between 1.6-1.8 m.							
14	2	2.0 Bore discontinued at 2.0m (Target)							2

RIG: 110 mm Hand Auger **DRILLER:** D Reaveley **LOGGED:** D Reaveley **SURVEY DATUM:**
TYPE OF BORING: Hand Auger **CASING:**
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface level interpolated from survey provided by Wood and Grieve Engineers

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: LandCorp
PROJECT: Kemerton Industrial Park
LOCATION: Kemerton, WA

SURFACE LEVEL: 32.5 mAHD*
EASTING: 383621
NORTHING: 6329774
DIP/AZIMUTH: 90°/--

BORE No: BH07
PROJECT No: 76136
DATE: 17/2/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm) 5 10 15 20
33	0.15	TOPSOIL - dark grey, silty sandy topsoil with some rootlets, dry.							
		SILTY SAND - loose, dark grey, fine to medium grained silty sand, dry.		D	0.4				1
	0.75	SAND - loose, grey, fine to medium grained sand with some silt, dry.							
34	1								
	2	2.0 Bore discontinued at 2.0m (Target)							2

RIG: 110 mm Hand Auger **DRILLER:** D Reaveley **LOGGED:** D Reaveley **SURVEY DATUM:**
TYPE OF BORING: Hand Auger **CASING:**
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface level interpolated from survey provided by Wood and Grieve Engineers

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: LandCorp
PROJECT: Kemerton Industrial Park
LOCATION: Kemerton, WA

SURFACE LEVEL: 16.0 mAHD*
EASTING: 384242
NORTHING: 6329485
DIP/AZIMUTH: 90°/--

BORE No: BH08
PROJECT No: 76136
DATE: 17/2/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm) 5 10 15 20
16		TOPSOIL - dark grey, silty sandy topsoil with some rootlets, dry.							
	0.25	SAND - medium dense, dark grey-brown, fine to medium grained sand with some silt, dry.							
		- becoming light grey-brown from 0.8 m.							
17	1								1
	2	2.0 Bore discontinued at 2.0m (Target)							2

RIG: 110 mm Hand Auger **DRILLER:** D Reaveley **LOGGED:** D Reaveley **SURVEY DATUM:**
TYPE OF BORING: Hand Auger **CASING:**
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface level interpolated from survey provided by Wood and Grieve Engineers

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo Ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: LandCorp
PROJECT: Kemerton Industrial Park
LOCATION: Kemerton, WA

SURFACE LEVEL: 16.0 mAHD*
EASTING: 386301
NORTHING: 6329574
DIP/AZIMUTH: 90°/--

BORE No: BH09
PROJECT No: 76136
DATE: 17/2/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
16		TOPSOIL - dark grey, silty sandy topsoil, dry.							
	0.1	SAND - medium dense, grey, fine to medium grained sand with a trace of silt, dry.							
15	1			D	1.2				
	2	2.0 Bore discontinued at 2.0m (Target)							

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 110 mm Hand Auger
DRILLER: D Reaveley
LOGGED: D Reaveley
SURVEY DATUM:
TYPE OF BORING: Hand Auger
CASING:
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface level interpolated from survey provided by Wood and Grieve Engineers

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: LandCorp
PROJECT: Kemerton Industrial Park
LOCATION: Kemerton, WA

SURFACE LEVEL: 16.0 mAHD*
EASTING: 385157
NORTHING: 6328785
DIP/AZIMUTH: 90°/--

BORE No: BH10
PROJECT No: 76136
DATE: 17/2/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
16		SAND - medium dense, grey, fine to medium grained sand with a trace of silt, dry.		D	1.8				
17	1								1
	2	2.0 Bore discontinued at 2.0m (Target)							2

RIG: 110 mm Hand Auger
DRILLER: D Reaveley
LOGGED: D Reaveley
SURVEY DATUM:
TYPE OF BORING: Hand Auger
CASING:
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface level interpolated from survey provided by Wood and Grieve Engineers

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: LandCorp
PROJECT: Kemerton Industrial Park
LOCATION: Kemerton, WA

SURFACE LEVEL: 14.9 mAHD*
EASTING: 384643
NORTHING: 6328299
DIP/AZIMUTH: 90°/--

BORE No: BH11
PROJECT No: 76136
DATE: 17/2/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm) 5 10 15 20
15	0.15	TOPSOIL - dark grey, silty sandy topsoil, dry.							
		SAND - loose, grey-brown, fine to medium grained sand with a trace of silt, dry.							
		- becoming medium dense from 0.45 m.							
14	1								1
	1.5	Bore discontinued at 1.5m (Collapse)							
	2								2

RIG: 110 mm Hand Auger
DRILLER: D Reaveley
LOGGED: D Reaveley
SURVEY DATUM:
TYPE OF BORING: Hand Auger
CASING:
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface level interpolated from survey provided by Wood and Grieve Engineers

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: LandCorp
PROJECT: Kemerton Industrial Park
LOCATION: Kemerton, WA

SURFACE LEVEL: 38.7 mAHD*
EASTING: 383401
NORTHING: 6328201
DIP/AZIMUTH: 90°/--

BORE No: BH12
PROJECT No: 76136
DATE: 17/2/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
39	0.1	TOPSOIL - grey-brown, silty sandy topsoil, dry.							
		SAND - medium dense, yellow-brown, fine to medium grained sand with a trace of silt, dry.							
	1	- becoming orange-brown from 1.2 m.		D	1.5				
40	2	2.0 Bore discontinued at 2.0m (Target)							

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 110 mm Hand Auger
DRILLER: D Reaveley
LOGGED: D Reaveley
SURVEY DATUM:
TYPE OF BORING: Hand Auger
CASING:
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface level interpolated from survey provided by Wood and Grieve Engineers

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: LandCorp
PROJECT: Kemerton Industrial Park
LOCATION: Kemerton, WA

SURFACE LEVEL: 19.0 mAHD*
EASTING: 384004
NORTHING: 6327408
DIP/AZIMUTH: 90°/--

BORE No: BH13
PROJECT No: 76136
DATE: 17/2/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm) 5 10 15 20
19		TOPSOIL - grey, silty sandy topsoil, dry.							
	0.2	SAND - medium dense, light grey, fine to medium grained sand with a trace of silt, dry.							
20	1			D	1.0				1
		- becoming light brown from 1.7 m.							
	2	2.0 Bore discontinued at 2.0m (Target)							2

RIG: 110 mm Hand Auger
DRILLER: D Reaveley
LOGGED: D Reaveley
SURVEY DATUM:
TYPE OF BORING: Hand Auger
CASING:
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface level interpolated from survey provided by Wood and Grieve Engineers

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: LandCorp
PROJECT: Kemerton Industrial Park
LOCATION: Kemerton, WA

SURFACE LEVEL: 14.0 mAHD*
EASTING: 385059
NORTHING: 6326995
DIP/AZIMUTH: 90°/--

BORE No: BH14
PROJECT No: 76136
DATE: 17/2/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
14	0.2	TOPSOIL - grey sandy topsoil, dry.							
		SAND - medium dense, light grey, fine to medium grained sand, dry.							
13	1								1
	2.0	Bore discontinued at 2.0m (Target)							2

Dynamic Penetrometer Test (blows per 150mm) scale: 5, 10, 15, 20

RIG: 110 mm Hand Auger **DRILLER:** D Reaveley **LOGGED:** D Reaveley **SURVEY DATUM:**
TYPE OF BORING: Hand Auger **CASING:**
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface level interpolated from survey provided by Wood and Grieve Engineers

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo Ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	⧗	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: LandCorp
PROJECT: Kemerton Industrial Park
LOCATION: Kemerton, WA

SURFACE LEVEL: 12.0 mAHD*
EASTING: 385072
NORTHING: 6325764
DIP/AZIMUTH: 90°/--

BORE No: BH15
PROJECT No: 76136
DATE: 17/2/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm) 5 10 15 20
12	0.05	TOPSOIL - dark brown, silty sandy topsoil with some rootlets, dry.							
		PEATY SAND - medium dense, dark brown, fine to medium grained peaty sand with a trace of silt, dry.		D	0.4				
	0.6	SAND - medium dense, grey-brown, fine to medium grained sand, dry.							
	0.85	CEMENTED SILTY SAND (COFFEE ROCK) - moderately cemented, dark brown, cemented silty sand (coffee rock), dry.							
11	1								1
	1.1	Bore discontinued at 1.1m (Refusal)							
	2								2

RIG: 110 mm Hand Auger **DRILLER:** D Reaveley **LOGGED:** D Reaveley **SURVEY DATUM:**
TYPE OF BORING: Hand Auger **CASING:**
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface level interpolated from survey provided by Wood and Grieve Engineers

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: LandCorp
PROJECT: Kemerton Industrial Park
LOCATION: Kemerton, WA

SURFACE LEVEL: 16.0 mAHD*
EASTING: 386808
NORTHING: 6326045
DIP/AZIMUTH: 90°/--

BORE No: BH16
PROJECT No: 76136
DATE: 17/2/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm) 5 10 15 20
16	0.45	TOPSOIL - grey, silty sandy topsoil, dry.							
15	1	SAND - medium dense, light grey, fine to medium grained sand with a trace of silt, dry.							1
	1.4	Bore discontinued at 1.4m (Collapse)							
14	2								2

RIG: 110 mm Hand Auger
DRILLER: D Reaveley
LOGGED: D Reaveley
SURVEY DATUM:
TYPE OF BORING: Hand Auger
CASING:
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface level interpolated from survey provided by Wood and Grieve Engineers

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: LandCorp
PROJECT: Kemerton Industrial Park
LOCATION: Kemerton, WA

SURFACE LEVEL: 14.0 mAHD*
EASTING: 386427
NORTHING: 6324995
DIP/AZIMUTH: 90°/--

BORE No: BH17
PROJECT No: 76136
DATE: 17/2/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm) 5 10 15 20
14		TOPSOIL - dark brown, silty sandy topsoil with some rootlets, dry.							
	0.1	SAND - medium dense, light grey-brown, fine to medium grained sand with a trace of silt, dry.							
	0.5	CLAYEY SAND- medium dense, grey-brown mottled orange-brown, fine to medium grained clayey sand, moist.		D	0.7				1
13	1								
	1.2	Bore discontinued at 1.2m (Refusal)							2
12	2								

RIG: 110 mm Hand Auger **DRILLER:** D Reaveley **LOGGED:** D Reaveley **SURVEY DATUM:**
TYPE OF BORING: Hand Auger **CASING:**
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface level interpolated from survey provided by Wood and Grieve Engineers

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo Ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: LandCorp
PROJECT: Kemerton Industrial Park
LOCATION: Kemerton, WA

SURFACE LEVEL: 13.3 mAHD*
EASTING: 386420
NORTHING: 6324510
DIP/AZIMUTH: 90°/--

BORE No: BH18
PROJECT No: 76136
DATE: 17/2/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		TOPSOIL - grey, silty sandy topsoil, dry.							
	0.2	SAND - medium dense, light grey, fine to medium grained sand, dry.							
14									
	1								1
	2	2.0 Bore discontinued at 2.0m (Target)							2

RIG: 110 mm Hand Auger **DRILLER:** D Reaveley **LOGGED:** D Reaveley **SURVEY DATUM:**
TYPE OF BORING: Hand Auger **CASING:**
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface level interpolated from survey provided by Wood and Grieve Engineers

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: LandCorp
PROJECT: Kemerton Industrial Park
LOCATION: Kemerton, WA

SURFACE LEVEL: 12.8 mAHD*
EASTING: 384479
NORTHING: 6324506
DIP/AZIMUTH: 90°/--

BORE No: BH19
PROJECT No: 76136
DATE: 17/2/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
13	0.05	TOPSOIL - light grey, silty sandy topsoil, dry.							
		SAND - medium dense, light grey, fine to medium grained sand, dry.		D	0.5				
	1								1
14	1.1	Bore discontinued at 1.1m (Collapse)							
	2								2

RIG: 110 mm Hand Auger **DRILLER:** D Reaveley **LOGGED:** D Reaveley **SURVEY DATUM:**
TYPE OF BORING: Hand Auger **CASING:**
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface level interpolated from survey provided by Wood and Grieve Engineers

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: LandCorp
PROJECT: Kemerton Industrial Park
LOCATION: Kemerton, WA

SURFACE LEVEL: 12.0 mAHD*
EASTING: 385849
NORTHING: 6323229
DIP/AZIMUTH: 90°/--

BORE No: BH20
PROJECT No: 76136
DATE: 17/2/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm) 5 10 15 20
12		TOPSOIL - grey, silty sandy topsoil, dry.							
	0.25	SAND - medium dense, light grey-brown, fine to medium grained sand with a trace of silt, dry.							
11	1	- becoming light grey from 1.2 m.		D	1.0				1
	1.5	Bore discontinued at 1.5m (Target)							
	2								2

RIG: 110 mm Hand Auger **DRILLER:** D Reaveley **LOGGED:** D Reaveley **SURVEY DATUM:**
TYPE OF BORING: Hand Auger **CASING:**
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface level interpolated from survey provided by Wood and Grieve Engineers

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics I Environment I Groundwater

BOREHOLE LOG

CLIENT: LandCorp
PROJECT: Kemerton Industrial Park
LOCATION: Kemerton, WA

SURFACE LEVEL: 12.5 mAHD*
EASTING: 384735
NORTHING: 6323613
DIP/AZIMUTH: 90°/--

BORE No: BH21
PROJECT No: 76136
DATE: 17/2/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm) 5 10 15 20
		TOPSOIL - grey, silty sandy topsoil, dry.							
	0.15	SAND - medium dense, grey, fine to medium grained sand, dry.							
13									
	1								1
14									
	2	2.0 Bore discontinued at 2.0m (Target)							2

RIG: 110 mm Hand Auger **DRILLER:** D Reaveley **LOGGED:** D Reaveley **SURVEY DATUM:**
TYPE OF BORING: Hand Auger **CASING:**
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface level interpolated from survey provided by Wood and Grieve Engineers

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: LandCorp
PROJECT: Kemerton Industrial Park
LOCATION: Kemerton, WA

SURFACE LEVEL: 13.1 mAHD*
EASTING: 384386
NORTHING: 6323622
DIP/AZIMUTH: 90°/--

BORE No: BH22
PROJECT No: 76136
DATE: 17/2/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm) 5 10 15 20
14	0.15	TOPSOIL - dark grey, silty sandy topsoil, dry.							
	1	SAND - medium dense, light grey, fine to medium grained sand, dry.		D	1.0				1
	1.4	Bore discontinued at 1.4m (Collapse)							
	2								2

RIG: 110 mm Hand Auger
DRILLER: D Reaveley
LOGGED: D Reaveley
SURVEY DATUM:
TYPE OF BORING: Hand Auger
CASING:
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface level interpolated from survey provided by Wood and Grieve Engineers

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics I Environment I Groundwater

BOREHOLE LOG

CLIENT: LandCorp
PROJECT: Kemerton Industrial Park
LOCATION: Kemerton, WA

SURFACE LEVEL: 16.7 mAHD*
EASTING: 324420
NORTHING: 6324420
DIP/AZIMUTH: 90°/--

BORE No: BH23
PROJECT No: 76136
DATE: 17/2/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
17	0.2	TOPSOIL - dark grey, silty sandy topsoil, dry.							
		SAND - medium dense, grey, fine to medium grained sand, dry.							
	1								1
18		- light brown from 1.2 m.		D	1.5				
	2 2.0	Bore discontinued at 2.0m (Target)							2

RIG: 110 mm Hand Auger **DRILLER:** D Reaveley **LOGGED:** D Reaveley **SURVEY DATUM:**
TYPE OF BORING: Hand Auger **CASING:**
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface level interpolated from survey provided by Wood and Grieve Engineers

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: LandCorp
PROJECT: Kemerton Industrial Park
LOCATION: Kemerton, WA

SURFACE LEVEL: 13.0 mAHD*
EASTING: 383092
NORTHING: 6324410
DIP/AZIMUTH: 90°/--

BORE No: BH24
PROJECT No: 76136
DATE: 17/2/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
13		SAND - medium dense, light brown, fine to medium grained sand, dry.		D	1.0				5 10 15 20
14	1								1
	2	2.0 Bore discontinued at 2.0m (Target)							2

RIG: 110 mm Hand Auger **DRILLER:** D Reaveley **LOGGED:** D Reaveley **SURVEY DATUM:**
TYPE OF BORING: Hand Auger **CASING:**
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface level interpolated from survey provided by Wood and Grieve Engineers

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics I Environment I Groundwater

BOREHOLE LOG

CLIENT: LandCorp
PROJECT: Kemerton Industrial Park
LOCATION: Kemerton, WA

SURFACE LEVEL: 14.0 mAHD*
EASTING: 384497
NORTHING: 6325505
DIP/AZIMUTH: 90°/--

BORE No: BH25
PROJECT No: 76136
DATE: 17/2/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
14		TOPSOIL - dark grey, silty sandy topsoil, dry.							
	0.1	SAND - medium dense, light grey, fine to medium grained sand with a trace of silt, dry.							
13	1								1
	2.0	Bore discontinued at 2.0m (Target)							2

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: 110 mm Hand Auger **DRILLER:** D Reaveley **LOGGED:** D Reaveley **SURVEY DATUM:**
TYPE OF BORING: Hand Auger **CASING:**
WATER OBSERVATIONS: No free groundwater observed
REMARKS: * Surface level interpolated from survey provided by Wood and Grieve Engineers

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

Appendix B

Geotechnical Laboratory Testing

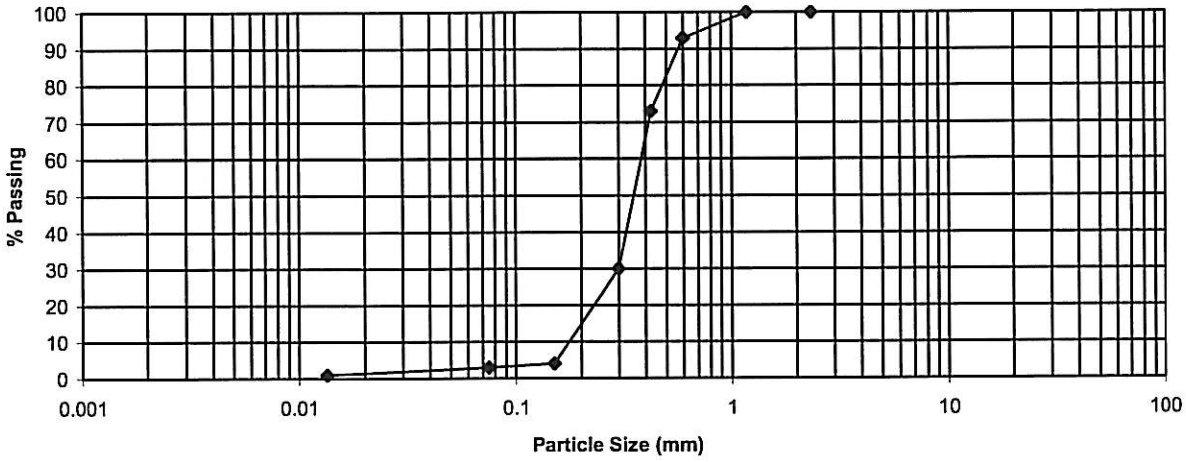
Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: kevin@mcgeotest.com.au

Job No:	**60017**
Report No:	**60017-P11/542**
Sample No:	**P11/542**
Issue Date:	**28 February 2011**

Client: **Landcorp**
Project: **Kemerton Industrial Park**
Location: **Kemerton**

Sample Location: **BH 3**
Depth (m): **1.5**



SIEVE ANALYSIS WA 115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	93
0.425	73
0.300	30
0.150	4
0.075	3
0.0135	1

Plasticity Index tests
Australian Standard 1289.

Liquid Limit 3.1.1	na	%
Plastic Limit 3.2.1		%
Plasticity Index 3.3.1		%
Linear Shrinkage 3.4.1		%
Cracked	☐	
Curled	☐	

Client address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA
WORLD RECOGNISED ACCREDITATION

Approved signature

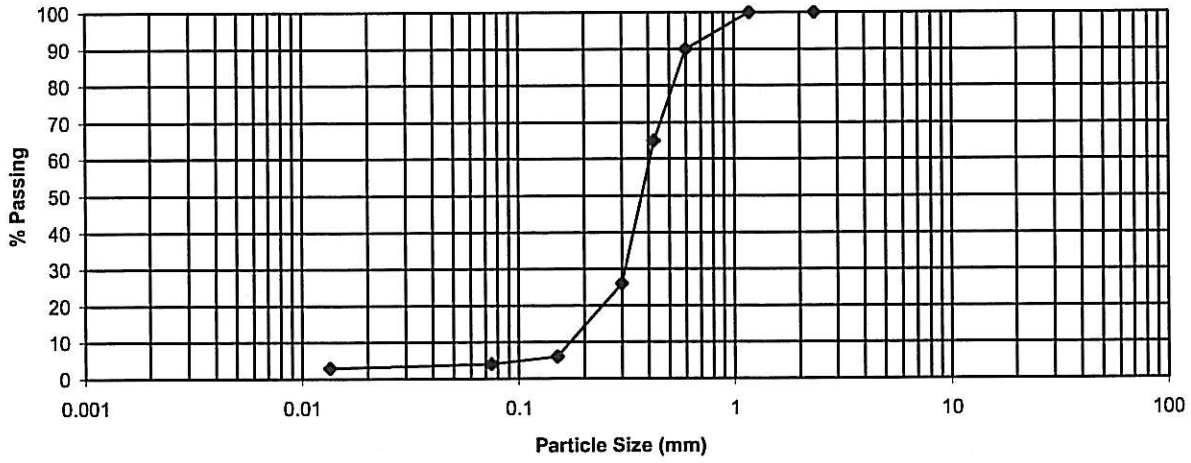
Kevin M Jones

Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: kevin@mcgeotest.com.au

Job No:	**60017**
Report No:	**60017-P11/543**
Sample No:	**P11/543**
Issue Date:	**28 February 2011**
Sample Location:	**BH 4**
Depth (m):	**0.4**

Client: **Landcorp**
Project: **Kemerton Industrial Park**
Location: **Kemerton**



SIEVE ANALYSIS WA 115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	90
0.425	65
0.300	26
0.150	6
0.075	4
0.0135	3

Plasticity Index tests
Australian Standard 1289.

Liquid Limit 3.1.1	na	%
Plastic Limit 3.2.1		%
Plasticity Index 3.3.1		%
Linear Shrinkage 3.4.1		%
Cracked	☐	
Curled	☐	

Client address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

Approved signature

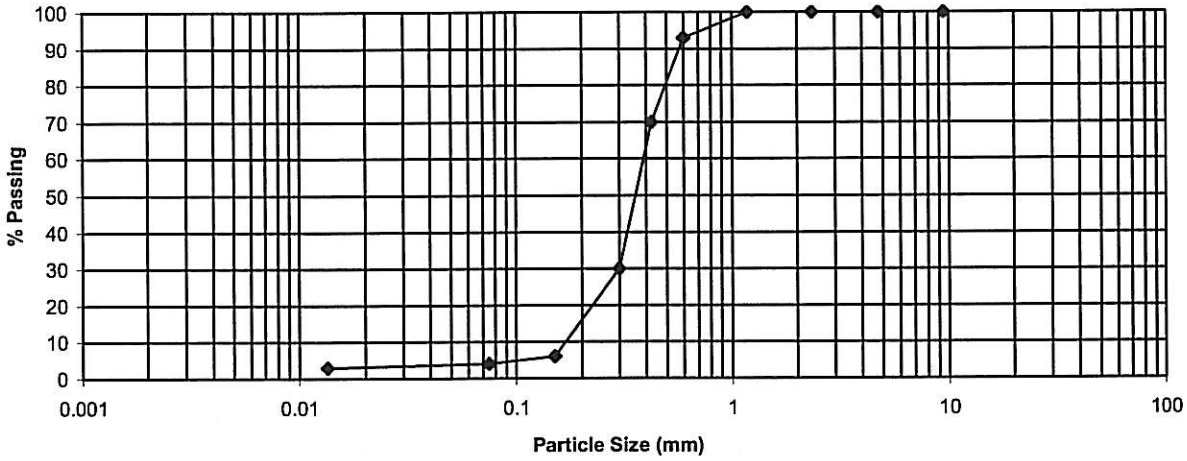
Kevin M Jones

Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: kevin@mcgeotest.com.au

Job No:	**60017**
Report No:	**60017-P11/544**
Sample No:	**P11/544**
Issue Date:	**28 February 2011**
Sample Location:	**BH 9**
Depth (m):	**1.2**

Client: **Landcorp**
Project: **Kemerton Industrial Park**
Location: **Kemerton**



SIEVE ANALYSIS WA 115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	100
4.75	100
2.36	100
1.18	100
0.600	93
0.425	70
0.300	30
0.150	6
0.075	4
0.0135	3

Plasticity Index tests
Australian Standard 1289.

Liquid Limit 3.1.1	na	%
Plastic Limit 3.2.1		%
Plasticity Index 3.3.1		%
Linear Shrinkage 3.4.1		%
Cracked	☐	
Curled	☐	

Client address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

Approved signature

Kevin M Jones

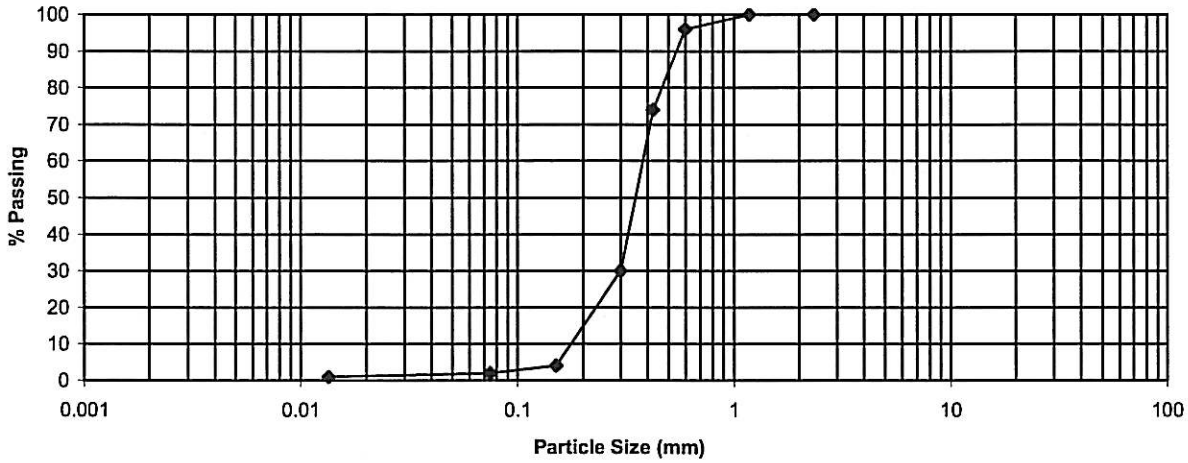
Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: kevin@mcgeotest.com.au

Job No:	**60017**
Report No:	**60017-P11/545**
Sample No:	**P11/545**
Issue Date:	**28 February 2011**

Client: **Landcorp**
Project: **Kemerton Industrial Park**
Location: **Kemerton**

Sample Location: **BH 12**
Depth (m): **1.5**



SIEVE ANALYSIS WA 115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	96
0.425	74
0.300	30
0.150	4
0.075	2
0.0135	1

Plasticity Index tests
Australian Standard 1289.

Liquid Limit 3.1.1	na	%
Plastic Limit 3.2.1		%
Plasticity Index 3.3.1		%
Linear Shrinkage 3.4.1		%
Cracked	☐	
Curled	☐	

Client address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

Approved signature

Kevin M Jones

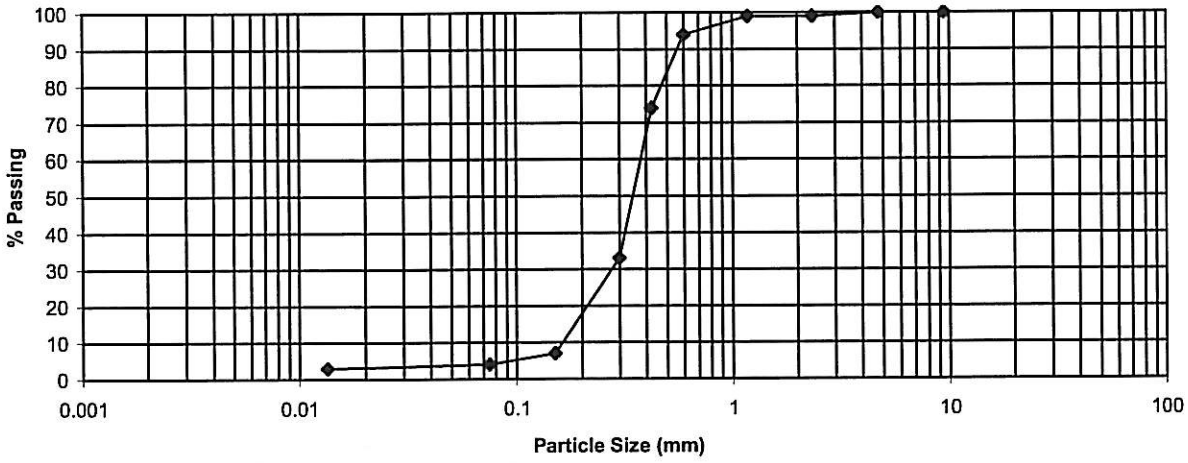
Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: kevin@mcgeotest.com.au

Job No:	**60017**
Report No:	**60017-P11/546**
Sample No:	**P11/546**
Issue Date:	**28 February 2011**

Client: **Landcorp**
Project: **Kemerton Industrial Park**
Location: **Kemerton**

Sample Location: **BH 15**
Depth (m): **0.4**



SIEVE ANALYSIS WA 115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	100
4.75	100
2.36	99
1.18	99
0.600	94
0.425	74
0.300	33
0.150	7
0.075	4
0.0135	3

Plasticity Index tests
Australian Standard 1289.

Liquid Limit 3.1.1	na	%
Plastic Limit 3.2.1		%
Plasticity Index 3.3.1		%
Linear Shrinkage 3.4.1		%
Cracked	☐	
Curled	☐	

Client address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

Approved signature

Kevin M Jones

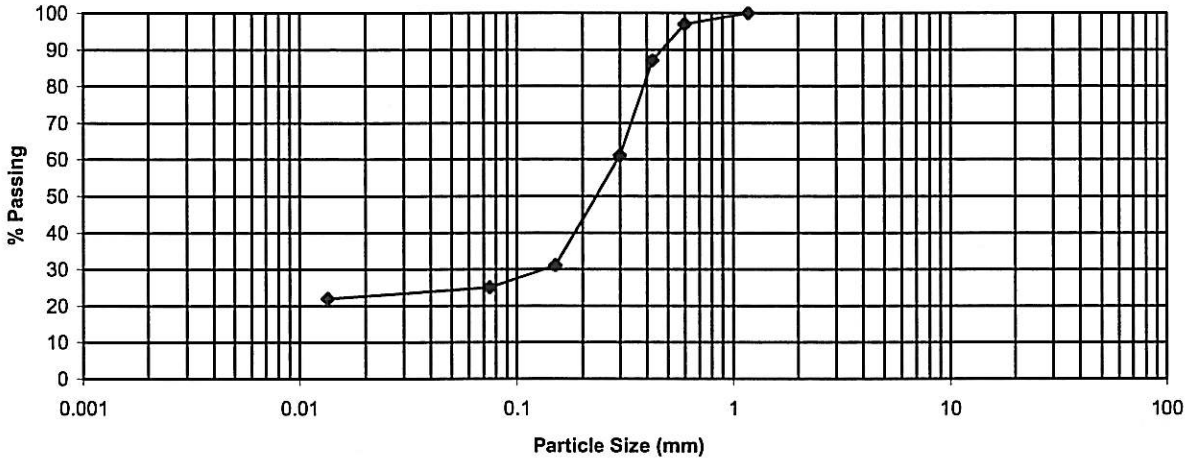
Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: kevin@mcgeotest.com.au

Job No:	**60017**
Report No:	**60017-P11/547**
Sample No:	**P11/547**
Issue Date:	**28 February 2017**

Client: **Landcorp**
Project: **Kemerton Industrial Park**
Location: **Kemerton**

Sample Location: **BH 17**
Depth (m): **0.7**



SIEVE ANALYSIS WA 115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	
1.18	100
0.600	97
0.425	87
0.300	61
0.150	31
0.075	25
0.0135	22

Plasticity Index tests
Australian Standard 1289.

Liquid Limit 3.1.1	38	%
Plastic Limit 3.2.1	15	%
Plasticity Index 3.3.1	23	%
Linear Shrinkage 3.4.1	8.0	%

Cracked ☑
Curled ☐

Client address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA
WORLD RECOGNISED ACCREDITATION

Approved signature

Kevin M Jones

Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
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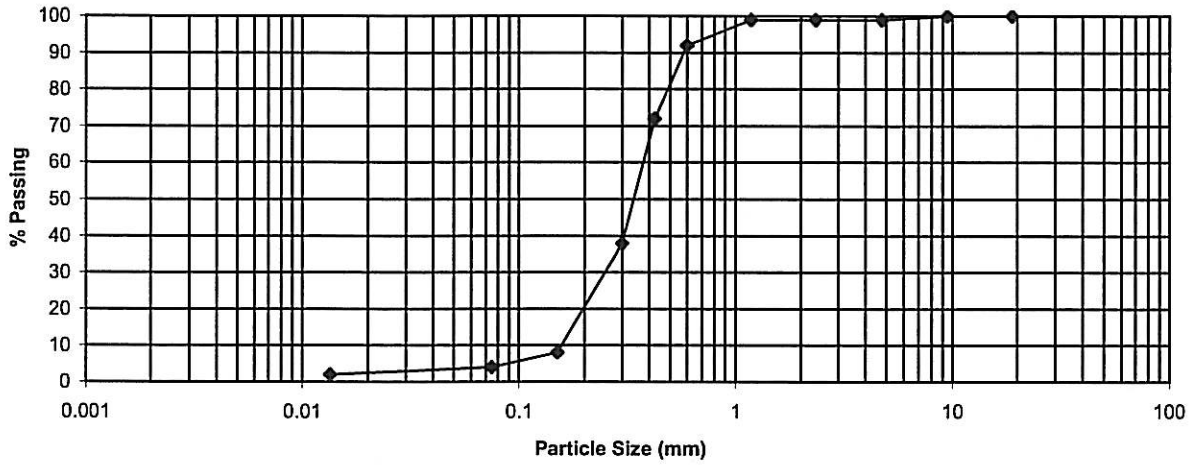
Email: kevin@mcgeotest.com.au

Job No:	**60017**
Report No:	**60017-P11/548**
Sample No:	**P11/548**
Issue Date:	**28 February 2017**
Client:	**Landcorp**
Project:	**Kemerton Industrial Park**
Location:	**Kemerton**
Sample Location:	**BH 20**
Depth (m):	**1.0**



SIEVE ANALYSIS WA 115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	100
9.5	100
4.75	99
2.36	99
1.18	99
0.600	92
0.425	72
0.300	38
0.150	8
0.075	4
0.0135	2

Plasticity Index tests		
Australian Standard 1289.		
Liquid Limit 3.1.1	na	%
Plastic Limit 3.2.1		%
Plasticity Index 3.3.1		%
Linear Shrinkage 3.4.1		%
Cracked	☐	
Curled	☐	

Client address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

Approved signature

Kevin M Jones

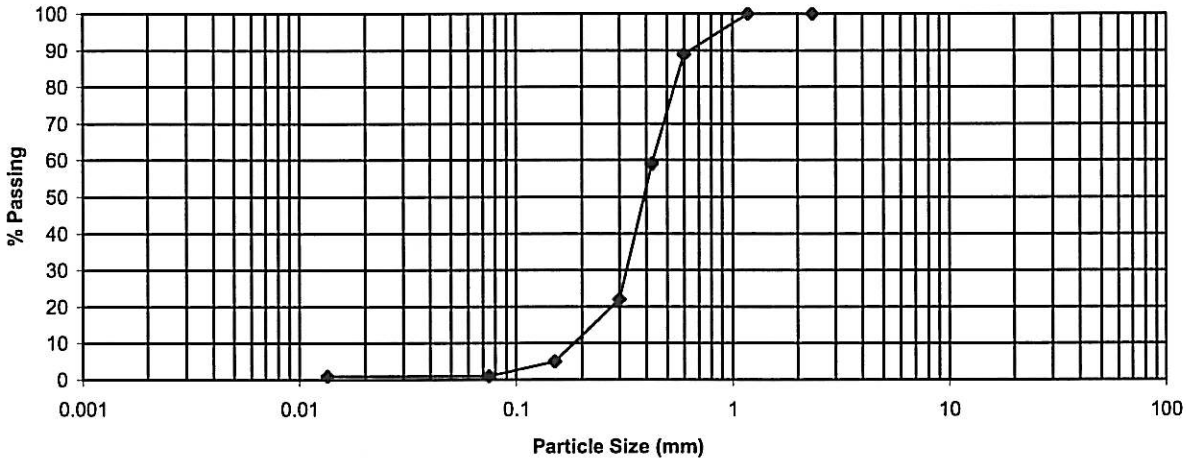
Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: kevin@mcgeotest.com.au

Job No:	**60017**
Report No:	**60017-P11/549**
Sample No:	**P11/549**
Issue Date:	**28 February 2017**

Client: **Landcorp**
Project: **Kemerton Industrial Park**
Location: **Kemerton**

Sample Location: **BH 23**
Depth (m): **1.5**



SIEVE ANALYSIS WA 115.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	89
0.425	59
0.300	22
0.150	5
0.075	1
0.0135	1

Plasticity Index tests
Australian Standard 1289.

Liquid Limit 3.1.1	na	%
Plastic Limit 3.2.1		%
Plasticity Index 3.3.1		%
Linear Shrinkage 3.4.1		%
Cracked	☐	
Curled	☐	

Client address: 36 O'Malley Street, Osborne Park

Sampling Procedure: Tested as received

NATA
WORLD RECOGNISED ACCREDITATION

Approved signature

Kevin M Jones

Mining & Civil Geotest Pty Ltd

Ph (08) 9414 8022 Fax (08) 9414 8011

Email kevin@mcgeotest.com.au

Unit 1/1 Pusey Road, JANDAKOT WA 6164

Organic content of Soils
ASTM: D 2974-07a
Test Method C

Job No: 60017

Report No: 60017-P11/543

Date of issue: 28 February 2011

Client: Landcorp

Project: Kemerton Industrial Park
Kemerton

Date tested: 23 February 2011

Tested by: J Waldron

Checked: K M Jones

Sample Number	Sample Identification & Depth (m)	Ash content %	Organic content %
P11/543	BH 4, 0.4	96.7	3.3
P11/546	BH 15, 0.4	96.9	3.1
Tested as received	Furnace temperature 440^{oc}		

Client address: 36 O'Malley St, Osborne Park

Organic content April 2009

Approved Signature Kevin M Jones

Appendix P

Annual Average Maximum Groundwater Levels Plan (RPS)

38 Station Steet, Subiaco | T +61 8 92111111 | F +61 8 92111122 | www.rpsgroup.com.au

LEGEND

- Site Boundary
- Site Boundary Buffer
- Cadastre
- Average Annual Maximum Groundwater Level (mAHD)

MYALUP BEACH RD
MYALUP RD
BOONIJUP RD
FREDRICK RD
PEAD RD
RUNNYMEDE RD
TARANTO RD
NOBLE ST
ALLANSON RD
BINNINUP RD
OLD COAST RD
CAVES RD
SPRINGHILL RD
TREASURE RD
RHODES RD
MELLESSE RD N
MELLESSE RD
CAMPBELL RD
HOPEAY
MITCHELL RD
BUFFALO RD
ROSAMEL RD
HARRIOTT RD
PARTRIDGE RD
DEVLIN RD
ENGLAND RD
WHEELESLEY RD
PETREN RD
MELVILLE RD
NOAKES L
GEORGE AV
SOUTH WESTERN HWY
CLIFTON RD
AVALON RD
LEISURE DR
PARIS RD
BRIGHTON RD
BARTON DR
NEWSON DR
LITTLE PL
CANTERBURY AV
STANLEY RD
1
2
3
4
5
6
8
9
10
11
12
13
14

Job Number: D1054201
Date: 18.11.14
Scale: 1:50,000 @ A3
Version: A
Drafted by: MR
Source: Orthophoto - Landgate, 2008 Cadastre - Landgate, 2011

0 0.25 0.5 1 1.5 2 km

Figure 7

Average Annual Maximum Groundwater Levels (AAMGL)

Appendix Q

Transport Assessment Report, by Transcore (Transcore ref. t10.209 Revision r02b, dated August 2014)

Kemerton Industrial Park
Updated Local Structure Plan
Transport Assessment

PREPARED FOR:
Landcorp

August 2014

Document history and status

Author	Revision	Approved by	Date approved	Revision type
C Sun	r02	B Bordbar	July 2011	Draft
C Sun	r02a	B Bordbar	July 2011	Final
M Rasouli	r02b	B Bordbar	August 2014	Revised Final

File name: t10.209.mr.r02b.docx

Author: Mohammad Rasouli

Project manager: Behnam Bordbar

Client: Landcorp

Project: Kemerton Industrial Park, Revised Structure Plan

Document revision: r02b

Project number: t10.209

TABLE OF CONTENTS

REPORT FIGURES

REPORT TABLES

1.0 Introduction

In July 2010 Transcore prepared a Transport Assessment (TA) report for Kemmerton Industrial Park (KIP) Local Structure Plan (LSP). Recently TPG Town Planners have prepared an updated LSP for KIP (dated June 2014). This TA provides an update on the July 2010 report and is based on the latest LSP.

One of the key objectives of this report is to ensure that the existing road infrastructure and proposed internal roads are capable of accommodating the projected additional vehicle flows generated by the proposed updated LSP land uses.

The subject site is located approximately 17km northeast of Bunbury, 160km south of Perth, and 3.5km east of Old Coast Road and Marriott Road intersection (refer **Figure 1**). The KIP is situated between two highways, Forrest Highway (Old Coast Road) and South Western Highway, which makes it highly accessible and well positioned to connect to the Perth metropolitan area and serve the hinterland of the South West region and its substantial primary industries.

The majority of the land within the KIP Core is owned by LandCorp. Existing Industry within the Park is predominately located in the south half of the KIP Core along Marriott Road, including Simcoa (Silicon Smelter) Cristal Global (Titanium Dioxide Plant) Coogee Chemicals (Chlorine Gas and Sodium Hydroxide Plant).

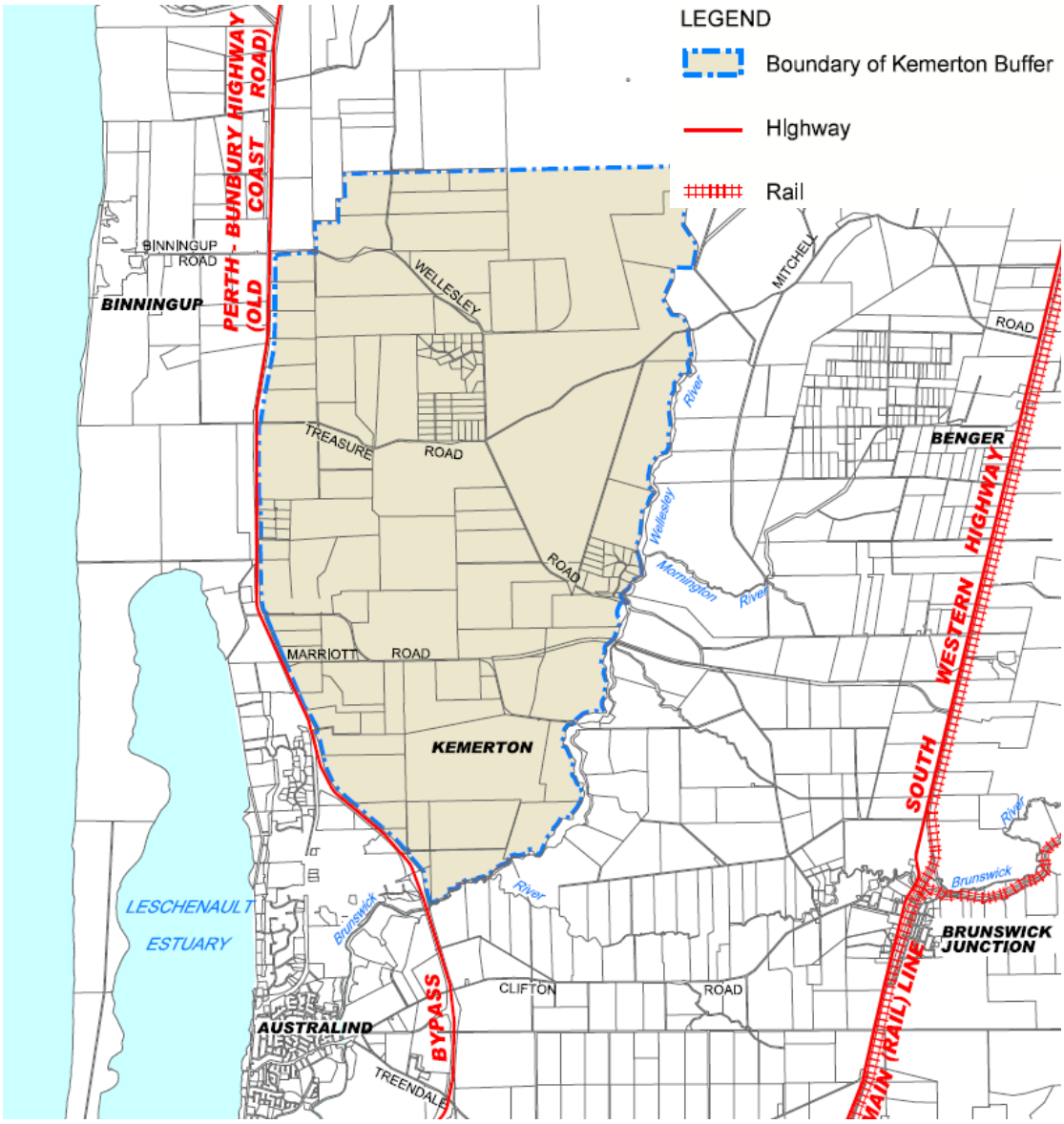


Figure 1: Location of the Subject Site

2.0 Proposed Local Structure Plan

The proposed revised LSP concept is shown in **Figure 2**. The proposed LSP includes two major parts: the KIP core industry which covers the majority of the subject site and the KIP ancillary (support) industry. The proposed LSP will gain access to Old Cost Road from west though Marriott Road, Treasure Road and Kemerton Road. Marriot Road also provides connection to South Western Highway to the east.

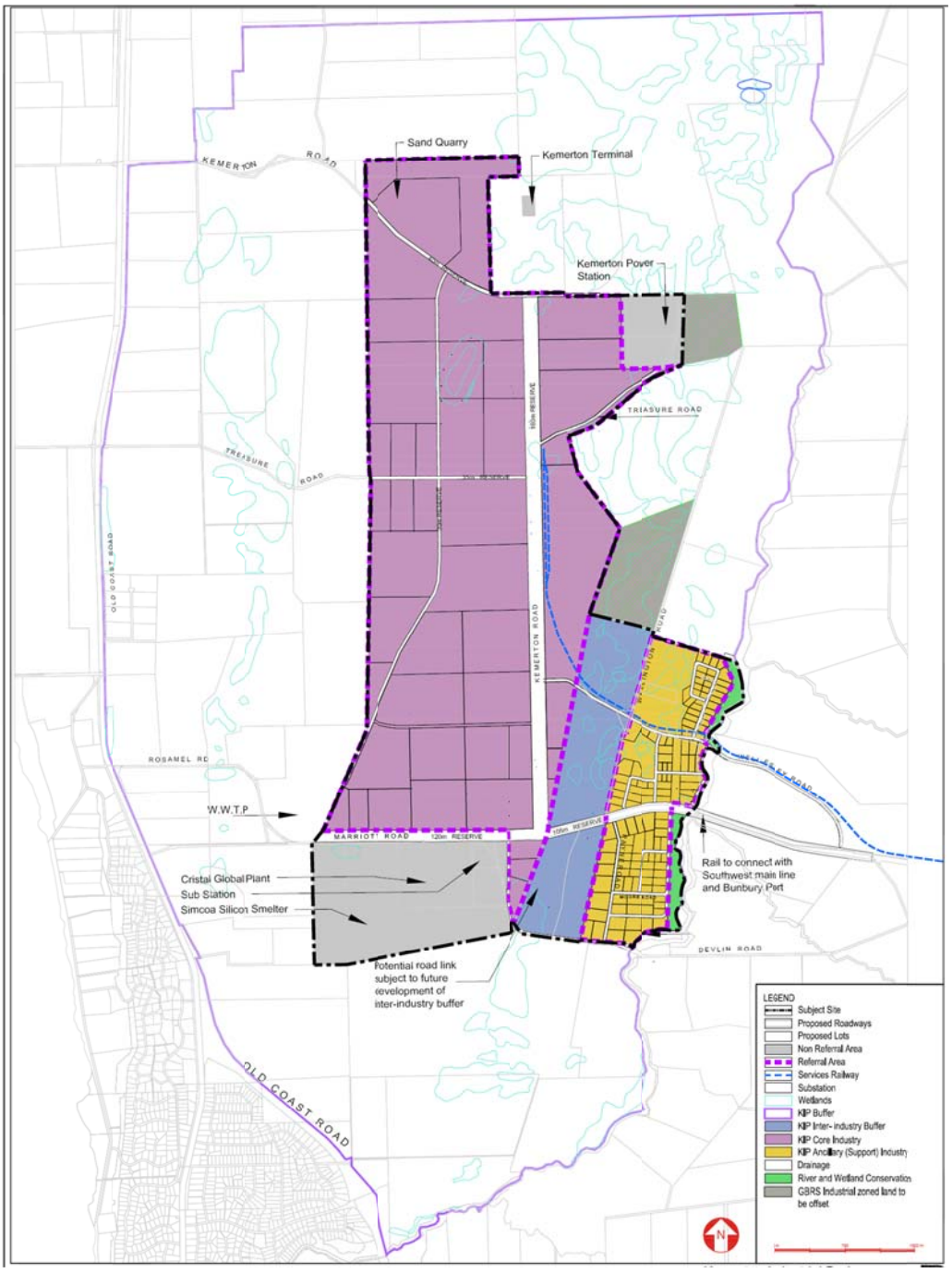


Figure 2: Proposed Revised Local Structure Plan

3.0 Existing Situation

3.1 Existing Land Use

There are existing industrial land uses to the south of Marriott Road including Simcoa (Silicon Smelter) Cristal Global (Titanium Dioxide Plant) Coogee Chemicals (Chlorine Gas and Sodium Hydroxide Plant). The balance of the site is currently

3.2 Existing Road Network

Marriott Road is a Regional Distributor with constructed to single carriageway standard. It links Old Coast Road to the west and South Western Highway to the east. Currently, the speed limit is 90km/h between Old Coast Road and Devlin Road (southeast corner of the subject site). It increases to 110km/h east of Devlin Road and drops to 80km/h on the approach to South Western Highway intersection. Most of the road has a seal width of 7m.

Marriott Road intersects with Old Coast Road at a priority controlled T-intersection with a wide median on Old Coast Road. The left-turn pocket on Old Coast Road is approximately 200m long (including taper) and the right-turn pocket is approximately 720m long (including taper).

Marriott Road traverses the subject site but most of the LSP area is located to its north. According to the information obtained from the Shire of Harvey, the average weekday traffic in January-February 2009 on Marriott Road east of the subject site is 335 vehicles per day (vpd). The average weekday traffic west of the subject site is 1,440vpd, based on an April 2010 Main Roads WA (MRWA) traffic count.

Kemerton Industrial Park Strategy Plan (Government of Western Australia, 2009: p.93) states that "*Marriott Road would be built to industrial standards and has good capacity for connection to the regional road network, especially to the Port of Bunbury*".

Old Coast Road (Forrest Highway) is classified as a Primary Distributor, connecting WA's second-largest city (Mandurah) to the third-largest city Bunbury. Old Coast Road is a dual carriageway with two-lanes in each direction and speed limit of 110km/h in the vicinity of the subject site. Approximately 3.5km west of the subject site, Old Coast Road intersects with Marriott Road.

In the vicinity of the subject site, Old Coast Road has intersections with Marriott Road, Dunn Road, Treasure Road and Wellesley Road, all of which are T-intersections with a wide median. According to MRWA's traffic counts dated August 2013, Old Coast Road carried about 14,000 vehicles on an average weekday south of Marriott Road.

South Western Highway stretches from Armadale to Walpole, about 406km in length. It passes Bunbury's industrial suburb of Picton but does not enter Bunbury. It is a Primary Distributor constructed to single carriageway standard, with one lane in each direction. It has a seal width of about 9m and speed limit of 110km/h in the vicinity of the Marriott Road.

South Western Highway intersects with Marriott Road at a priority controlled T-intersection on South Western Highway, the left turn pocket (including taper) is about 160m long and the southbound traffic lane is widened to allow through traffic to pass right turning vehicles. According to MRWA's traffic counts dated Dec 2005, South Western Highway carried 4,890 vehicles on an average weekday north of Marriott Road.

Wellesley Road is a two-lane Local Distributor built to rural standard with single carriageway. It connects to Old Coast Road in the north and Clifton Road in the south. Marriott Road breaks it into Wellesley Road North and Wellesley Road South, with the seal width of 5m and 5.8m respectively. Wellesley Road also intersects with Treasure Road within the Subject Site.

Old Coast Road intersects Wellesley Road at a T-intersection with wide median. The right turn pocket including taper is about 255m long and the left turn pocket including taper is about 220m long.

According to the Shire of Harvey traffic counts, Wellesley Road carried average weekday traffic of 235vpd east of Old Coast Road (March 2008), 164vpd (March 2008) west of Marriott Road and 181vpd south of Marriott Road (February 2011). The latest traffic counts on 17 February 2012 sourced from the Shire indicate 154vpd on Wellesley Road 1 km south of Treasure Road.

Treasure Road connects Old Coast Road and Wellesley Road. It is a two-lane Access Road built to rural road standard with single carriageway (seal width 5m).

At the intersection with Old Coast Road the right turn pocket including taper is about 220m long, and the left turn pocket including taper is about 190m long. Currently no traffic counts are available for this road.

Dunn Road and Bonny Road

In the vicinity of the Subject Site Dunn Road intersects with Old Coast Road. However, at the other end it connects to Bonny Road which is a cul-de-sac that provides access to local residents only. As a result both of these roads are not significantly affected by the KIP.

3.3 Changes to the Surrounding Road Network

The changes to the surrounding road network include the realignment of Wellesley Road and a new T-intersection on Marriott Road at its intersection with the proposed main N-S spine road (Kemerton Road).

4.0 Proposed Transport Network

4.1 Road Hierarchy and Road Reserve Width

The proposed road hierarchy of the KIP as shown in **Figure 3** is based on transport modelling undertaken, the resultant projected traffic volumes and the recommendations contained in the following guide lines:

- *WAPC Policy DC 4.1 (Industrial Subdivision); and*
- *Austroads Guide to Road Design Part 3: Geometric Design (2011).*

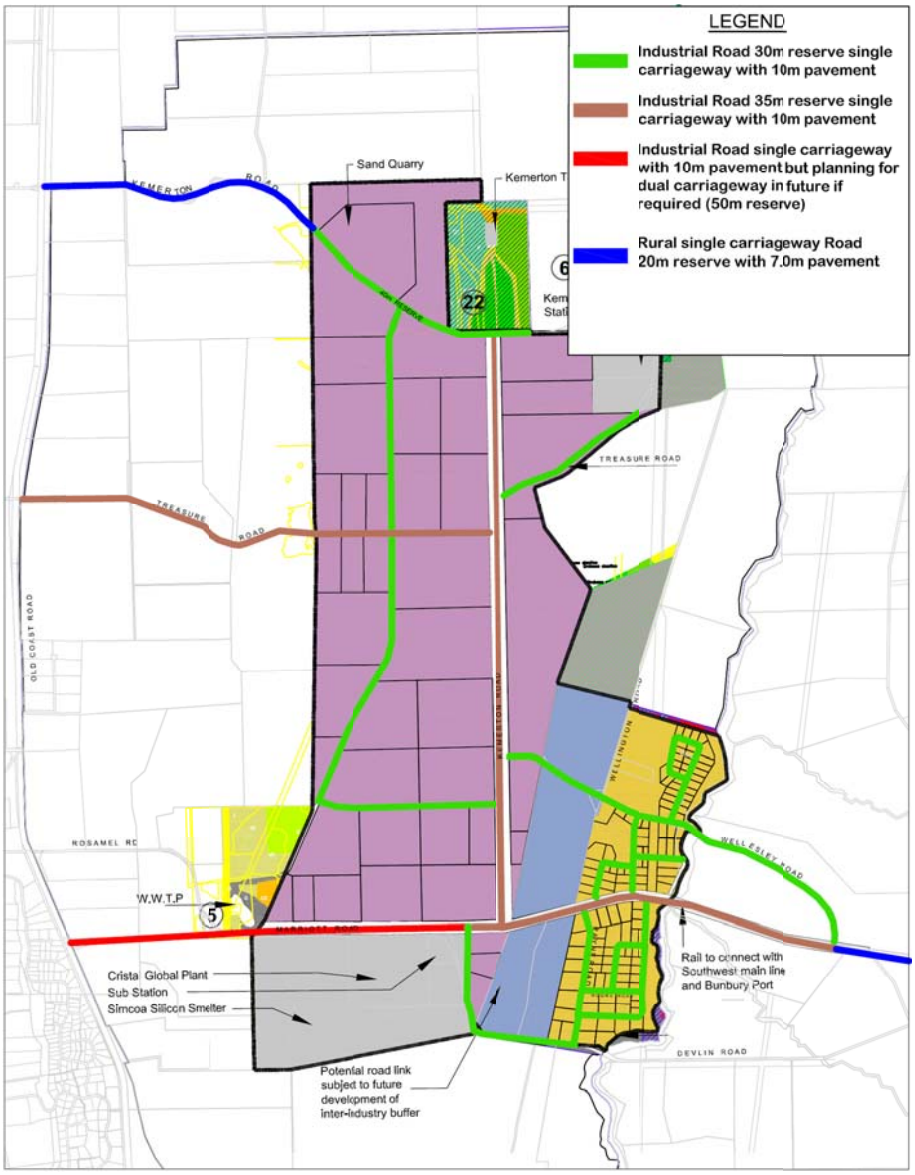


Figure 3: Proposed Road Hierarchy for the KIP

According to the modelling results, the estimated daily traffic volumes on Marriott Road west of Devlin Road are expected to be about 9,000vpd after the full development of the KIP. This level of traffic volumes can be accommodated on a single carriageway road but there would be limited overtaking opportunities with this volume of traffic. As the industrial traffic would include significant volume of slow moving heavy vehicles, this may become an issue for motorists as this area develops. It is therefore recommended that planning make allowance for Marriott Road to be upgraded to a dual divided carriageway between Old Coast Road and Devlin Road if required in future. The suggested road reserve for the dual carriageway is 50m in addition to the rail reserve requirements (the existing Marriott Road and rail reserve is 60m).

Marriott Road currently has a seal width of approximately 7m. However in order to accommodate traffic for the initial development of the KIP it is recommended to upgrade the section of Marriott Road within the boundaries of the KIP and west to Old Coast Road to 10m wide sealed width. The existing road and rail reserve for Marriott Road allows for the widening of the pavement.

It is currently anticipated that open drains will be used in this area rather than underground piped drainage, so it is recommended that an extra 5m road reserve be allowed on each side to accommodate open drainage. Therefore, a 35m road reserve is recommended for Marriott Road between Devlin Road and Wellesley Road. This 35m requirement can be accommodated within the existing 60m road and rail reserve.

For traffic volumes of 1,000-3,000vpd Austroads *Guide to Road Design Part 3: Geometric Design* (2011) recommends that rural roads should have 2x3.5m traffic lanes, 2x1m sealed shoulders and 2x1m unsealed shoulder widths (total seal width 9m, total carriageway width 11m). For traffic volumes above 3,000vpd the sealed shoulders increase to 1.5m (i.e. total seal width 10m, total carriageway width 12m).

In comparison, WAPC Policy DC 4.1 (Industrial Subdivision) recommends road reservation widths of 20m and 25m for industrial subdivisions depending on function and projected traffic volumes. It also recommends a 10m road carriageway width (sealed) in both cases.

Part of Kemerton Road and Marriott Road which are located within the KIP and are expected to carry ultimately high traffic volumes are recommended to be constructed to industrial standard with 35m reserve and 10m pavement width.

Treasure Road to the west of Wellesley Road is expected to carry up to 8,000vpd so it is recommended to be built to industrial road standard with 35m reserve and 10m pavement width.

Other proposed industrial roads within the KIP are recommended to have 30m reserve and 10m wide sealed pavements. Rural Single Carriageway standard is recommended for Marriott Road to the east of the KIP and Kemerton Road to the north-west of the KIP, subject to further discussions with relevant authorities.

5.0 Analysis of the Transport Network

5.1 Assessment Period

The assessment year that has been adopted for this analysis is for full development of the Kemerton LSP. The KIP is estimated to be fully developed in 20-30 years

5.2 Traffic generation and distribution

Transcore has developed a transport model for year 2031 for weekday traffic flows for this area using the EMME transport modelling software package.

The trip generation of the KIP is based on potential employment numbers. And the trip rate per employee is estimated by using "*Guide to Traffic Generating Developments*" (RTA - The Road and Traffic Authority of NSW, October 2002). In this case, 2.5vpd/person is adopted.

In order to reflect the nature of different industries, two employment densities have been adopted. For KIP core industry, the employment density of 3 persons/ha is adopted. This figure is derived from Kwinana Beach Industrial Area based on the advice by TPG.

Service Industries (KIP ancillary industry) will be more labour intensive. An anticipated employment density of 27 employees/ha has been advised by TPG for this component based on other industrial developments.

Table 1 summarises the assumptions, trip rates and trip generation for the LSP area. Total trip generation is estimated to be about 24,172vpd including internal trips.

Table 1: Daily Trip Generation Calculation

Development	Area (ha)	Employees/ha	Vpd/ employee	Total Daily Trip Generation (vpd)
KIP Core Industry	1513	3	2.5	11,347
KIP Ancillary (Support)Industry	190	27	2.5	12,825
Total	**1703**	-	-	**24,172**

The KIP is estimated to be fully developed in 20-30 years. Therefore, the background traffic on Marriott Road and South Western Highway is assumed to grow 40% by the time it is fully developed.

The trip distribution to the external zones is partly based on the existing traffic patterns. The existing counts on Marriott Road show that about 80% of traffic travel

west toward Old Coast Road and the remaining 20% travel east toward South Western Highway. It is assumed that most of these trips are generated by the established industries in the KIP and the pattern will remain for future developments.

The predicted traffic generated by the KIP is split into west (80%) and east bound (20%). Westbound traffic is likely to use Marriott Road, Treasure Road and Kemerton Road to access Old Coast Road. This traffic is further split to north and south directions. Given the proximity of the KIP to Australind and Bunbury and the importance of Bunbury Port to serve the international market, it is anticipated that 80% of the traffic from KIP would travel south. All eastbound traffic is assumed to use Marriott Road to access South Western Highway, where an even split between northbound and southbound traffic is assumed. **Table 2** summaries the trip distribution of the KIP traffic.

Table 2: Trip Distribution

Direction	Trip Distribution
Northbound via Old Coast Road	16%
Southbound via Old Coast Road	64%
Northbound via South Western Highway	10%
Southbound via South Western Highway	10%

5.3 Traffic Flow Forecasts

Figure 4 illustrates future total daily traffic flows estimated for the road network of the LSP area. The projected traffic volumes reflect the full development of the KIP LSP area.

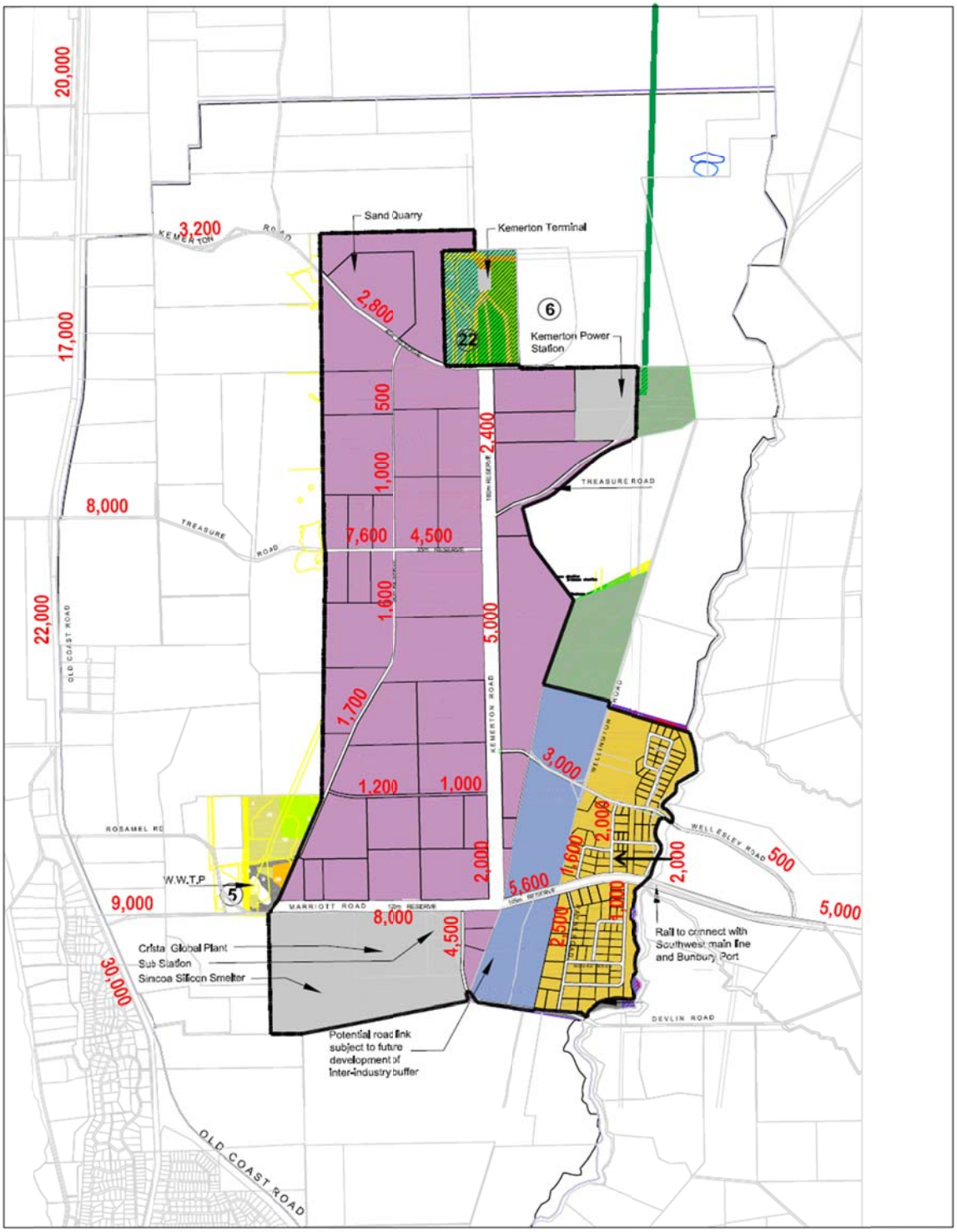


Figure 4: Projected Ultimate Daily Traffic Volumes including Background Traffic

According to the modelling output, the highest projected traffic on Marriott Road would occur to the west of the KIP. The forecast daily traffic on this section of Marriott Road is estimated to be about 9,000vpd.

The forecast daily traffic on Marriott Road east of the KIP is estimated to be 5,000vpd.

The projected traffic volume on Kemerton Road immediately north of Marriott Road is about 2,000vpd which will increase to about 5,000vpd further north and again will reduce to 2,400vpd north of Treasure Road.

The projected traffic volume on Old Coast Road near Marriott Road intersection is about 3,000vpd.

5.4 Roads and Intersections

The proposed road network to accommodate the LSP traffic volumes has been detailed in section 4 of this report, including the details of the proposed road hierarchy in section 4.1. Figure 5 details the proposed intersection controls for key intersections within the LSP area.

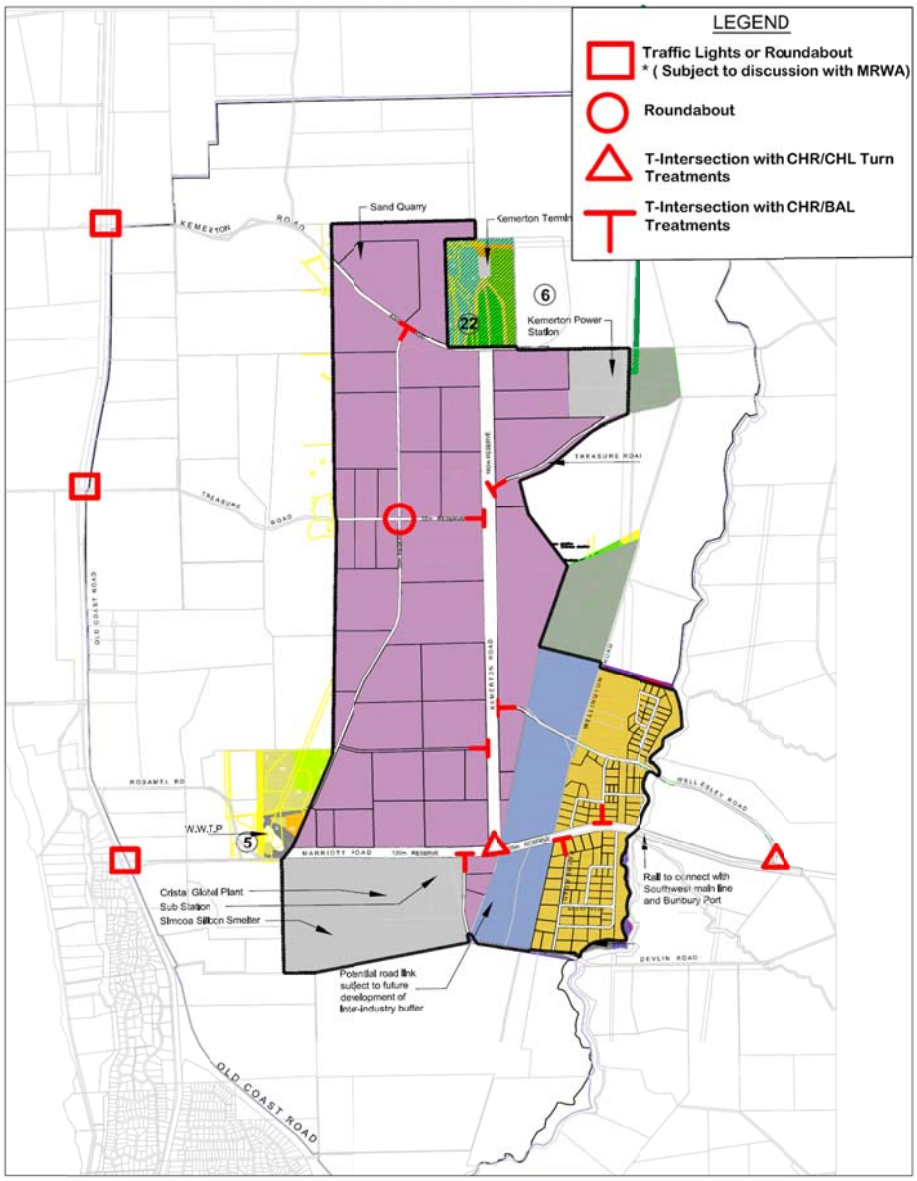


Figure 5: Proposed Intersection Treatments

The intersections treatments proposed in Figure 5 are based on the outcome of SIDRA analysis (refer section 5.5 and Appendix A) and the guidelines provided in Austroads' document *Guide to Road Design, Part 4A: Unsignalised and Signalised Intersections.*

As indicated in Figure 5, Traffic lights or roundabouts are proposed for the three intersections on Old Coast Road after full development of KIP and in order to accommodate the future traffic growth on Old Cost Road and the additional traffic generated by KIP.

Intersections of Kemerton Road/ Marriott Road and Wesley Road/ Marriott Road are proposed to operate as priority controlled T-intersections with CHR/ CHL treatments as shown in **Figure 6.** 110m slip lanes are proposed to satisfy Austroads requirements for the proposed speed limit of 90km/hr along the section of Marriott Road fronting the LSP area.

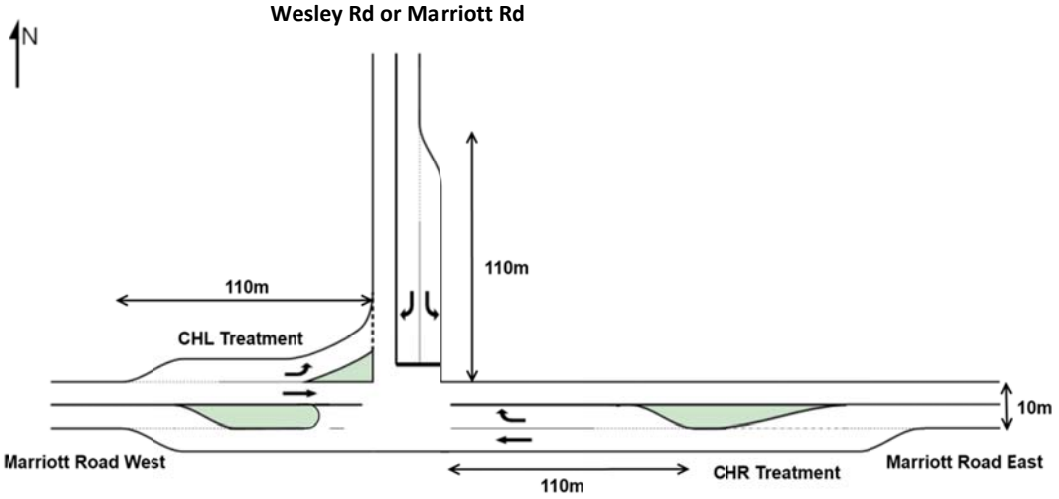


Figure 6: Typical CHL/CHR Treatment

The other key priority controlled T-intersections within the LSP area which are marked in Figure 5 are expected to operate satisfactorily with the CHR/ BAL treatment. The CHR/ BAL treatment is shown at **Figure 7.** 110m slip lanes are proposed to satisfy Austroads requirements for the proposed speed limit of 90km/hr along Kemerton Road and Marriott Road within the LSP area.

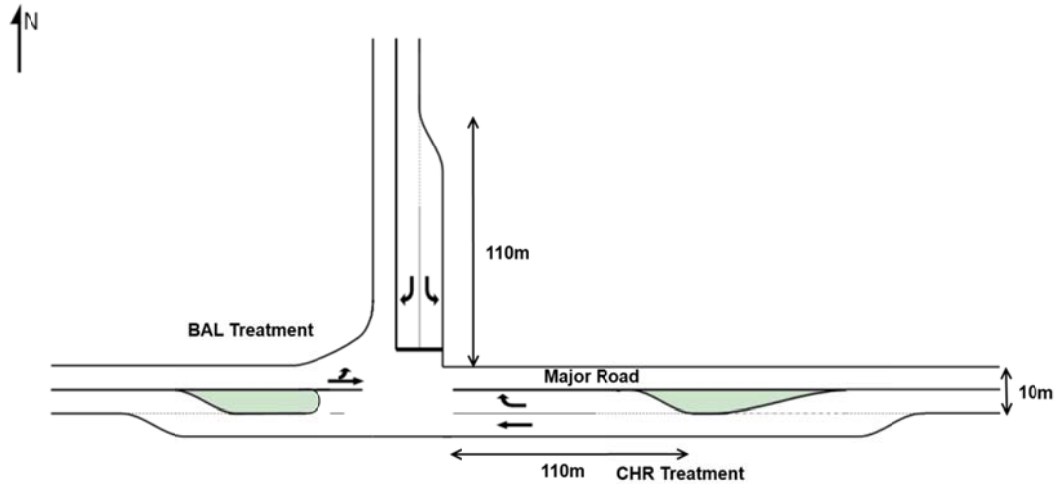


Figure 7: Typical BAL/ CHR Treatment

The BAR/BAL treatments (refer **Figure 8)** are proposed for the rest of the T-intersections which are considered to be intersections on minor roads.

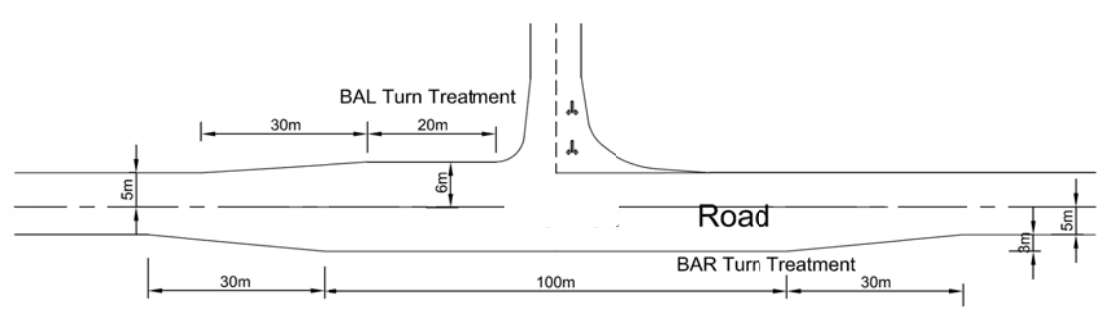


Figure 8: Typical BAL/BAR Treatment

Roundabouts are proposed for the internal 4-way intersection.

5.5 Intersection Analysis

The key intersections on the surrounding road network that are expected to be affected by the proposed LSP traffic are:

- Intersections of Old Cost Road with Marriott Rd, Treasure Road and Kemerton Road;
- Intersection of South Western Highway/ Marriott Road; and
- Intersections of Marriott Road with Kemerton Road and Wellesley Road.

Capacity analysis is undertaken for the selected intersections for a typical weekday using the SIDRA computer software package. SIDRA is an intersection modelling tool commonly used by traffic engineers for all types of intersections. SIDRA outputs are presented in the form of Degree of Saturation, Level of Service, Average Delay and 95% Queue. These characteristics are defined as follows:

- Degree of Saturation is the ratio of the arrival traffic flow to the capacity of the approach during the same period. The Degree of Saturation ranges from close to zero for infrequent traffic flow up to one for saturated flow or capacity.
- Level of Service is the qualitative measure describing operational conditions within a traffic stream and the perception by motorists and/or passengers. In general, there are 6 levels of service, designated from A to F, with Level of Service A representing the best operating condition (i.e. free flow) and Level of Service F the worst (i.e. forced or breakdown flow).
- Average Delay is the average of all travel time delays for vehicles through the intersection.
- 95% Queue is the queue length below which 95% of all observed queue lengths fall.

The results of the SIDRA analysis are summarised in Appendix A.

SIDRA analysis indicates that the existing standards of the three intersections along Old Coast Road (Intersection of Old Cost Road with Marriott Rd, Treasure Road and Kemerton Road) will not able to accommodate the additional traffic generated by the LSP area and the growth of the background traffic after full development of KIP and therefore these intersections ultimately need to be upgraded to traffic lights or roundabouts. SIDRA analysis undertaken indicates that both traffic lights and roundabout option will operate satisfactorily in future.

SIDRA analysis also indicates that the existing intersection of South Western Highway/ Marriott Road has sufficient spare capacity to accommodate the KIP traffic in future.

The intersections of Marriott Road with Kemerton Road and Wellesley Road would operate satisfactorily and well within capacity with the proposed CHR/CHL layout.

6.0 Conclusions

The proposed revised KIP LSP will entail approximately 2,024ha of industrial land. The proposed LSP will gain access to Old Cost Road though Marriott Road, Treasure Road and Kemerton Road. Marriot Road also provides connection to South Western Highway from east.

The road network of the LSP has been planned based on WAPC Policy DC 4.1 (Industrial Subdivision); and Austroads Guide to Road Design Part 3: Geometric Design (2011). The proposed road network and the road hierarchy would accommodate the full development of KIP traffic.

SIDRA analysis undertaken for the existing standard of the intersections along Old Coast Road (Intersections of Old Cost Road with Marriott Rd, Treasure Road and Kemerton Road) indicates that these intersections need to be upgraded to traffic lights or roundabout standard in order to accommodate the full development of LSP area and the growth in background traffic.

Existing intersection of South Western Highway/ Marriott Road has sufficient spare capacity to accommodate the KIP traffic that would be distributed to this intersection and therefore upgrades of this intersection are not anticipated.

Appendix A

DETAILED INTERSECTION ANALYSIS

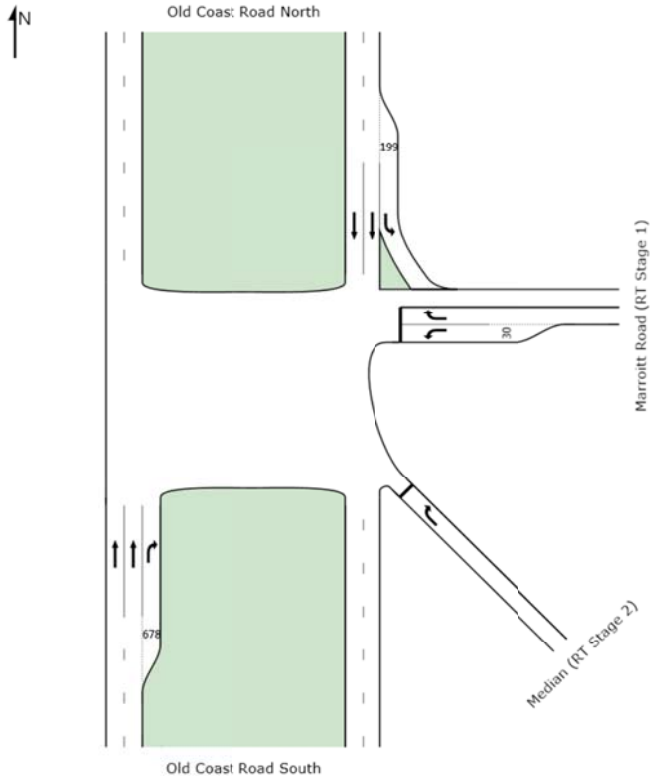


Figure A1: Existing Layout

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Old Coast Road South											
11	T	1053	20.0	0.305	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
12	R	448	20.0	2.093	1019.9	LOS F	154.9	1270.4	1.00	7.04	2.1
Approach		1501	20.0	2.093	304.7	NA	154.9	1270.4	0.30	2.10	6.5
South East: Median (RT Stage 2)											
32	R	17	20.0	1.000[4]	438.6	LOS F	3.1	22.2	1.00	1.34	0.9
Approach		17	20.0	1.000	438.6	LOS F	3.1	22.2	1.00	1.34	0.9
East: Marroitt Road (RT Stage 1)											
1	L	448	20.0	0.484	14.6	LOS B	1.6	12.9	0.57	1.08	44.8
3	R	17	20.0	1.000[4]	433.0	LOS F	3.0	24.8	1.00	1.15	4.1
Approach		465	20.0	1.000	29.7	LOS D	3.0	24.8	0.59	1.08	34.2
North: Old Coast Road North											
4	L	17	20.0	0.018	13.3	LOS B	0.1	0.6	0.36	0.85	45.8
5	T	1053	20.0	0.305	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		1069	20.0	0.305	0.2	NA	0.1	0.6	0.01	0.01	59.7
All Vehicles		3053	20.0	2.093	156.8	NA	154.9	1270.4	0.24	1.21	11.3

Table A1: SIDRA results – Existing Performance of the Intersection of Old Coast Road/ Marriott Road, 2031, Full Development of KIP

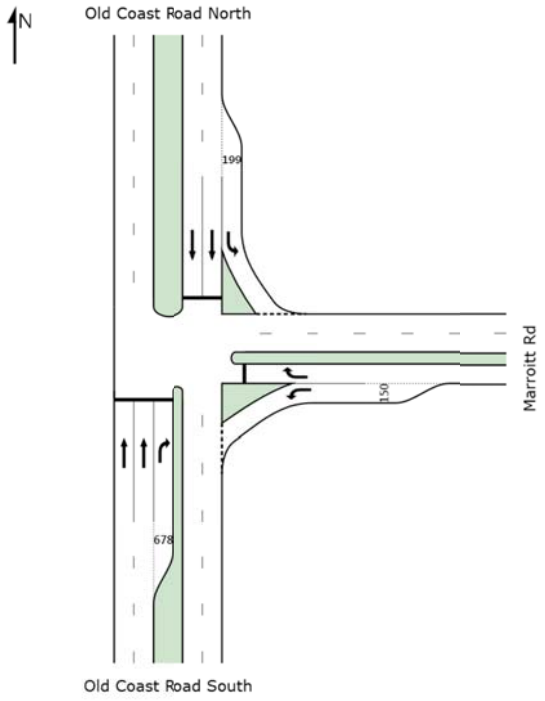


Figure A2: Proposed Signalised Layout

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Old Coast Road South											
11	T	1053	20.0	0.381	2.7	LOS A	6.6	53.7	0.31	0.28	69.9
12	R	448	20.0	0.710	29.5	LOS C	11.2	91.6	0.90	0.93	38.3
Approach		1501	20.0	0.710	10.8	LOS B	11.2	91.6	0.49	0.47	57.1
East: Marroitt Rd											
1	L	448	20.0	0.522	21.6	LOS C	10.9	89.4	0.70	0.88	41.1
3	R	17	20.0	0.155	55.5	LOS E	0.7	6.1	0.97	0.70	26.1
Approach		465	20.0	0.522	22.8	LOS C	10.9	89.4	0.71	0.87	40.3
North: Old Coast Road North											
4	L	17	20.0	0.018	12.9	LOS B	0.2	1.3	0.33	0.68	53.8
5	T	1053	20.0	0.704	22.5	LOS C	18.9	155.4	0.88	0.78	43.1
Approach		1069	20.0	0.704	22.3	LOS C	18.9	155.4	0.87	0.78	43.2
All Vehicles		3036	20.0	0.710	16.7	LOS B	18.9	155.4	0.65	0.64	48.4

Table A2: SIDRA results –Performance of the Proposed Signalised Intersection of Old Coast Road/ Marriott Road, 2031, Full Development of KIP

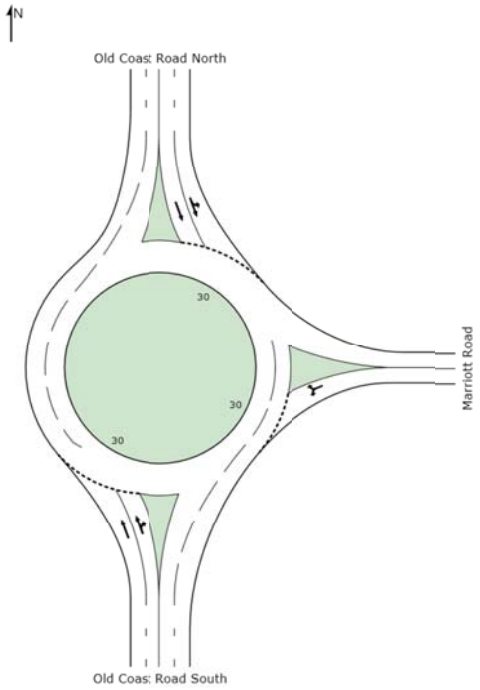


Figure A3: Proposed Roundabout Layout

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Old Coast Road South											
2	T	1053	20.0	0.509	4.9	LOS A	5.3	43.6	0.19	0.36	52.1
3	R	448	20.0	0.509	11.9	LOS B	5.2	42.6	0.20	0.68	46.2
Approach		1501	20.0	0.509	7.0	LOS A	5.3	43.6	0.19	0.46	50.1
East: Marriott Road											
4	L	448	20.0	0.962	39.4	LOS D	14.2	116.3	0.98	1.65	29.0
6	R	17	20.0	0.962	45.3	LOS D	14.2	116.3	0.98	1.65	28.6
Approach		465	20.0	0.962	39.6	LOS D	14.2	116.3	0.98	1.65	29.0
North: Old Coast Road North											
7	L	17	20.0	0.558	10.5	LOS B	4.9	40.3	0.76	0.83	48.0
8	T	1053	20.0	0.558	9.7	LOS A	4.9	40.3	0.77	0.82	47.4
Approach		1069	20.0	0.558	9.7	LOS A	4.9	40.3	0.77	0.83	47.4
All Vehicles		3036	20.0	0.962	12.9	LOS B	14.2	116.3	0.52	0.77	44.3

Table A3: SIDRA results –Performance of the Proposed Roundabout Intersection of Old Coast Road/ Marriott Road, 2031, Full Development of KIP

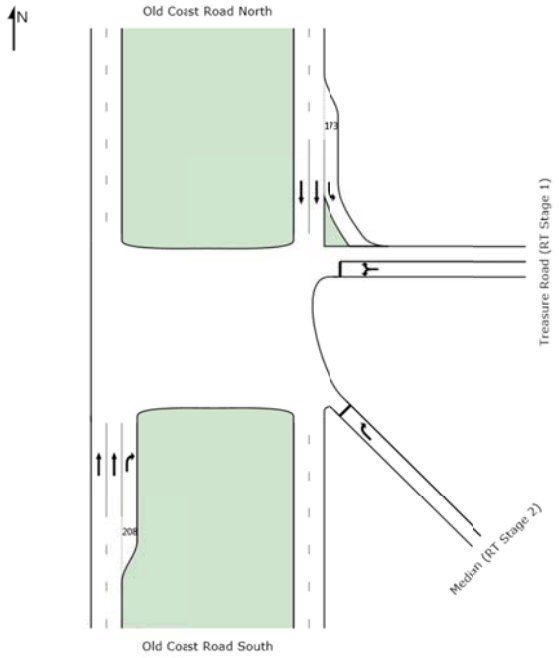


Figure A4: Existing Layout

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Old Coast Road South											
11	T	914	20.0	0.265	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
12	R	368	20.0	1.267	280.1	LOS F	57.2	469.4	1.00	4.43	7.1
Approach		1282	20.0	1.267	80.5	NA	57.2	469.4	0.29	1.27	18.8
South East: Median (RT Stage 2)											
32	R	51	20.0	1.000[4]	191.9	LOS F	4.4	31.5	1.00	1.77	2.0
Approach		51	20.0	1.000	191.9	LOS F	4.4	31.5	1.00	1.77	2.0
East: Treasure Road (RT Stage 1)											
1	L	368	20.0	2.554	1444.0	LOS F	168.0	1377.9	1.00	7.25	1.5
3	R	51	20.0	2.554	1446.7	LOS F	168.0	1377.9	1.00	5.88	1.3
Approach		419	20.0	2.554	1444.3	LOS F	168.0	1377.9	1.00	7.09	1.4
North: Old Coast Road North											
4	L	29	20.0	0.035	13.9	LOS B	0.1	1.1	0.43	0.87	45.4
5	T	914	20.0	0.265	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		943	20.0	0.265	0.4	NA	0.1	1.1	0.01	0.03	59.4
All Vehicles		2695	20.0	2.554	266.6	NA	168.0	1377.9	0.32	1.75	7.1

Table A4: SIDRA results –Performance of the Existing Intersection of Old Coast Road/ Treasure Road, 2031, Full Development of KIP

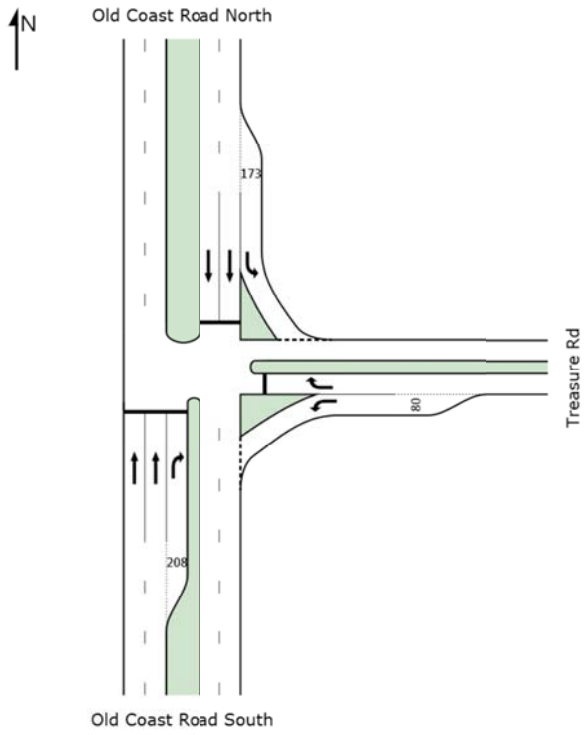


Figure A5: Proposed Signalised Layout

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Old Coast Road South											
11	T	914	20.0	0.331	2.6	LOS A	5.4	44.1	0.29	0.26	70.4
12	R	368	20.0	0.591	24.3	LOS C	9.2	75.2	0.85	0.89	42.2
Approach		1282	20.0	0.591	8.8	LOS A	9.2	75.2	0.45	0.44	59.9
East: Treasure Rd											
1	L	368	20.0	0.561	18.5	LOS B	9.1	74.7	0.66	0.83	43.3
3	R	51	20.0	0.466	57.2	LOS E	2.3	19.1	1.00	0.75	25.7
Approach		419	20.0	0.561	23.1	LOS C	9.1	74.7	0.70	0.82	40.0
North: Old Coast Road North											
4	L	51	20.0	0.053	12.0	LOS B	0.4	2.9	0.28	0.69	55.1
5	T	914	20.0	0.596	20.4	LOS C	15.2	124.7	0.81	0.71	45.0
Approach		964	20.0	0.596	20.0	LOS B	15.2	124.7	0.78	0.71	45.4
All Vehicles		2665	20.0	0.596	15.1	LOS B	15.2	124.7	0.61	0.60	50.1

Table A5: SIDRA results –Performance of the Proposed Signalised Intersection of Old Coast Road/ Treasure Road, 2031, Full Development of KIP

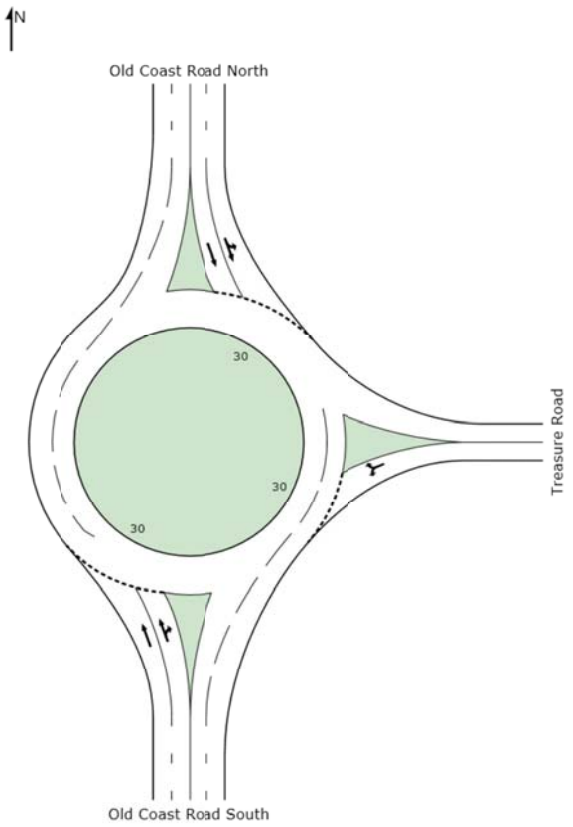


Figure A6: Proposed Roundabout Layout

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Old Coast Road South											
2	T	914	20.0	0.461	5.1	LOS A	4.2	34.3	0.31	0.39	51.0
3	R	368	20.0	0.461	12.2	LOS B	4.1	33.3	0.33	0.67	45.9
Approach		1282	20.0	0.461	7.2	LOS A	4.2	34.3	0.32	0.47	49.3
East: Treasure Road											
4	L	368	20.0	0.755	15.9	LOS B	5.8	47.2	0.88	1.10	42.1
6	R	51	20.0	0.755	21.8	LOS C	5.8	47.2	0.88	1.15	39.7
Approach		419	20.0	0.755	16.6	LOS B	5.8	47.2	0.88	1.11	41.8
North: Old Coast Road North											
7	L	51	20.0	0.476	8.8	LOS A	3.5	28.9	0.68	0.72	48.3
8	T	914	20.0	0.476	7.7	LOS A	3.5	28.9	0.69	0.67	48.2
Approach		964	20.0	0.476	7.8	LOS A	3.5	28.9	0.69	0.68	48.2
All Vehicles		2665	20.0	0.755	8.9	LOS A	5.8	47.2	0.54	0.65	47.6

Table A6: SIDRA results –Performance of the Proposed Roundabout Intersection of Old Coast Road/ Treasure Road, 2031, Full Development of KIP

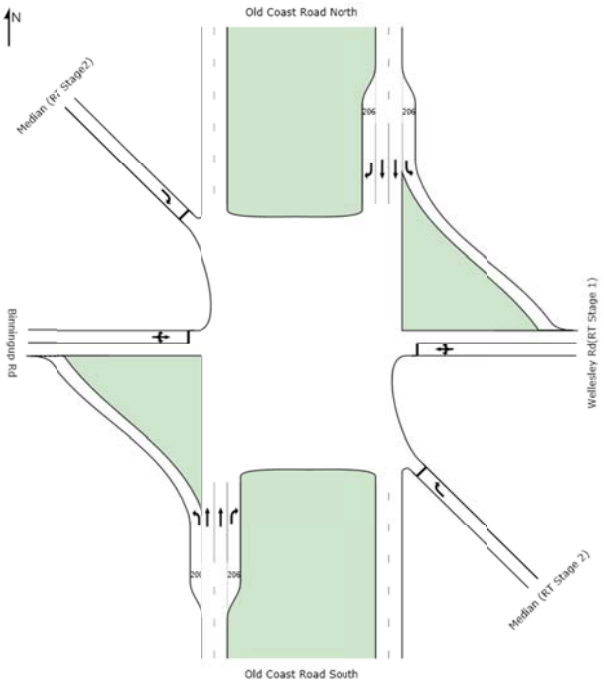


Figure A7: Existing Layout

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Old Coast Road South											
10	L	66	5.0	0.037	7.7	LOS A	0.0	0.0	0.00	0.60	49.8
11	T	842	20.0	0.244	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
12	R	29	20.0	0.087	17.0	LOS C	0.3	2.5	0.75	0.88	41.5
Approach		938	18.9	0.244	1.1	NA	0.3	2.5	0.02	0.07	58.3
South East: Median (RT Stage 2)											
32	R	143	20.0	2.386	1330.4	LOS F	58.2	419.3	1.00	6.48	0.3
Approach		143	20.0	2.386	1330.4	LOS F	58.2	419.3	1.00	6.48	0.3
East: Wellesley Rd(RT Stage 1)											
1	L	29	20.0	2.965	1855.4	LOS F	82.8	675.7	1.00	4.25	1.2
2	T	8	5.0	2.965	1859.8	LOS F	82.8	675.7	1.00	3.67	1.2
3	R	143	20.0	2.965	1858.1	LOS F	82.8	675.7	1.00	3.64	1.0
Approach		181	19.3	2.965	1857.7	LOS F	82.8	675.7	1.00	3.74	1.0
North: Old Coast Road North											
4	L	143	20.0	0.122	12.2	LOS B	0.5	4.2	0.12	0.92	46.2
5	T	842	20.0	0.244	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
6	R	14	5.0	0.029	13.5	LOS B	0.1	0.7	0.68	0.81	44.2
Approach		999	19.8	0.244	1.9	NA	0.5	4.2	0.03	0.14	57.2
North West: Median (RT Stage2)											
29	R	66	5.0	1.105	272.0	LOS F	8.7	54.6	1.00	1.54	7.2
Approach		66	5.0	1.105	272.0	LOS F	8.7	54.6	1.00	1.54	7.2
West: Binningup Rd											
10	L	14	5.0	1.474	539.6	LOS F	22.4	163.4	1.00	2.62	3.8
11	T	8	5.0	1.474	544.8	LOS F	22.4	163.4	1.00	2.27	4.0
12	R	66	5.0	1.474	540.2	LOS F	22.4	163.4	1.00	2.23	4.0
Approach		88	5.0	1.474	540.5	LOS F	22.4	163.4	1.00	2.29	3.9
All Vehicles		2416	18.5	2.965	246.5	NA	82.8	675.7	0.22	0.88	7.4

Table A6: SIDRA results –Performance of the Existing Intersection of Old Coast Road/ Wellesley Road, 2031, Full Development of KIP

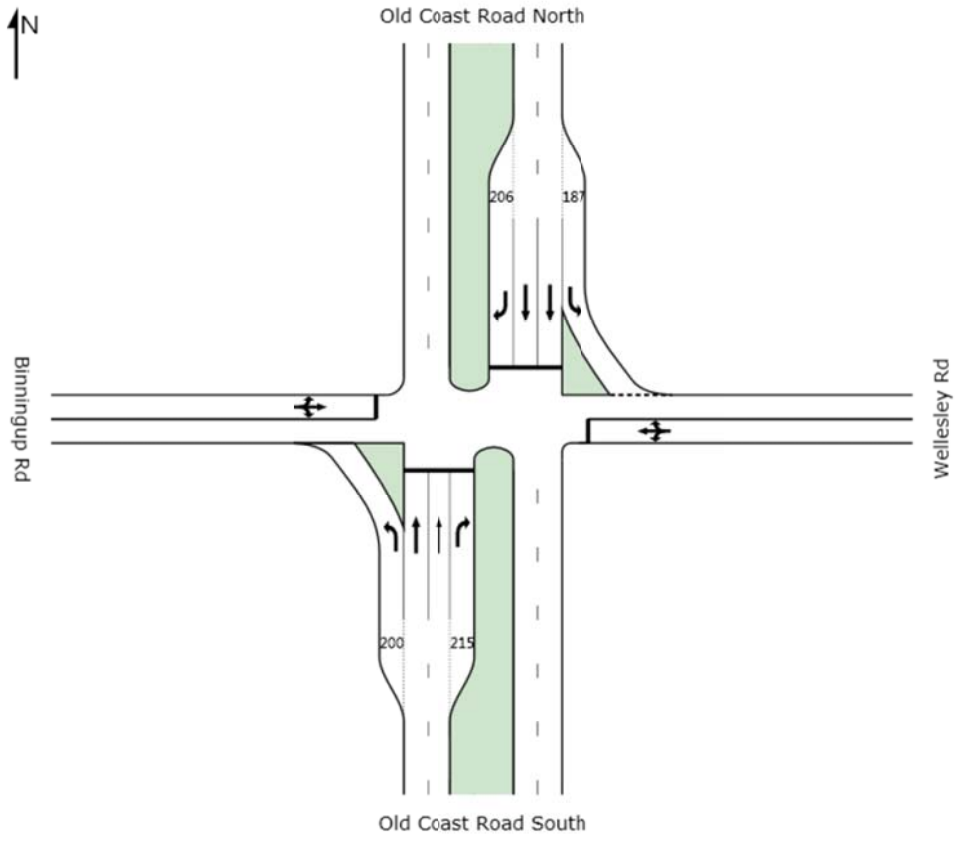


Figure A8: Proposed Signalised Layout

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Old Coast Road South											
10	L	66	5.0	0.049	11.9	LOS B	0.2	1.5	0.22	0.95	46.1
11	T	842	20.0	0.472	10.1	LOS B	8.0	65.4	0.68	0.60	56.0
12	R	29	20.0	0.136	25.5	LOS C	0.6	5.1	0.70	0.75	41.2
Approach		938	18.9	0.472	10.7	LOS B	8.0	65.4	0.65	0.63	54.7
East: Wellesley Rd											
1	L	29	20.0	0.471	30.0	LOS C	4.6	37.5	0.87	0.82	36.2
2	T	8	5.0	0.471	20.1	LOS C	4.6	37.5	0.87	0.72	34.8
3	R	143	20.0	0.471	29.8	LOS C	4.6	37.5	0.87	0.81	36.1
Approach		181	19.3	0.471	29.4	LOS C	4.6	37.5	0.87	0.80	36.0
North: Old Coast Road North											
4	L	143	20.0	0.120	11.0	LOS B	0.5	3.9	0.23	0.69	55.9
5	T	842	20.0	0.472	10.1	LOS B	8.0	65.4	0.68	0.60	56.0
6	R	14	5.0	0.050	22.0	LOS C	0.3	2.0	0.67	0.70	37.5
Approach		999	19.8	0.472	10.4	LOS B	8.0	65.4	0.62	0.61	55.7
West: Binningup Rd											
10	L	14	5.0	0.207	26.5	LOS C	2.0	14.9	0.80	0.77	35.0
11	T	8	5.0	0.207	18.2	LOS B	2.0	14.9	0.80	0.63	36.1
12	R	66	5.0	0.207	26.3	LOS C	2.0	14.9	0.80	0.76	35.1
Approach		88	5.0	0.207	25.5	LOS C	2.0	14.9	0.80	0.75	35.2
All Vehicles		2206	18.8	0.472	12.7	LOS B	8.0	65.4	0.66	0.64	51.9

Table A7: SIDRA results –Performance of the Proposed Signalised intersection of Old Coast Road/ Wellesley Road, 2031, Full Development of KIP

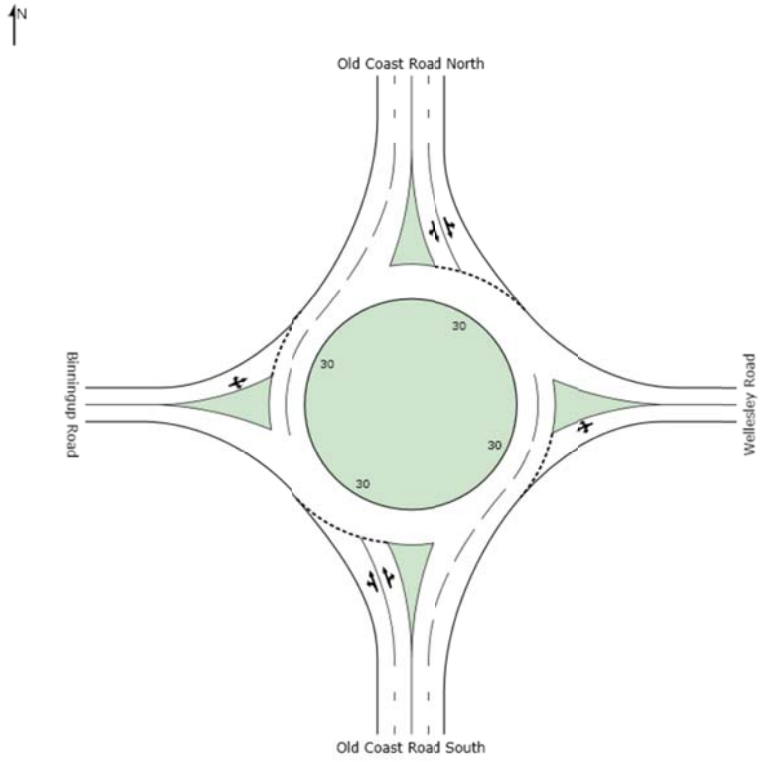


Figure A8: Proposed Roundabout Layout

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Old Coast Road South											
1	L	66	5.0	0.372	6.8	LOS A	2.7	21.8	0.46	0.57	49.4
2	T	817	20.0	0.372	5.9	LOS A	2.7	21.8	0.47	0.50	49.8
3	R	29	20.0	0.372	13.1	LOS B	2.6	21.1	0.49	0.82	46.5
Approach		913	18.9	0.372	6.2	LOS A	2.7	21.8	0.47	0.51	49.6
East: Wellesley Road											
4	L	29	20.0	0.286	9.9	LOS A	1.2	9.9	0.66	0.81	47.0
5	T	8	5.0	0.286	8.5	LOS A	1.2	9.9	0.66	0.75	47.1
6	R	143	20.0	0.286	15.8	LOS B	1.2	9.9	0.66	0.91	43.4
Approach		181	19.3	0.286	14.5	LOS B	1.2	9.9	0.66	0.88	44.1
North: Old Coast Road North											
7	L	143	20.0	0.368	6.8	LOS A	2.6	21.4	0.34	0.53	50.0
8	T	817	20.0	0.368	5.4	LOS A	2.6	21.4	0.36	0.43	50.7
9	R	14	5.0	0.368	12.1	LOS B	2.5	20.8	0.37	0.82	46.7
Approach		974	19.8	0.368	5.7	LOS A	2.6	21.4	0.35	0.45	50.5
West: Binningup Road											
10	L	14	5.0	0.126	8.8	LOS A	0.6	4.0	0.66	0.76	47.2
11	T	8	5.0	0.126	7.8	LOS A	0.6	4.0	0.66	0.69	47.2
12	R	66	5.0	0.126	14.7	LOS B	0.6	4.0	0.66	0.89	44.1
Approach		88	5.0	0.126	13.1	LOS B	0.6	4.0	0.66	0.85	44.8
All Vehicles		2156	18.8	0.372	7.0	LOS A	2.7	21.8	0.44	0.53	49.2

Table A8: SIDRA results –Performance of the Proposed Roundabout intersection of Old Coast Road/ Wellesley Road, 2031, Full Development of KIP

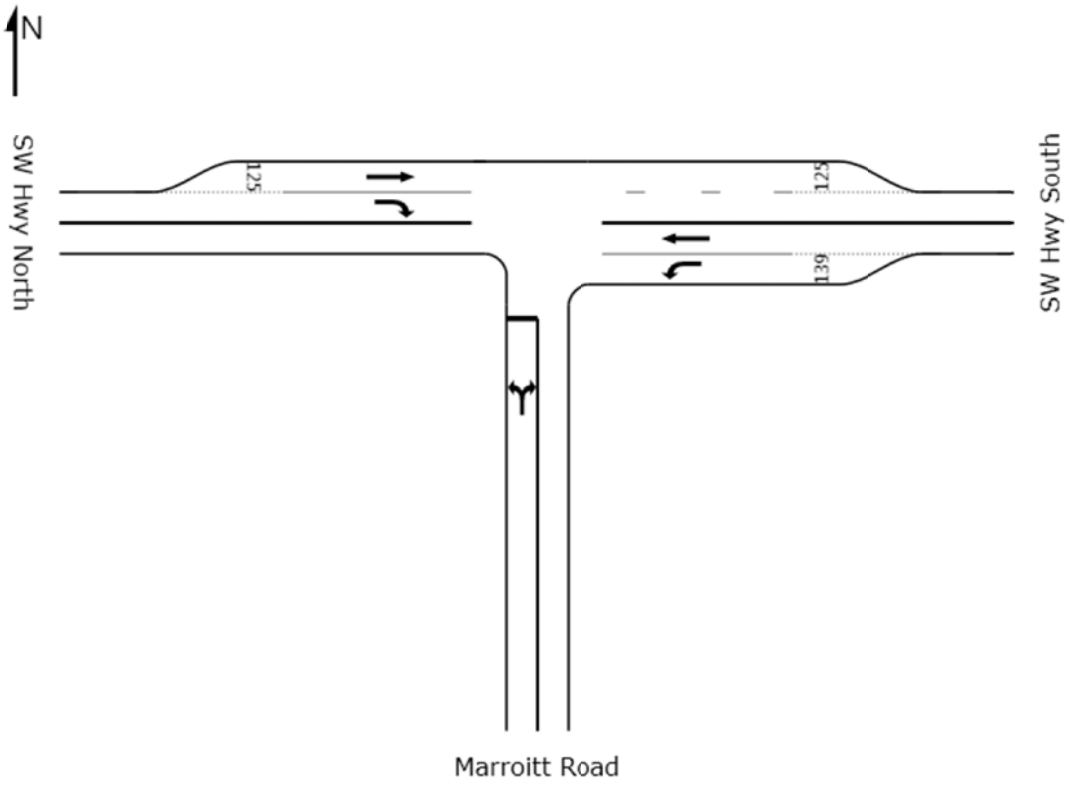


Figure A9: Existing Layout

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Marroitt Road											
1	L	133	20.0	0.700	33.4	LOS D	5.0	40.7	0.80	1.28	47.0
3	R	133	20.0	0.700	33.1	LOS D	5.0	40.7	0.80	1.21	47.3
Approach		265	20.0	0.700	33.2	LOS D	5.0	40.7	0.80	1.25	47.2
East: SW Hwy South											
4	L	133	20.0	0.082	14.3	LOS B	0.0	0.0	0.00	0.76	67.2
5	T	335	23.0	0.197	0.0	LOS A	0.0	0.0	0.00	0.00	110.0
Approach		467	22.1	0.197	4.1	NA	0.0	0.0	0.00	0.22	95.5
West: SW Hwy North											
11	T	335	23.0	0.197	0.0	LOS A	0.0	0.0	0.00	0.00	110.0
12	R	133	20.0	0.154	17.3	LOS C	0.7	5.6	0.57	0.84	62.4
Approach		467	22.1	0.197	4.9	NA	0.7	5.6	0.16	0.24	93.1
All Vehicles		1200	21.7	0.700	10.8	NA	5.0	40.7	0.24	0.45	76.7

Table A9: SIDRA results –Performance of the intersection of South Western Highway/ Marriott Road , 2031, Full Development of KIP

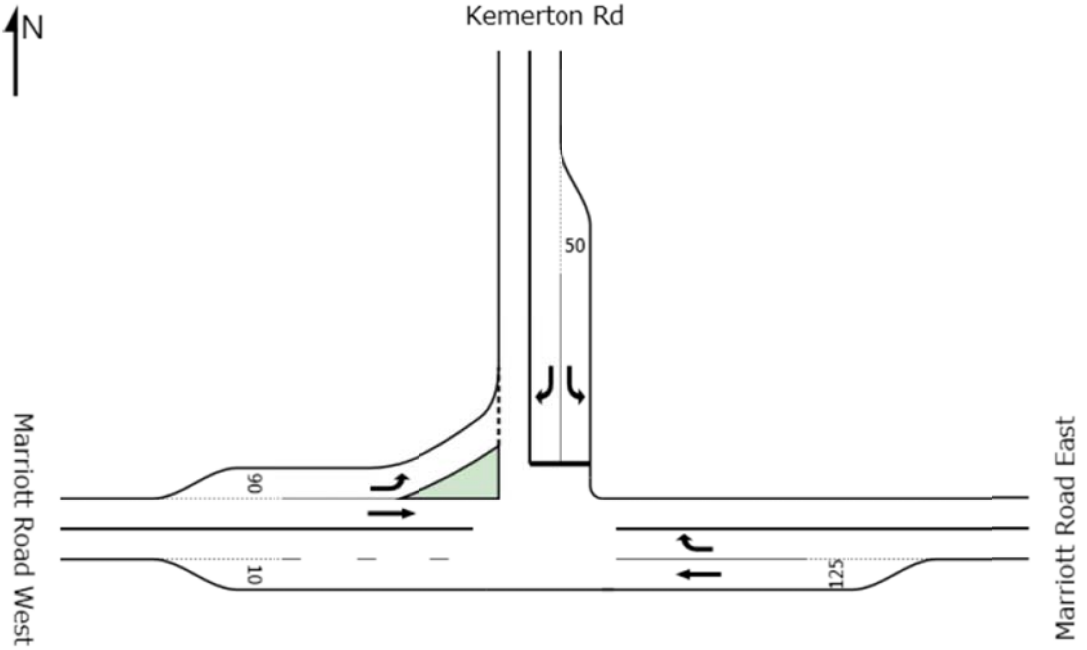


Figure A10: Proposed Layout

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Marriott Road East											
5	T	245	20.0	0.142	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
6	R	53	20.0	0.046	8.4	LOS A	0.2	1.7	0.41	0.63	41.8
Approach		298	20.0	0.142	1.5	NA	0.2	1.7	0.07	0.11	48.3
North: Kemerton Rd											
7	L	53	20.0	0.060	11.9	LOS B	0.2	1.9	0.41	0.88	40.1
9	R	58	20.0	0.129	16.2	LOS C	0.5	3.7	0.60	1.00	37.3
Approach		111	20.0	0.129	14.1	LOS B	0.5	3.7	0.51	0.94	38.6
West: Marriott Road West											
10	L	58	20.0	0.053	6.1	LOS A	0.2	1.6	0.16	0.49	43.4
11	T	245	20.0	0.142	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		303	20.0	0.142	1.2	NA	0.2	1.6	0.03	0.09	48.6
All Vehicles		712	20.0	0.142	3.3	NA	0.5	3.7	0.12	0.23	46.6

Table A10: SIDRA results –Performance of the intersection of Kemerton/ Marriott Road, 2031, Full Development of KIP

Appendix R

Western Power Feasibility Study for the Kemerton Industrial Park

Feasibility Study

February 2011

Feasibility Study Report

Project :	**Kemerton Industrial Area**
Developer/Consultant :	**WGE**
Customer Reference :	**2276-PER-U**
WP Reference :	**SF010041**
Lot/Load/Capacity :	**Heavy Industrial 120-200MVA**
Related Files	**NA**

Prepared By: - **Kurt Franklin** **(Network Planning)**
- **Vi Nguyen** **(Land Development)**

Queries:
For any queries, please contact the Network Planning or Land Development officer mentioned above, via Western Power's Customer Service Centre on **131087**

Alternatively – email: **subdivisionsadmin@westernpower.com.au**

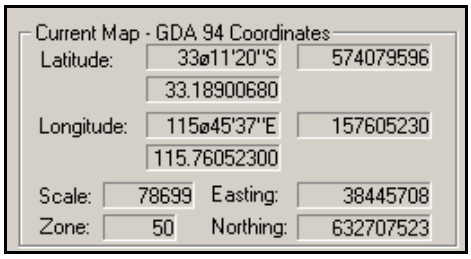
DMS#: 8004467

CONTENTS

1 Development Proposal

1.1 Location Details

Vicinity of Marriott, Wellesley and Treasure Roads, Kemerton



See **Figure 1 and**

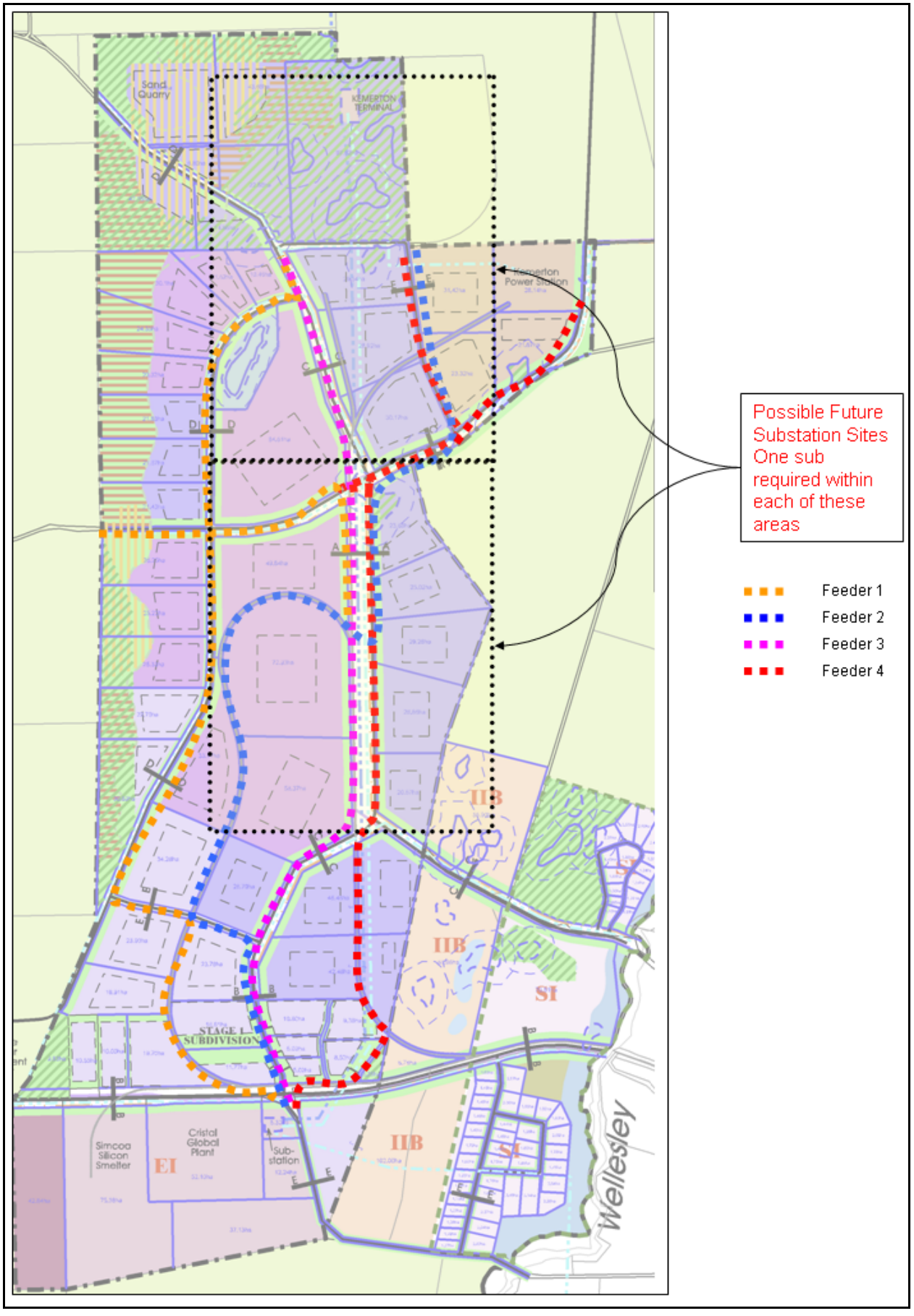


Figure 2

DMS#: 8004467

1.2 Development Details

Number of lots:

Land Use: Heavy Industry

Calculated Area: ~1000 ha (developable area estimated to be ~600 ha)

Staging: Staging and timing indeterminate.
Assumed, for the purposes of transmission planning, to be a load increase of 10 MVA per year for ten years

1.3 Electrical Requirements

The nominal design capacity required is based on an assumed 200 kVA/ha over 100 ha per year for ten years.

A diversified maximum load, based on the design capacity, the nature of the area and the actual developable area is considered to determine the requirements for this project.

Given the possible industry that may reside here in the future, a potential horizon load of up to 200 MVA is not unreasonable.

2 Study

2.1 Electrical Connection

The area is adjacent to Marriot Rd substation, Kemerton terminal and contains several major transmission lines and one three phase “backbone” 22 kV distribution line.

The distribution connections will initially be made to the Marriot Road substation – either directly to new feeder circuits, or possibly from existing circuits – this will be dependent on timing and loading.

See **Figure 1** and **Figure 2**

2.2 Study Model

Given the nature of this development, no detailed network modelling at the distribution level was able to be carried out. However, based on the proposed layout and the design capacity, the number of the 22kV feeders and their probable/preferred spatial arrangements has been proposed as a conceptual “model”

2.3 Study Results

Details at hand indicate that four “main-line” distribution feeders will be necessary to supply the basic electrical requirements of this development. As the staging occurs and new zone substations are constructed, the four feeders will be progressively split up with the creation of new “Normally Open Points” that should allow a staged and resource efficient method of minimising feeder and substation investment.

Four feeders will become eight – and will further split to become twelve and sixteen feeders if necessary.

3 Conclusion

3.1 Connection Requirements

Connections will be made from new networks constructed through the developments as the staging occurs.

The general concept to be followed is shown in **Figure 2,** which is based on the assumption that each lot will require a 3+1 RMU and direct connection to main-line feeder cables

Details will be provided through the DIP (Design Information Package) process as the stages develop.

3.2 Reinforcement Requirements

This development area is likely to require significant transmission reinforcement (in the form of new substations with the requisite transmission line connections) as the load and capacity develops.

The timing for this reinforcement will be driven by the type and timing of the load uptake.

This does not preclude internal or connection issues that will need to be dealt with at the time of application and during the DIP process.

Applicants need to be aware that the information herein is provided in good faith and is accurate at the time of issue. However, power systems are dynamic in nature and Western Power's distribution electricity networks will change over time.

4 General Comments

Based on the study undertaken for the indicative ultimate load, at least 2 new zone substations and several new HV feeders are required to supply the Kemerton Industrial area. Please refer to Figure 2.

Feasibility studies are for the purpose of providing feedback on the distribution HV reinforcements required to accommodate the proposed development. In this case, no estimate has been provided as the cable route and distances of HV feeders is dependant on the location of the zone substation from the development area.

As per the UDS, the developer is to provide Western Power with suitable sites for the future zone substations having a minimum area of 1.44 hectares (120mx120m), at a location approved by Western Power. The land for the substation site must be of an estate in fee simple free from all encumbrances provided by way of gift and for no consideration free of all taxes, duties, charges and registration. Registration of the transfer is to be negotiated between Western Power and the developer.

The details in this feasibility study report are only indicative. Further in-depth study and analysis will be required to determine the exact requirement of the transmission and distribution reinforcement works once a formal application to Western Power has been lodged.

Western Power can neither reserve capacity nor guarantee supply to this development without a formal request being lodged. In order to provide a firm connection proposal and cost, a formal application to Western Power will have to be made, in accordance with our connection policies.

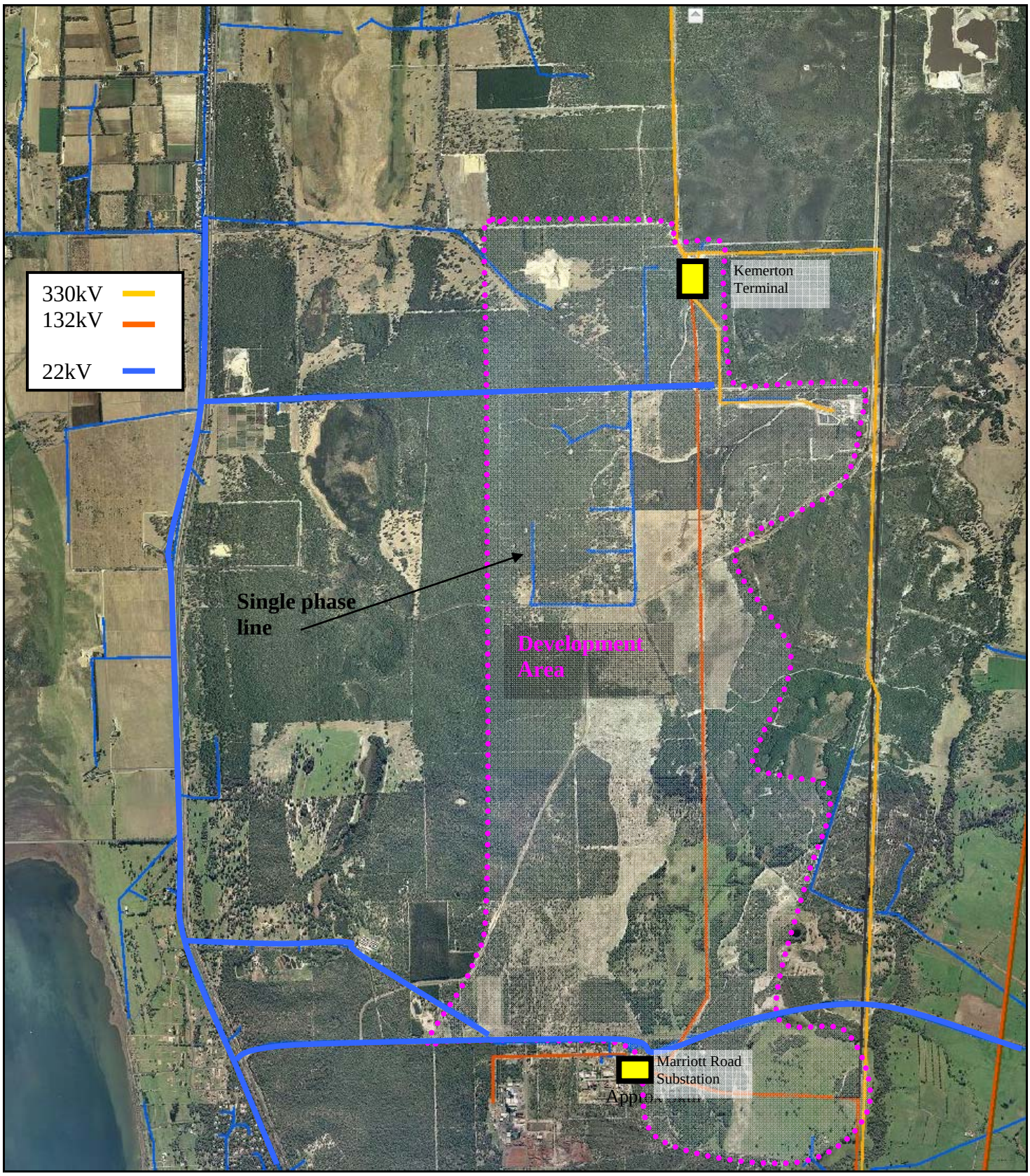


Figure 1 – Overview of Existing Networks

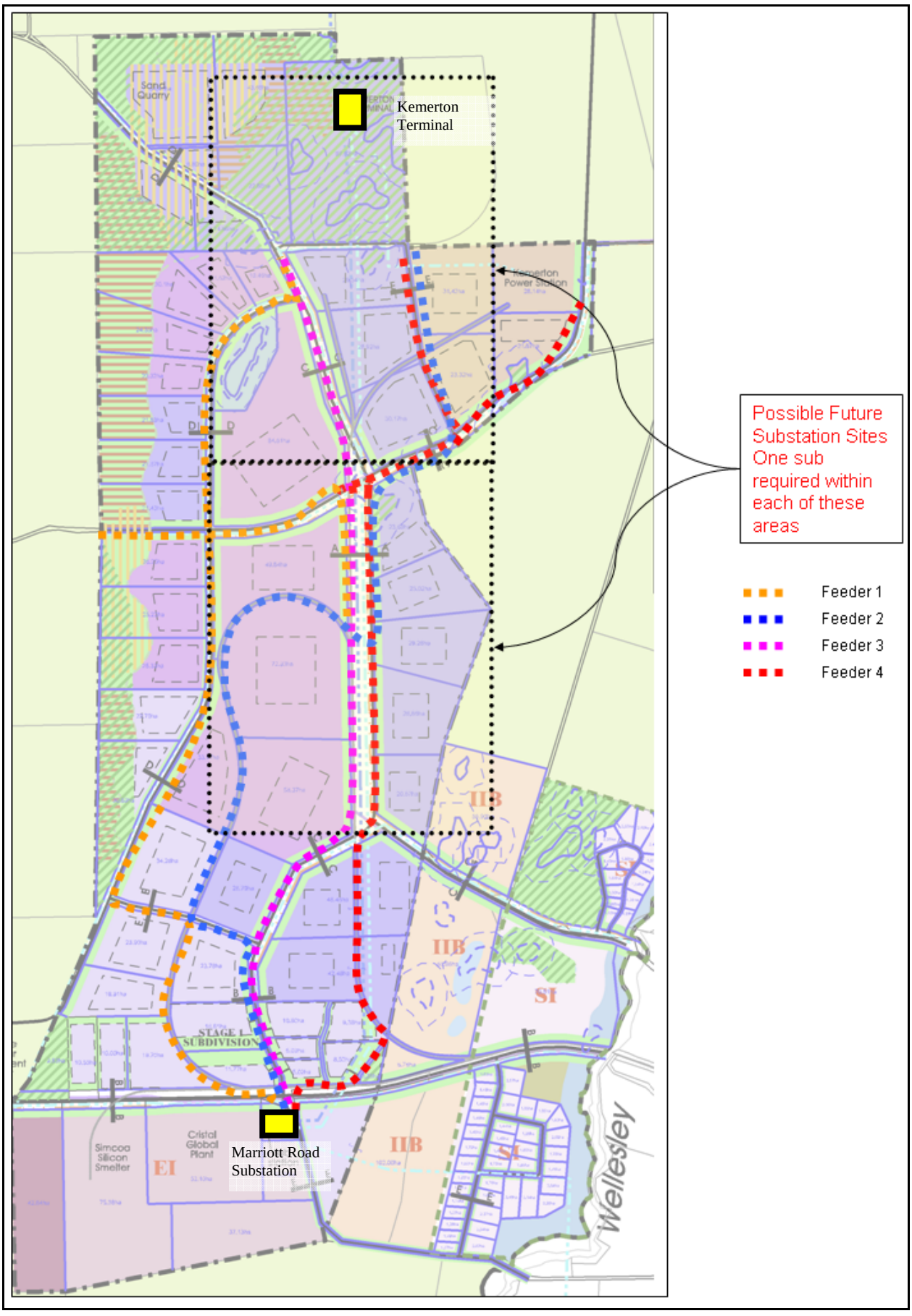


Figure 2 – Development area and Surrounds
Conceptual Distribution and Substation Layout

DMS#: 8004467

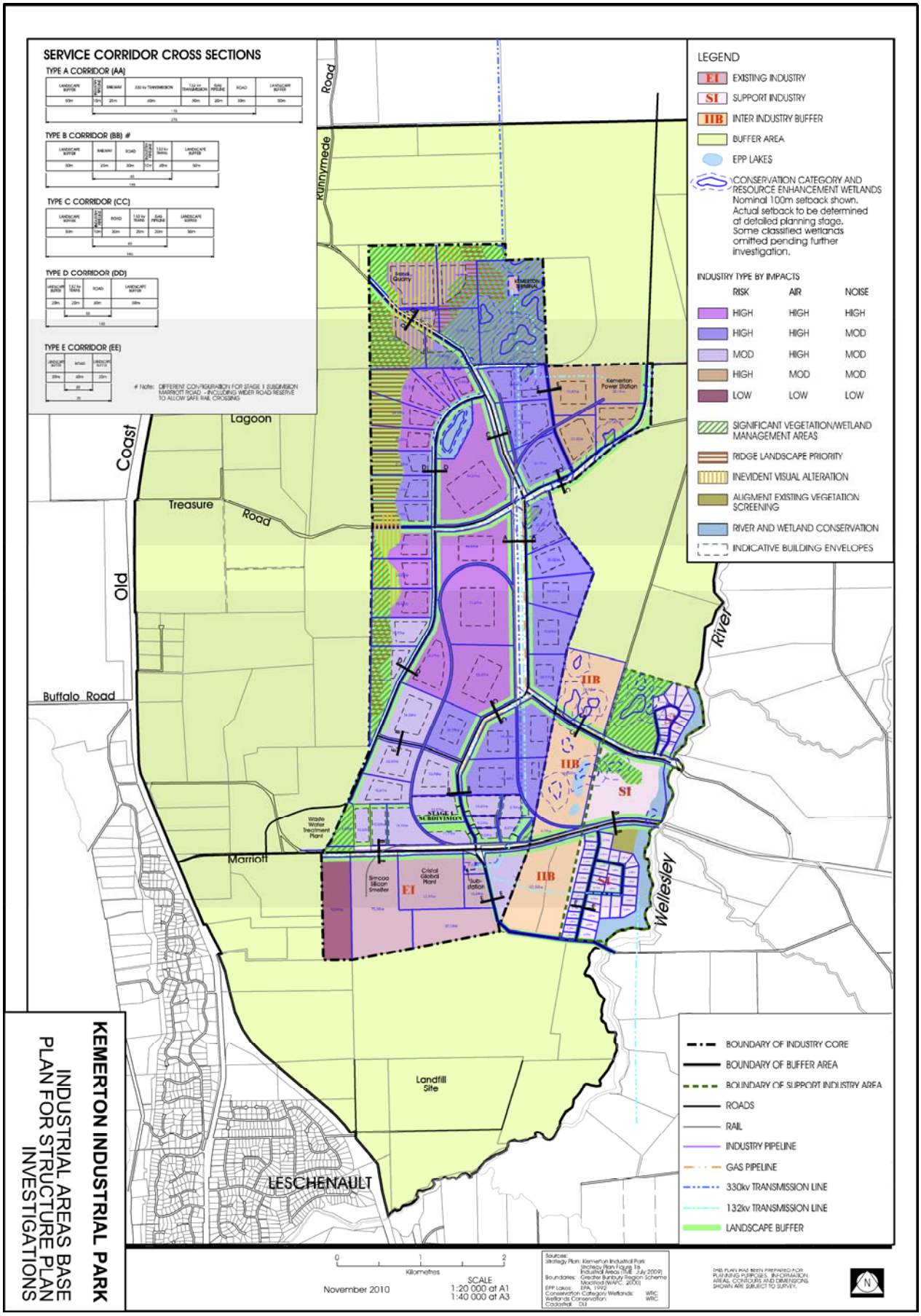
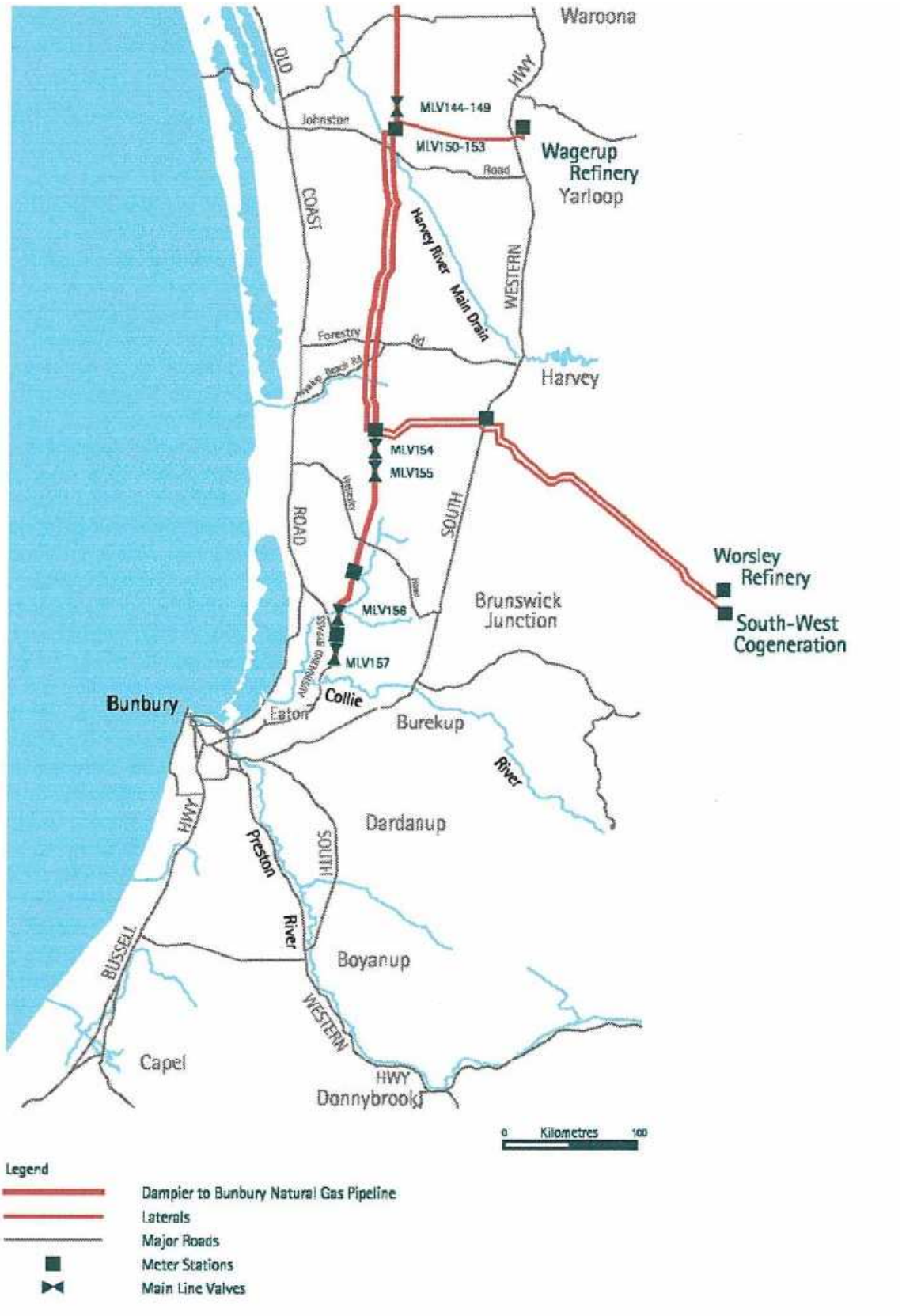


Figure 3 – Development Area Detail – Plan From Consultant

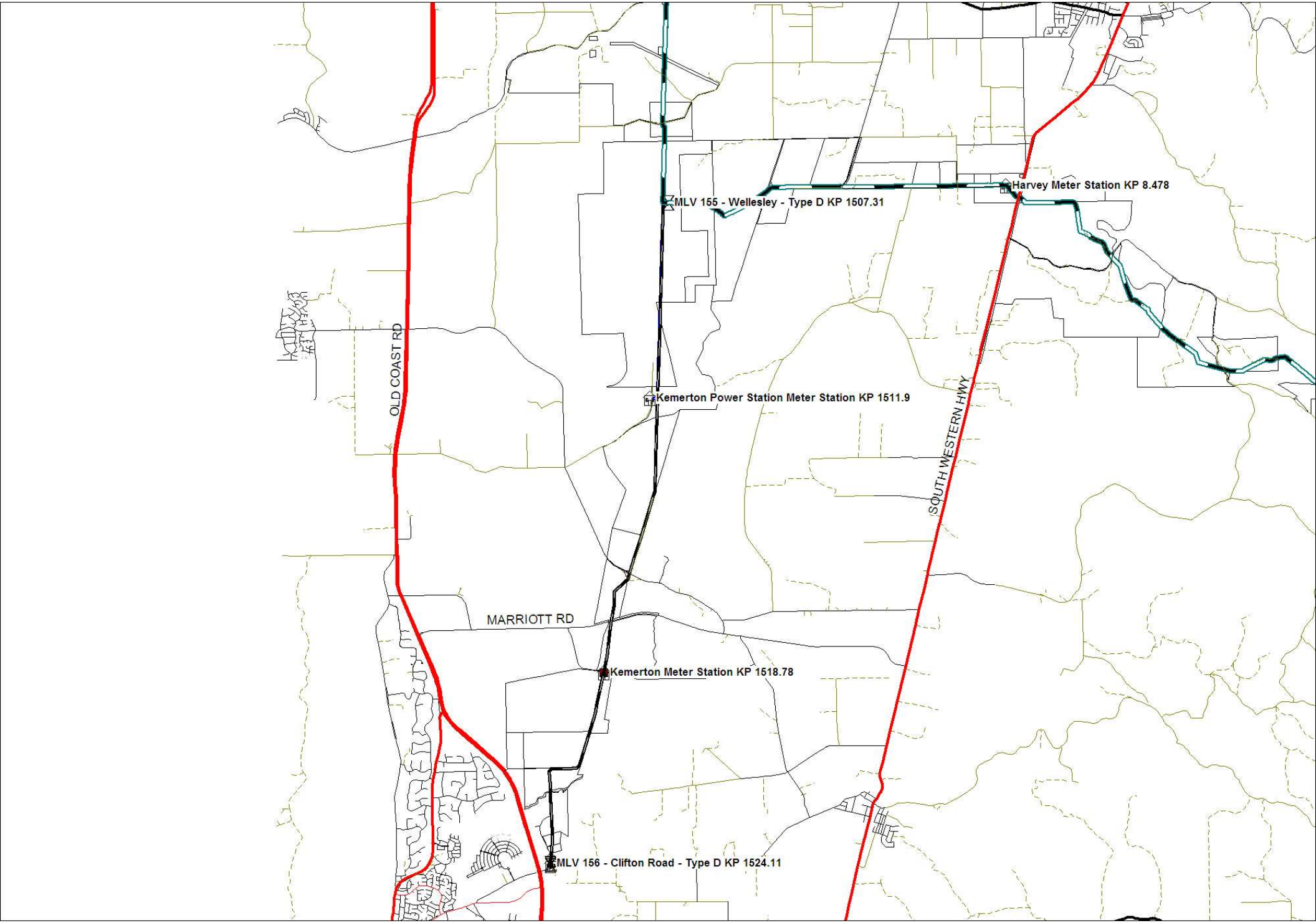
Appendix S

Dampier to Bunbury Natural Gas Pipeline - Main Line Gas Pipeline Plan (DBP)


Waroona
OLD
HWY
MLV144-149
Johnston
MLV150-153
Wagerup
Refinery
Yarloop
Road
COAST
Harvey River Main Drain
WESTERN
Forestry
Rd
Harvey
MLV154
MLV155
ROAD
SOUTH
Worsley
Refinery
South-West
Cogeneration
Brunswick
Junction
MLV156
MLV157
Bunbury
Collie
Eaton
Burekup
River
HWY
Preston
SOUTH
Dardanup
BUSSELL
River
Boyanup
WESTERN
HWY
Capel
Donnybrook
0
Kilometres
100
Legend
Dampier to Bunbury Natural Gas Pipeline
Laterals
Major Roads
Meter Stations
Main Line Valves

Appendix T

Dampier to Bunbury Natural Gas Pipeline - Kemerton Lateral Gas Pipeline Plan (DBP)


Harvey Meter Station KP 8.478
MLV 155 - Wellesley - Type D KP 1507.31
OLD COAST RD
Kemerton Power Station Meter Station KP 1511.9
SOUTH WESTERN HWY
MARRIOTT RD
Kemerton Meter Station KP 1518.78
MLV 156 - Clifton Road - Type D KP 1524.11

Appendix U

Potential Water, Power & Gas Requirements – Table 5.2 (Parsons Brinckerhoff)

Table 5.2 Power and water requirements for proposed KIP based on GHD assessment for Oakajee

Industry type	GHD classification	KIP industries that fit in the classification	Total power requirements		Total water requirements – Ml/a (ktpa)			Water discharge ML/a (ktpa)	By-products/ waste (ktpa)	Direct employment (persons)
			Power (MW)	Gas (TJ/a)	Domestic	TDS (100–200 mg/L) High quality industry	TDS (800–1000 mg/L) Cooling water			
INDUSTRIAL FACILITIES										
Large non-ferrous mineral processing /manufacturing	Covers a range of possible mineral groups. Pyrometallurgic, hydrometallurgical processing, refining, export. These processes are typically high energy use/production, high water use.	1. Silica sand facility* 2. Aluminium smelter	30	40,000	22	3,500	6,500	8,026	198	800
Medium size non-ferrous mineral processing /manufacturing	Pyrometallurgic, hydrometallurgical, refining and export. These processes are typically moderate energy use/production and high water use.	1. Synthetic rutile plant 2. vanadium refining plant 3. Silicon smelter (Simcoa)* 4. Pigment plant (Cristal Global)* 5. Titanium metal plant 6. Lithium metal facility	45	60,000	33	5,250	5,571	9,750	117	1,200
Organic based industrial processing plant – agricultural industrial	Industrial scale processes that are based on organic chemicals (e.g. specialised oil refining,	1. Urea plant 2. fertilizer plant,	100	1000	20	2,000	2,000	6,600	1000	500

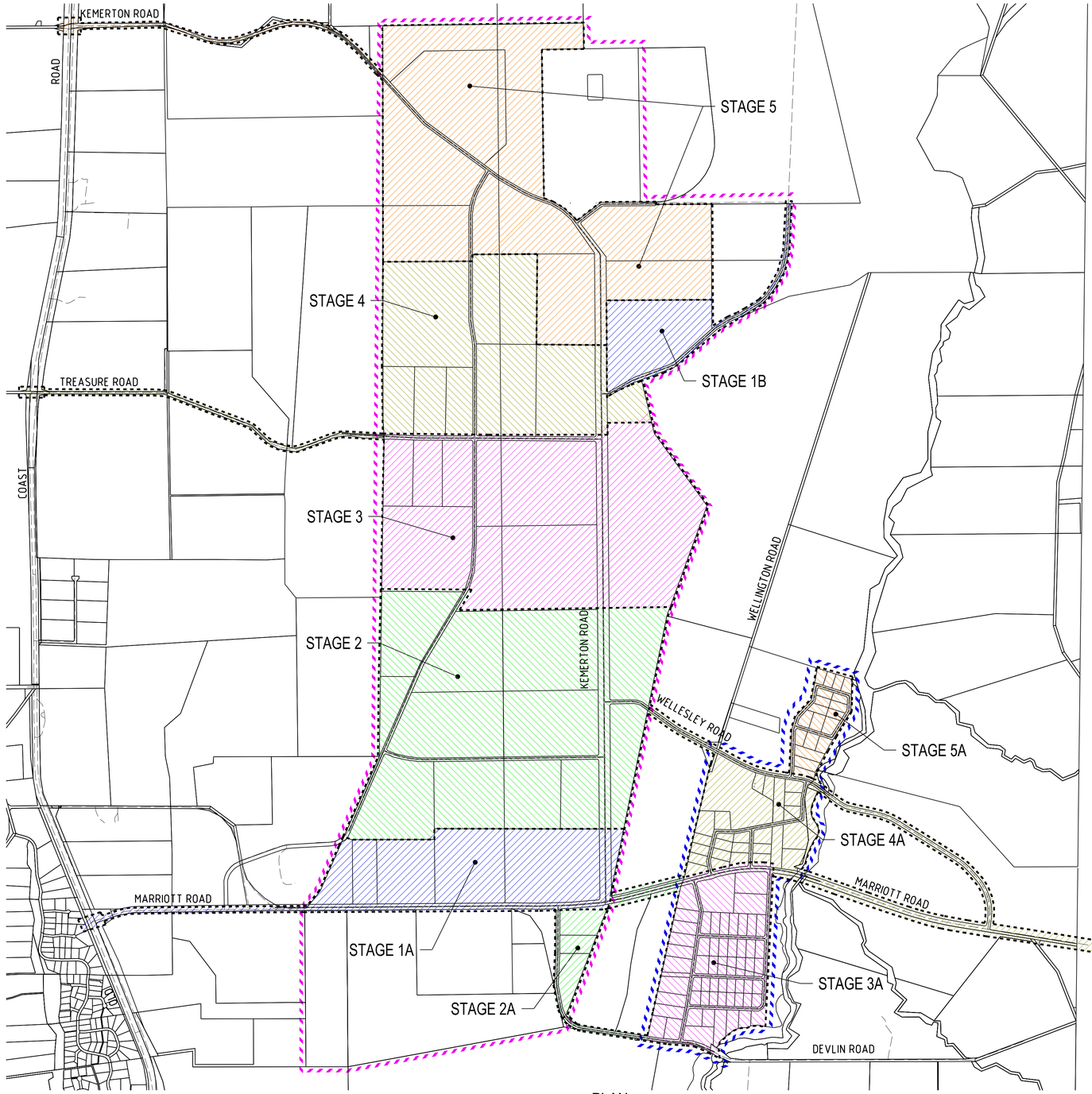
Industry type	GHD classification	KIP industries that fit in the classification	Total power requirements		Total water requirements – Ml/a (ktpa)			Water discharge ML/a (ktpa)	By-products/ waste (ktpa)	Direct employment (persons)
			Power (MW)	Gas (TJ/a)	Domestic	TDS (100–200 mg/L) High quality industry	TDS (800–1000 mg/L) Cooling water			
processing (AIP)	gas production).	3. BOC gases* 4. timber products plant 5. pulp and paper mill[(A)]								
General industries	No description	1. Ammonium nitrate storage 2. Chlor-alkali plant (Nufarm Cooge)* 3. Xanthate plant 4. ammonia plant 5. Hydrogen peroxide plant. 6. Lime hydration plant – Cockburn Cement*	3	144	2.25	120	120	198	300	240
Other classification	Fuel storage	1. Fuel terminal	2	11	1	10	25	28	3	50
		Subtotal	179.5	102,655	78.25	10,880	15,145	24,600	1,617	2,790
SUPPORTIVE INFRASTRUCTURE										
Solid waste industrial processing (large scale)	A processing facility that uses industrial processes to convert solid waste into useful	1. Recycling facilities – Recovery of general recyclable material, industrial waste, inert waste,	15	2,500	5	700	1,300	1,605	43	200

Industry type	GHD classification	KIP industries that fit in the classification	Total power requirements		Total water requirements – Ml/a (ktpa)			Water discharge ML/a (ktpa)	By-products/ waste (ktpa)	Direct employment (persons)
			Power (MW)	Gas (TJ/a)	Domestic	TDS (100–200 mg/L) High quality industry	TDS (800–1000 mg/L) Cooling water			
	products	construction and demolition waste								
Water factory	A facility to process multiple sources of water to produce a variety of qualities and volumes of water.	1. Treatment facilities of hazardous and industrial liquid waste streams	22	0	0.9	0.2	0	11,300^	294.2	70
Energy factory	Co/tri-generation or combined cycle facility, analogous to the water factory, to receive natural gas, hot waste process, liquid etc., and supply electrical energy, power, steam, hot air, hot water back to industries.	1. Power station/energy factory	-	20^	1	0	0	-	-	25
		Sub total	37	2,500	6.9	700.2	1,300	1,605	337.2	298
		Total	216.5	105,155	85.45	14,080	16,445	26,207	1,954	3,088

**Notes: ***Existing Industry ^indicates water/heat produced/required by the water factory/power factory, respectively, which have therefore not been included as KIP's output/input.
(A) Water demands and discharge not included in this table, given the particular high water demands typical of this industry.

Appendix V

Preliminary Staging Plan (Wood & Grieve Engineers)



PLAN
SCALE 1:20,000

LEGEND

- STRATEGIC INDUSTRY ZONE BOUNDARY
- ANCILLARY INDUSTRY ZONE BOUNDARY
- PROPOSED STAGE BOUNDARY
- STAGE 1
- STAGE 2
- STAGE 3
- STAGE 4
- STAGE 5

REV.	DESCRIPTION	DRAWN	VER	APPROVED
D	PROJECT NAME AMENDED	NJHE		
C	CADASTRAL UPDATED	NJHE		
B	REVISED CADASTRAL	GAB		
A	ORIGINAL ISSUE	GAB		21/10/11

CELEBRATING 50 YEARS
WOOD & GRIEVE ENGINEERS
Wood & Grieve Engineers Ltd
A.C.N. 137 999 609
Level 3, Hyatt Centre
3 Plain Street, East Perth
Western Australia 6004
Phone: +61 8 6222 7000
Fax: +61 8 6222 7100
Email wge@wge.com.au
Web www.wge.com.au
PERTH
MELBOURNE
SYDNEY
BRISBANE
GOLD COAST
ALBANY
BUSSELTON
SHENZHEN

CLIENT:
LANDCORP

PROJECT:
KEMERTON STRATEGIC INDUSTRIAL AREA - STRUCTURE PLANNING

TITLE:
PROPOSED STAGING PLAN

PRELIMINARY

SECTION: CIVIL SERVICES	VERIFIED :	SCALE : A1
DESIGNED :	APPROVED FOR TENDER:	DATUM : A.H.D.
DRAWN : GAB	APPROVED FOR CONSTRUCTION :	WAPC : -

PROJECT No.	DRAWING No.	REVISION
22726-PER-C	PS	D

P:\22726\Civil Drawings\Sketches\140722 Sketches new report\c plan staging.dgn

Appendix W

Extract from Local Water Management Strategy – Kemerton Strategic Industrial Area Report, by RPS (RPS ref D1054201 Rev 0, dated December 2014) - Section 5.0 Water Supply, Section 6.0 Wastewater Treatment and 7.0 Surface Water Management.

5.0 WATER SUPPLY

5.1 Existing Potable and Process Water Supply at the KSIA

The existing industries at the KSIA abstract water for process and potable water requirements from unconfined and confined aquifers. A brief summary (sourced from Aquaterra 2002) of the abstraction bores for each existing industry is outlined below:

- Simcoa Operations Pty Ltd (Kemerton Silica Smelter) operates two production bores, PB1 and PB2. Bore PB2 extracts water from the Yarragadee Formation and is the primary source of water. Bore PB1 has been used from time to time as a back-up and extracts water from the Superficial formation. The site operates a water treatment plant for water pumped from the production bores. The treated water is then pumped to a process water tank, which is used to meet potable and process water requirements. Problems have been encountered with treatment of groundwater extracted from the Superficial formation due to high TDS, dissolved organics and hydrogen sulfide. Wastewater is discharged via drainage channels or pumped to a polyethylene lined settling pond where, after solids have settled out, it is recycled for on-site use for dust suppression and irrigation purposes.

- Kemerton Silica Sands operate two production bores, KW7 and KW14, both extracting water from the Superficial formation. The process water supply is primarily made up of return water used in the process and supplemented by water from the production borefield. Water from the production borefield is also the source for on-site potable water requirements.

- Millennium Inorganic Chemicals (MIC) operates three production bores, KW-1, KW-3 and KW-4. Bore KW-1 draws water from the Leederville formation and bores KW-3 and KW-4 from the Cattamarra Coal Measures. This water is treated prior to use in the process. All wastewaters, excluding stormwater, are directed to their wastewater treatment plant. The treatment plant currently discharges around 1 GL/yr to the ocean.

- Nufarm-Coogee – No production bores. All water requirements for the site are provided by MIC. All effluent produced from the process, and run-off from the salt slabs, is pumped to the wastewater treatment plant operated by MIC.

- Cockburn Cement – No production bores. All water requirements for the site are provided by MIC. All effluent produced from the process is pumped to the wastewater treatment plant operated by MIC.

- BOC Gases – As for Nufarm, process and potable water requirements for BOC Gases, located in the southern part of the Estate, is supplied by MIC. The water is treated on site for potable needs using side stream filters and water softeners through a cooling tower. The wastewater from the cooling tower is conveyed to a concrete lined pit, which is then pumped back to MIC to be treated in the wastewater treatment plant, and discharged to the ocean.

- Kemerton Power Station (Transfield Services) commenced operation in November 2005. In June 2008, a 40 MW upgrade was completed on Kemerton Power Station, increasing its capacity to 300 MW. Transfield Service has an agreement with Harvey Water to supply up to 5 GL per year of water from the Harvey Irrigation Scheme to the Transfield Worley power station as and when required. Wastewater generated at the Power Station is disposed of on site using evaporation ponds.

5.2 Future Potable and Process Water Requirements

5.2.1 Aquaterra Water Study (2002)

An estimate of the type and number of industries that would locate to the KSIA and estimated future water demand were completed in the Phase 2 Water Study (Aquaterra 2002). It was estimated that the water demand at the KSIA is likely to range between 7 GL/yr and 23 GL/yr. Table 4 below provides an estimate of the predicted water demand required at the KSIA for various growth scenarios.

Table 4: Future Water Demand for the KSIA

Scenario	Demand	Comments
Low Growth	7 GL/yr	Status quo with demand dictated by the expansion of Cristal and Simcoa operations. Included also is the possibility of titanium sponge production and a few small unspecified industries.
Medium Growth	10 GL/yr	Volume required is higher to meet the demands of a synthetic rutile plant, wool processing, iron briquetting plant and a pulp mill.
High Growth	14 to 18 GL/yr	High growth scenario view considering the full development of with a wide range of industries including an aluminium smelter, power station and other industries.
Maximum	23 GL/yr	High growth demand plus the introduction of a “high water demand” industry.

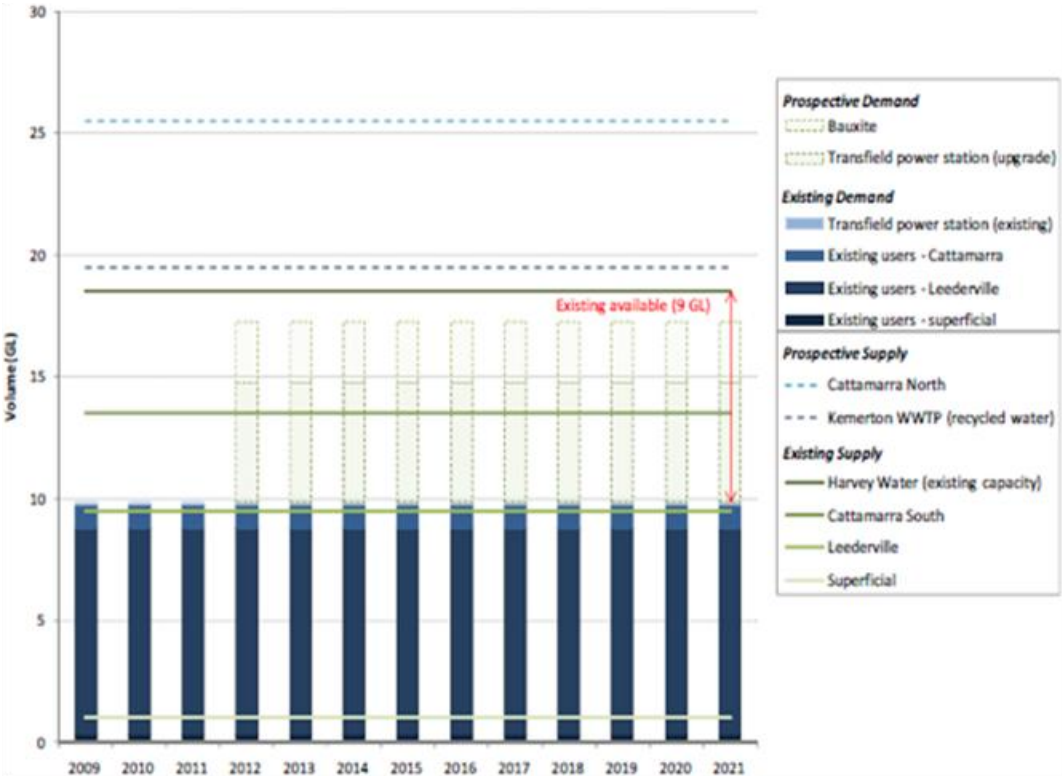
Source: Aquaterra 2002 Table 3.2

5.2.2 Marsden Jacob Associates (2011)

Marsden Jacob Associates were commissioned by the South West Development Commission to undertake an economic analysis of the likely demand for industrial water supplies and assess the supply options that may be obtained from local sources. A copy of this document is provided in Appendix 5. Water supply is a key factor in maintaining

both existing industrial output and supporting growth in the region. The investigation was required in order to establish future possible water supply options and the feasibility for agricultural and industrial uses in the south-west.

The potential water supply and water demand of the KSIA was investigated as part of this study. Using other industrial parks in Australia as a benchmark, it was calculated that diversified industrial estates, similar to the KSIA, have a general water demand of 0.025 GL/ha/yr. At full development of the KSIA, the benchmark forecast suggests that additional water use could be in the order of 18 to 27 GL/year at the KSIA, as indicated in Figure A below.



(Source: MJA 2011)

Figure A: Existing Supply and Planned Supply/Demand in the Kemerton Strategic Industrial Area

In assessing possible water supply to the KSIA, the study estimated that 9 GL per year of water can be provided from sources considered "easily accessible" in the KSIA, including the Superficial, Leederville and Cattamarra South aquifers (Catammarra north is relatively deep and has a high salinity) and Harvey Water's existing pipeline in the area.

Various water supply and demand scenarios were calculated for the KSIA in order to assess various short and long-term supply and demand options required at the KSIA. A summary for each scenario is summarised in Table 5 below.

Table 5: Summary of Supply and Demand Balance for Each Scenario (Marsden Jacobs 2010)

	Current Supply/ Demand (GL)	Prospective Demand and Supply, 2016 (GL)	High Demand and Supply (GL)	High Demand, Low Supply (GL)
Kemerton Water Supply	19	26	26	19
Kemerton Water Demand	10	17	40	40
Shortfall	NA	NA	14	21

Excluding the potential conflicting water requirements of other industries located in the vicinity that may require water, the summary indicates that water demand can be met at the KSIA under the predicted scenarios until 2016.

In the event that a number of high demand industries locate to the KSIA, such as an aluminum smelter, the water demand for the KSIA is likely to be 40 GL/year. This will exceed the 26 GL of supply proposed to be available. The 26 GL of supply is based on existing groundwater supplies as well as recycled wastewater from the Kemerton Water Treatment Plant and groundwater from the Cattamarra Coal measures.

In this instance, additional alternate water supplies will be required to meet the water demands of possible high demand industries that may locate to the KSIA in the long term. Should capacity be reached however in the long term (which is predicted to be in 20 to 30 years), further water provision options shall be sought from possible sources such as improved water recycling initiatives on site and from local industries. These two options mentioned above and additional water sources are discussed in further detail in Section 5.3.

It is anticipated that growth in irrigated agriculture will be met by existing water entitlements. Water is currently available for agriculture in the Wellesley groundwater sub-area and may become available for Harvey Water if salinity in the Wellington Dam improves or if additional water efficiency projects are funded by government.

The priority in the region is therefore to provide fit for purpose water supplies to support industrial growth.

5.3 Future Supply Options

The Marsden Jacob study assessed the feasibility of a wide range of possible water sources and uses. The key water sources available for the KSIA include (MJA 2011):

- Integrated Water Supply Scheme (Potable)
- Wellington Dam (Potable and Process)

- Groundwater Abstraction (Potable and Process)
- Recycled water from the Verve Pipeline (Process)
- Recycled water from the Kemerton Wastewater Treatment Plant (Process)
- Recycled water from the Millennium Inorganic Chemicals Treatment Plant (Process).

An additional water supply option not investigated by the Marsden Jacob study includes the broad scale application of water recycling within the KSIA at the lot scale and between industries located within the KSIA.

In the long term, once a sufficient mass of industry is located at the KSIA, the establishment of an on-site wastewater treatment and recycling plant to allow for the large scale collection and recycling of water within the KSIA will be investigated.

5.3.1 Integrated Water Supply Scheme

Harvey is supplied by the Integrated Water Supply Scheme that services the Perth metropolitan area. The Water Corporation presumes the supply to KSIA would be limited to domestic and low usage industry only with major industrial water use sourced through other means such as groundwater or recycled water.

5.3.2 Wellington Dam

Wellington Dam has an estimated annual yield of 86.2 GL and a storage capacity of 185 GL, however is under utilised due to high salinity levels. The total allocation available from the Wellington Dam is currently 85.1 GL, with water currently allocated or reserved for the following purposes (MJA 2011):

- Harvey Water irrigators currently use around 47.5 GL of the 86 GL per year entitlement (average since 1996–1997). Harvey Water has been in negotiations with a number of industrial customers to supply water to industry from the remaining allocation.
- To expand the potential for industrial supply, Harvey Water has constructed a pipeline that can, at present, transfer up to 6 GL of water from the Collie River catchment. Harvey Water has constructed a pipeline capable of supplying up to 5 GL per year of water to the Transfield Worley power station as and when required.
- The Collie Water River Project has outlined an option to reduce salinity by diverting high saline flows from the Collie River. Harvey Water has indicated that if salinity is reduced to the target levels and a Commonwealth funded initiative to

pipe the Collie irrigation area is undertaken, Harvey Water would provide 11 GL of water to the Commonwealth Environmental Water Holder, 11 GL for industrial use and the remaining 46 GL for irrigation.

5.3.3 Groundwater Abstraction

The remaining groundwater allocation available for abstraction for the groundwater management areas the KSIA is located in is 11 GL/year, the majority of which is within the Cattamarra coal measures in the KSIA north and south sub-area.

As discussed in Section 3.4, 2 GL is contained in the Superficial aquifer in a dispersed nature making extraction of the water for industrial use difficult. In addition, the water from Cattamarra Coal Measures in Kemerton North is relatively deep with high salinity. Therefore, only 3 GL of water contained in the Cattamarra Coal Measures in Kemerton South might be considered readily accessible by industry (MJA 2011).

An application was lodged with the DoW in 2011 to secure a groundwater allocation of 9 GL/year from the Cattamarra Coal Measures aquifer of the Kemerton North and South groundwater sub-areas for the purpose of industrial processing within the KSIA.

The DoW advised that a staged development plan would be required and that the maximum permitted licence term for large staged developments with a water entitlement exceeding 500 ML/yr is five years. In 2011, a staged development plan was not available and the time frames for development of the KSIA were also uncertain. In addition the DoW requested that a H3 Hydrogeological Assessment report and successful drilling of the aquifer be completed prior to the DoW issuing a 5C licence to take water.

Future applications to secure a groundwater licence for both potable and process water will be supplied to the DoW following approval of the KSIA Structure Plan and the required information being available.

5.3.4 Kemerton Domestic Wastewater Treatment Plant

The Water Corporation's Kemerton Wastewater Treatment Plant treats wastewater from the nearby towns of Australind and Eaton. The plant is currently capable of treating 3 ML per day (approximately 1 GL per year) of wastewater. The Water Corporation is currently examining alternatives to upgrade the plant to treat 7.2 ML per day (2.6 GL per year at full capacity). Harvey Water understands that the volume available from recycling could ultimately be increased to 8 GL per year; however, this could not be confirmed by MJA at the time of reporting. A portion of the treated water from the plant is recycled and waters nearby tree farms at the KSIA. The Water Corporation is also in discussions with a potential industrial customer to supply the remaining capacity of the plant as recycled water (MJA 2011).

Correspondence with the Water Corporation has commenced to seek advice as to whether they would look favorably on diverting treated wastewater to the KSIA for reuse. The Corporation has supported the proposal to draw some or all of the treated wastewater from the Kemerton WWTP subject to availability and a commercial agreement. Refer to Appendix 6 for correspondence with the Water Corporation.

Since early discussions with the Water Corporation occurred regarding the recycling of wastewater from the Kemerton WWTP, it appears that Harvey Water are in negotiations to purchase the water from the Water Corporation to shandy with water from Harvey Water's dam supplies. The option of reusing water direct from the WWTP may not be an option; however purchasing the water from Harvey Water is a possibility.

5.3.5 Verve Ocean Outfall

The Verve Ocean outfall pipeline is licensed for approximately 7 ML per day of discharge. Verve has indicated that the pipeline will be at full capacity if and when current negotiations with DoW are finalised. The Verve pipeline passes the KSIA and could potentially be used as a source of recycled water, although the quality of the wastewater may make recycling an expensive alternative (MJA 2010).

Correspondence with the Water Corporation has commenced to seek advice as to whether they would look favorably on diverting treated effluent to the KSIA for reuse. The Water Corporation has responded outlining that discharge of treated wastewater via the Verve Energy outfall does not preclude commercial reuse alternatives such as the KSIA. Refer to Appendix 6 for correspondence with the Water Corporation.

5.3.6 MIC Wastewater Treatment Plant

The existing Millennium Inorganic Chemicals wastewater treatment plant discharges approximately 1 GL/yr to the ocean, with an effluent water quality of around 30,000 mg/L Total Dissolved Solids (TDS). Nutrient concentrations are generally around 0.35 mg/L for nitrate and 0.05 mg/L for phosphorous. This treated water quality is not suitable for re-use by the existing industries, but it may be suitable for use by future industries, or for further treatment by any future wastewater treatment plants at Kemerton (Aquaterra 2002).

5.3.7 KSIA Water Recycling

A potential source of water is the supply of recycled wastewater generated by the industries located within the KSIA. The strategy in the short term is for sites which generate industrial wastewater, to treat the water at the lot scale to a standard where it is suitable for disposal to a nearby facility or reuse on site or by a neighboring industry.

In the long term, once a sufficient mass of industry is located at the KSIA, alternate wastewater disposal options will be investigated, including the establishment of an on-site wastewater treatment and recycling plant to allow for the large scale collection and recycling of water within the KSIA.

Further details on this topic can be found in Section 6.1 Industrial Wastewater.

6.0 WASTEWATER TREATMENT

6.1 Industrial Wastewater

The Water Corporation does not support reticulated wastewater collection from industrial sites for treatment in conventional wastewater treatment plants. Industrial estates by nature of layout, discharge type and potential high flow rates are not readily compatible with domestic treatment processes. Industrial treatment, reuse and disposal are often better addressed on site or locally.

The Water Corporation has outlined the preferred options to manage industrial wastewater at the KSIA:

- Industry to treat effluent to predetermined acceptance criteria and recycled on site or to a neighbouring industry, (this currently occurs on site by some of the existing industries).

- Industrial wastewater to be collected centrally and recycling opportunities sought or disposal considered.

- If a critical mass of industry is reached, a combined application for a common outfall could be made whereby wastewater is treated to an acceptable standard on site or centrally within the KSIA prior to disposal (subject to required environmental approvals).

As the development timetable and occupancy rate of the KSIA is undefined at this stage in the planning process, the strategy in the short term is for sites which generate industrial wastewater, to treat the water at the lot scale to a standard where it is suitable for disposal to a nearby facility or reuse on site or by a neighboring industry.

In the long term, once a sufficient mass of industry is located at the KSIA, alternate wastewater disposal options will be investigated, including the establishment of an on-site wastewater treatment and recycling plant.

6.2 Commercial Wastewater

The population of employees expected to work at the KSIA on a daily basis is not expected to warrant the demand and expense of the infrastructure to install reticulated wastewater collection sewers provided by the Water Corporation to dispose of wastewater generated from toilets, bathrooms and kitchens at the lot scale.

As an alternative, the KSIA will rely on the use of Aerobic Treatment Units (ATUs) and/or septic tanks and leach drains to collect, store and treat wastewater from the Lots. The Shire of Harvey expressed their preference for the use of septic tanks and leach drains at a brief meeting held between the Shire of Harvey, RPS and Wood and Grieve Engineers on 11 July 2011. It was agreed at this meeting that the location, number and type of system would be confirmed in the UWMP, which is to be completed as a condition of subdivision and development applications submitted to the SoH for individual lots at time of construction.

6.2.1 Aerobic Treatment Units

Aerobic Treatment Units (ATU) are self-contained electrical wastewater (sewage) treatment systems for use on properties that are not connected to mains sewerage.

The ATUs shall be designed and located in accordance with the Department of Health's (DoH) *Code of Practice for the Design, Manufacture, Installation of Aerobic Treatment Units (DoH 2001)* and the Department of Water, *Water Quality Protection Note 70 Water Treatment and Disposal – Domestic Systems* (DoW 2010b).

ATUs consist of a series of treatment chambers including an aeration chamber and a solids settling chamber where the effluent is discharged via an underground soakage system.

These systems normally reduce degradable organic matter, sediment, suspended solids and grease to concentrations significantly less than conventional septic tank treatment systems.

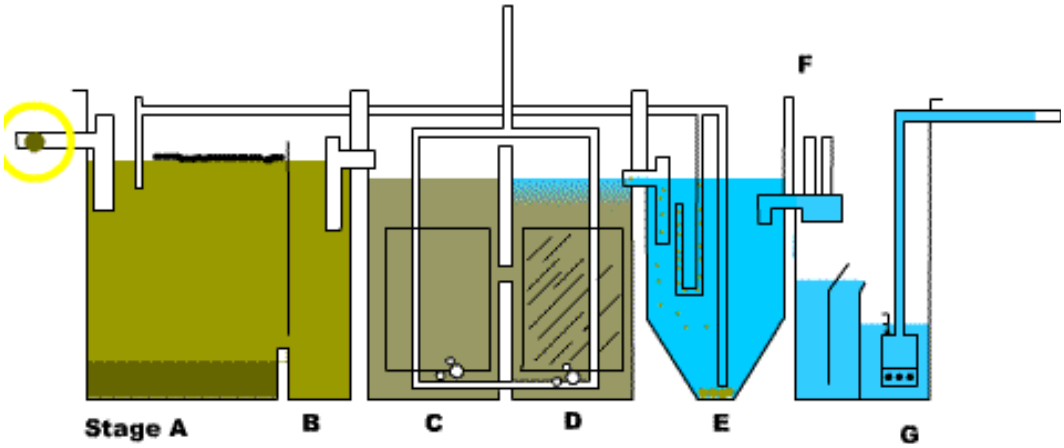


Figure B: Example ATU – DoH Approved Biomax Model C10

Figure B above illustrates that the ATU is divided into five principal chambers:

- Stage A – Anaerobic chamber – anaerobic treatment
- Stage B – Aerobic chamber – aerobic treatment
- Stage C/D –- Clarification chamber – sludge settlement and removal

- Stage E – Disinfection chamber – contact time with chlorine
- Stage F/G – Pumpout chamber – discharge to disposal system.

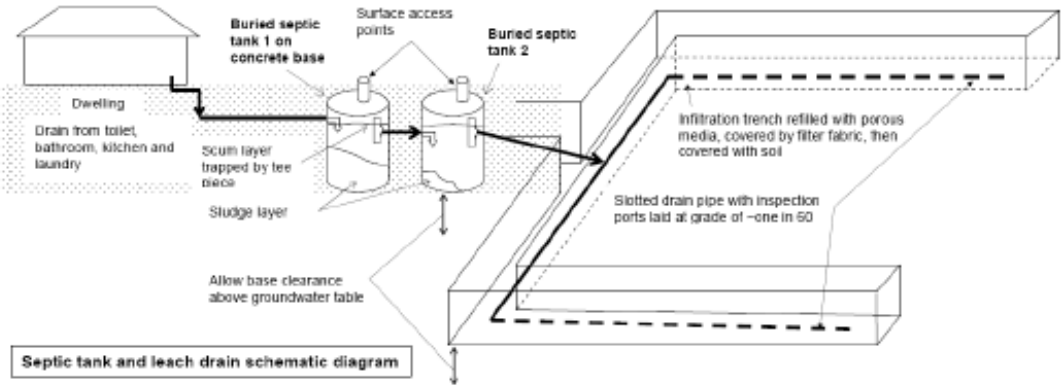
This system is approved for dripper irrigation. Other units that are DoH approved do not contain a disinfection chamber and effluent can be discharged to soakage wells or horizontal leach drains. Soakage through an approved amended soil mix (that retains phosphate on fine soil particles) in an effluent disposal area can achieve phosphorus removal. The amended soil has a finite operational life before becoming saturated with phosphate and will need replacing when phosphate breakthrough occurs

The soil characteristics at the disposal site should allow effective soakage of treated wastewater in accordance with the Health (Treatment of sewage and disposal of effluent and liquid waste) Regulations 1974.

Under DoH legislation, ATUs are required to be serviced at least every three months. Servicing can only be carried out by a person who has approval from the Executive Director, Public Health to service ATUs

6.2.2 Septic Tanks with Amended Soil Effluent Systems

A possible septic tank system for the KSIA consists of two conventional septic tanks in series, followed by leach drains surrounded by a permeable amended soil blend that removes phosphate (Figure C). One approved soil amendment material is a by-product of alumina processing known as red mud and red sand. This type of system reduces concentrations of biochemical oxygen demand, suspended solids, micro-organisms and phosphate in effluent.



(Source: DoW 2010b)

Figure C: Septic Tank System

6.2.3 Buffers to Wastewater Systems with Phosphorus Removal

Table 6 outlines the buffers recommended to wastewater treatment systems with phosphate removal near sensitive waterways or wetlands.

Table 6: Buffers to Wastewater Systems with Phosphate Removal (Source: DoW 2010)

Feature	Minimum Buffer Distance	Comments
Wetlands	50 m	Buffer in accordance with the DER and Environmental Protection Authority policies on the minimum buffer required for any type of development near a wetland.
Waterways and Estuaries	30 m	Buffer in accordance with DoW policy on foreshore protection for waterways.
	Outside the flooded area resulting from a 10 year (average recurrence interval) storm	

7.0 SURFACE WATER MANAGEMENT

7.1 Stormwater Management

The site will effectively manage stormwater through the implementation of Water Sensitive Urban Design (WSUD) principles and Best Management Practices (BMPs) to control water quality and quantity from both minor and major storm events.

To manage the increased run-off expected from development, the site has been divided into 10 sub-catchments to allow for a series of stormwater management measures to be implemented throughout the site, to manage stormwater close to source and to facilitate the infiltration of stormwater where possible.

In accordance with the Stormwater Management Manual for Western Australia (DoW 2004–2007) and the Department of Waters Water Quality Protection Note 52 "Stormwater Management at Industrial Sites" (May 2010), the drainage system will aim to achieve the following objectives:

- Maintain the existing hydrological regime by allowing the infiltration of uncontaminated water on site and limiting discharges from the KSIA to pre-development peak flows and volumes.

- Uncontaminated stormwater run-off from roofs for example will not be allowed to mix with process effluent and stored chemicals to allow for the infiltration of uncontaminated stormwater and recharge of the Superficial aquifer.

- Rainfall up to the 1:10 year ARI event will be retained and infiltrated within lot boundaries using soakwells. Lot run-off in excess of 1 in 10-year ARI event shall discharge to roadside swales.

- Roadside conveyance swales shall be sized to convey the critical 10-year ARI storm events from the road reserves wherever possible to minimise the use of a piped drainage network.

- Large rainfall events (>10 year) up to the 1:100 year ARI event will be conveyed through overland flow and road side swales to drainage detention basins within the site for storage and/or treatment prior to infiltration.

The proposed drainage strategy adopts a similar approach to the management of stormwater that is currently being used at the KSIA. The existing industries for example are primarily located on the main entrance road (Marriott Road) where roadside swales are used to collect stormwater from the road reserves.

As the site is zoned Industrial, fertiliser use is expected to be minimal. Landscaped POS areas will incorporate native species that will not require irrigation once established. Native vegetation will also be used in stormwater detention/retention areas to aid infiltration, control erosion and provide a degree of water quality treatment.

7.1.1 Post-development Drainage Design

Design of the drainage system focuses on maintaining the pre-development hydrological regime at the site as closely as possible, while concentrating on the protection of groundwater and surface water resources.

In order to establish the current baseline hydrological conditions at the KSIA, RPS has developed an XPSWMM surface water model of the site to determine the surface water catchment boundaries, pre-development surface water flow rates and the required volumes of stormwater detention needed on site to maintain the pre-development conditions. Figure 11 provides an assessment of the pre-development drainage flow paths and catchment boundaries.

Lidar data was received for the KSIA area and was used to create a digital elevation model for the area, which magnified the surface relief and drainage features for the area.

The preliminary drainage and earthworks designs provided in Figures 12 to 14 and Appendix 7 will need to be further refined at the subdivision stage. Although preliminary, the drainage and earthwork concepts demonstrate that the KSIA is capable of managing stormwater in events up to the 1 in 100 year ARI, while incorporating suitable best management practices.

7.1.2 Minor Drainage System

Rainfall will be retained on site and infiltrated as close to source as possible using the following practices:

- All rainfall on the permeable surfaces, particularly uncleared land surrounding the lots will infiltrate as per existing conditions.
- The use of rainwater tanks to collect run-off from roof areas will be encouraged as a potential source of water, and as a means of reducing enhanced run-off from paved surfaces.
- Lots will infiltrate rainfall in events up to the 1:10 year ARI event through the use of soakwells
- Road drainage within the development will incorporate roadside conveyance swales and limited piped network designed to accommodate the 10-year event.

Roads throughout the KSIA will incorporate roadside swales where possible. The swales will typically be 0.6 m deep and 3.6 m wide at the surface. Road side swales along Kemerton Road (Catchments 2 to 5 shown on Figure 12) will require larger or deeper swales (we have modelled 9 m wide swales at the surface that are 0.6 m deep), however this will need further refinement once the actual lot sizes and locations are confirmed at the detailed design phase. Swales can be located on one or both sides of the road reserve, the location will be affected by the final placement of services and the railway corridor. Refer to Figure D below for a schematic diagram of a typical cross section of the possible road and roadside swale design at the KSIA.

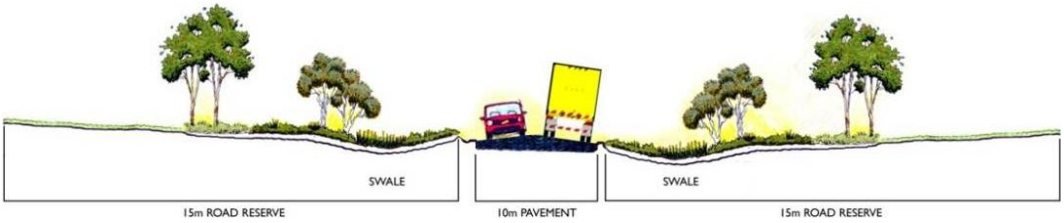


Figure D: Schematic Cross-section of Road and Swale Design at the KSIA

7.1.3 Major Drainage System

As water sensitive urban design approaches generally rely on infiltration, it is most effective for smaller, frequent storm events. Traditional methods including earth fill to create building pads and flood flow paths to convey larger floodwaters downstream are often required to augment water sensitive design practices when the rates of surface run-off significantly exceed the infiltration rate.

Due to the expansive area, the KSIA needs to be designed with a mix of water sensitive design and traditional design methods. Water sensitive design principles will be employed for the minor events while traditional design methods will need to be applied in areas where a shallow water table is present (eastern extent of the KSIA), notably using earth fill to construct pads for buildings, roads and car park or hard standing areas. Detailed drainage plans will be required to be developed for individual sites, consistent with the strategies outlined in the LWMS, with the details to be provided in future UWMPs.

Various engineering reports have been prepared throughout the development and planning of the KSIA to provide drainage strategy recommendations; many however rely on the artificial lowering of groundwater below the AAMGL by using sub-soil drainage systems to minimise fill and incorporate traditional piped drainage systems, as they reflect the policy requirements prior to water sensitive urban design. RPS considers these approaches would no longer be acceptable to the DoW as the wetlands would be impacted and nutrient rich groundwater would be exported from the site and discharged to the Wellesley River.

The refinement of the drainage strategy, incorporating current drainage best practice, is to maximise the infiltration within the development area of each lot. Broadly, this strategy relies on the use of undeveloped/uncleared areas on each lot for infiltration, along with the use of soakwells for run-off from "clean water" sources including roof areas and pedestrian paved areas surrounding the building pads, to avoid the need for substantial drainage control structures.

The strategy also relies on the use of the Multiple Use category wetlands as drainage infiltration basins or existing topographical low points for storage and infiltration of the larger flood events. It should be noted that the Multiple Use wetlands are "sumplands" which are seasonally inundated with run-off and groundwater inflows. They typically occur on the eastern side of the KSIA, and their use as drainage basins is consistent with their Multiple Use management category, provided that the hydrological functions (e.g. seasonal inundation) and any remaining ecological functions are preserved. As the basins are intended for flood storage, the pattern of seasonal inundation will continue. The roadside swales will provide an important function in the storage of stormwater in major events also.

The refined drainage strategy and development plan involves filling the developed portions of Lots with earth fill (preferably sourced from on-site material) to provide sufficient clearance to groundwater from building foundations. Hence, groundwater levels under adjacent undeveloped portions of the blocks could be as high as the natural surface without compromising the developed (earth filled) areas.

With this arrangement, sub-soil drainage beneath the developed areas may not be required, and only the portion of each block that is developed may require earth fill, depending on the depth to the water table.

In areas with the groundwater near the surface, earth fill levels for the developed portions of each block would need to be a minimum of 1.5 m from the AAMGL to guard against the potential for groundwater contamination and flooding of developed areas.

For larger storms (>10 year ARI), roads and hardstand areas will be designed to convey the major flood flows towards the road reserve where grassed swales and overland flow will be used to convey flood flows to retention basins (Multiple Use wetlands or existing topographical low points) located within individual sub-catchments, as shown on Figure 12.

Preliminary earthworks plans, completed by the project engineers, Wood and Grieve Engineering are provided in Figures 13 and 14 and indicate that areas of cut to fill have been investigated in order to provide a minimum clearance of 1.5 m to AAMGL over a majority of the site. The engineering plans will be further refined as subdivision commences and detailed design is completed.

In summary, the revised drainage strategy for major events, incorporating current best practice, involves the following:

- filling of land parcels within each lot to provide adequate building envelopes and a minimum clearance of 1.5 m to AAMGL
- lots to infiltrate all events up to the 10 year ARI through the use of soakwells for "clean" hard standing areas and infiltration in undeveloped portions of lots
- events greater than the 10 year ARI from the lots will be directed to the road reserve and road side swales (designed to have capacity for the 10 year ARI)
- roadside swales and overland flow through the road network will convey large flood flows to detention basins for storage and treatment prior to infiltration. Flow to Wellesley River shall be maintained at pre-development flow rates to ensure the hydrological regime and water quality is maintained at pre-development conditions.

7.1.3.1 Stormwater Storage Requirements

The stormwater modelling for the site has been completed by RPS using XPSWMM software. The stormwater treatment system shown in Figure 12 details the areas and volumes of stormwater detention for the 1, 10 and 100-year events to maintain pre-development conditions where possible.

The site has been divided into ten post development catchment areas. Stormwater storage areas have been sized to accommodate the 1:100 year ARI event within catchments 1 to 4. Catchments 5 and 6 are sized to cater for the 1:10 year ARI event with over flow to Wellesley River. The 100-year ARI flows are below predevelopment 1:10 year ARI rates (as lots are infiltrating up to the 1:10 year event). Catchment 7 has been sized to attenuate the 1:100 year event at predevelopment 1:10 year rates.

Appendix 7 contains a table summarising the stormwater requirements for each of the 10 sub-catchments.

The invert of all drainage structures will be designed to achieve a minimum clearance of 0.3 m to the Maximum Groundwater Level (MGL) across the site to comply with DoW policy and ensure that the drainage features will be free of standing water except for short periods of time after heavy rainfall.

The outline drainage design provided in Figure 12 is preliminary and is subject to variation following confirmation of the staged planning boundaries of the KSIA and lot boundaries and sizes. A detailed subdivision layout will be confirmed in future UWMP(s) along with the detailed drainage and earthwork designs. Refer to Appendix 7 for further details on the stormwater storage requirements and further model assumptions and detail.

7.2 Water Quality Treatment

In addition to the above management measures, the following best management practices and treatment measures shall be put in place to retain the quality of stormwater. These measures shall be in accordance with the DoW Water Quality Protection Note 52 "Stormwater Management at Industrial Sites" (May 2010). Industrial sites require effective management of stormwater run-off from roofs, pavements, exterior materials storage and process areas to avoid flooding and contamination of sensitive water resources.

7.2.1 Structural Treatment Systems

7.2.1.1 Soil Amendment

Soils within the lots will be amended to minimise the risk of soil and groundwater contamination from the industrial land uses. As a minimum, the soils surrounding the soakwells within lots will be amended to a depth of 0.3 m beneath the soakwells; however, the landowners may decide to amend the entire building footprint beneath the hardstand area for ease of earthworks.

7.2.1.2 Drainage Areas

A combination of using topographical lows points and Multiple Use wetlands for the attenuation and infiltration of flood flows is proposed for the management of the major rainfall events. Review of Lidar data and a site visit was completed to assess the suitability of various Multiple Use wetlands and areas of the site for drainage. The chosen wetlands are those in existing flood flow paths and are naturally contoured to hold water, requiring reduced earthworking and disturbance of existing vegetation that may remain.

Grassed conveyance swales will be used to convey stormwater through the site, in lieu of a piped drainage network wherever possible, which replicates the approach to managing stormwater for the developed industries existing at the site. Swales will incorporate rock pitching and erosion control measures, particularly along the central main road (Kemerton Road) which provides the main flood flow path through the KSIA. Vegetation will be included in all suitable stormwater structural controls for amenity to minimise erosion, maintain soil infiltration, restrict water flows and remove particulate and soluble pollutants, particularly nitrogen. The plants will mainly be associated with storage basins and will be appropriately selected based on their intended function using native vegetation as much as possible. The plant species used within the structural devices will be identified within the subsequent UWMPs

7.2.1.3 Building Control Measures

The DER has responsibility under Part V of the *Environmental Protection Act 1986* (EP Act) for the licensing and registration of prescribed premises, the issuing of works approvals and administration of a range of regulations. The DER also monitors and audits compliance with works approvals, licence conditions and regulations and takes enforcement actions as appropriate.

Certain industrial premises with the potential to cause emissions and discharges to air, land or water are known as "prescribed premises" and trigger regulation under the EP Act. The EP Act requires a works approval to be obtained before constructing prescribed industrial premises and makes it an offence to cause an emission or discharge unless a licence or registration is held for the premises.

Heavy industry exceeding specified production rates, including for example the manufacturing or blending of chemicals, food processing, animal feed manufacturing, scrap metal recovery, liquid waste facility and bulk storage of chemicals, is subject to licensing. It requires a works approval and monitoring by the DER, which requires the site to follow strict land-use management practices, and an annual monitoring regime and reporting program.

Possible building control measures include:

- Each premises preparing relevant plans to manage spillages should they occur. The Plans would include keeping spill response equipment on site, training staff in the use of equipment and plan for notifying relevant emergency services and government agencies to seek external assistance if required.

- Keep rainfall from directly contacting working areas where stormwater is allowed to mix with process effluent and chemicals, by installing roofs, placing structures, or moving industrial operations indoors.

- Prevent stormwater, which flows across the industrial area, from contacting industrial areas, indoors or out, by using properly designed berms or grading and contained drains.

- Storage of chemicals and handling areas should be bunded to allow containment and recovery of spills.

- Paved areas exposed to rainfall where dust, litter or spilt substances accumulate should be regularly cleaned using methods that prevent drainage or leaching of fluid into the surrounding environment.

- Provide sufficient facilities for rubbish disposal. Discouraging waste dumping in drains through the use of signage and restricted access.

7.2.1.4 In-line Controls

- The use of gross pollutant (litter), oil and sand traps at drain/soakwell entry points.
- Storm drain inlets that drain the loading areas should be equipped with a shutoff valve to keep oil, grease or fuel out of the drain in the event of a spill so that they can be isolated in the event of large fluid spills, until the contaminant is removed.
- Sand or membrane filters appear to be particularly effective if used in combination with detention or retention ponds. These shall be required and shall operate by diverting the first flush of run-off (often carrying the most pollutants) to the filter and routing the remainder of the water to the pond.
- Oil/water separators shall be installed in the vehicle loading areas to remove oily constituents from fuel spills.

Appropriate building control measures will be assessed and stipulated by the DER, where required, for those industries those are required to be regulated by the DER.

7.2.2 Non-structural Treatment Systems

Non-structural controls can be used to provide additional stormwater quality management and can include establishing operation and maintenance activities and employee education. The site will use the following non-structural controls to improve stormwater quality and reduce contamination.

7.2.2.1 Employee Education

Successful storm water pollution and contamination control relies in large part on appropriate training and education of employees. Industry operators will be responsible for the training and education of employees, and the preparation of appropriate Operation and Management Plans specific to their sites and industries.

7.2.2.2 Nutrient Control and Landscaping

An Operation and Management Plan with handover procedures will also be developed to ensure ongoing compliance with landscaping specifications. It is expected that these measures will provide improvement of stormwater quality through ensuring:

- Appropriate native plant species are continually used.
- Basins and swales are maintained.
- Recommended fertiliser, pesticide and irrigation regimes are followed.

7.2.3 Contingency Measures

Each proposal for commercial and industrial development at the KSIA will be assessed independently by the Shire of Harvey and DER. The assessment will consider the individual site conditions such as the type of underlying soil, depth to the water table, proximity to rivers and wetlands and their significance and potential contamination of groundwater. The proponents will be required to implement appropriate pollution control and management measures suitable for the proposed industry.

In an event of a spill or incident leading to possible contamination of stormwater, contingency measures should be put in place. Possible contingency measures may include:

- Site operators and designated staff should be trained to supervise the response to spills.

- Equipment such as absorbent litter should be available to clean up minor chemical spills. Hose-down of floor residues into drains should be avoided.

- When chemicals have escaped into drains, water sampling should be arranged using the services of an analytical laboratory accredited by the National Association of Testing Authorities. Results should be compared against guideline criteria for local water values and necessary recovery and remedial action taken without delay.

- Reintroduce or increase the public awareness program.

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Appendix X

Extract from Water Supply to Kemerton Industrial Park Report, by Harvey Water.

REPORT FROM HARVEY WATER

WATER SUPPLY TO KEMERTON INDUSTRIAL PARK

This proposal looks at trying to provide water from WD to the industrial users at the underdeveloped Kemerton Industrial Park (KIP). The lack of progress at the KIP is possibly a chicken and e.g. type situation where industries don't set up there because of the lack of infrastructure and vice versa.

Several options have been put together in the past and all have led nowhere simply because there are just not enough users in the area to cover the cost of a reticulated piped main and other delivery infrastructure. The previous ideas all utilised the pump station at Benger as the energy source and the reticulated main around the various industrial facilities. These options all proved to be too expensive.

There is a Harvey Water main pipeline that is connected to the Harvey system that supplies water to the peak load power station on Treasure Road. This opportunity is currently underutilised and could be used to supply some of the users in the KIP. However it uses water from Harvey dam not from WD which is the focus of these proposals.

Using the Benger pipeline and the Sandalwood Road pump station is also not desirable because if other industrial opportunities eventuate there will be very little capacity left to supply anybody else.

So it is essential that a different distribution source is identified that does not include Harvey Dam, the Benger pipeline or the Sandalwood Road pump station.

The nearest to the KIP and most appropriate large water source from WD would be the Collie North supply channel. Water would be transferred from WD into this channel and then transferred into Cactus Channel where the two meet at Benger.

The Cactus Channel travels west to the edge of the KIP and eventually crosses the Benger Main Drain near Wellesley Road. Both of these drains are very productive and receive run off water from many smaller drains and creeks for most of the winter months.

A small diversion structure and pump station could be constructed that would allow the water to be transferred to the heart of the KIP.

Similar to Picton there are two options from this point on. The first option is that the pump station transfers the water to a large holding dam somewhere central and the industries then pump out of that dam to meet their specific needs. This option is used extensively by local government to irrigate parkland and public open spaces. The holding dam is made into a feature, is landscaped and becomes part of public open space and it gets a tick from the environmental agencies as it is seen as a very green solution. All that HW would have to do is make sure that it is topped up when required which can be done automatically.

There is no restriction on how many dams that can be installed. There could be several of them, all serviced by the one pump station, which means the industrial users would not have to pump the water very far.

This option can also accept water from other sources provided that it is suitable, for example the treatment plant at Kemerton could deposit water in these dams which would assist in the dilution of the water from WD.

The other option is to construct a reticulated main around the KIP and install a supply point on each block.

Obviously this is the most expensive and by far the most complicated as we have no way of knowing how many potential customers there would be in the future, their specific location, what kind of flow and pressure they require and the location of the service to their facility.

The reticulated main would have to be designed and installed to meet some perceived future requirement which means it would be very expensive for the few companies that are there now.

For the above reasons this option has not been evaluated further.

The most appropriate and cost effective option would be to construct some sort of check structure in the Benger drain near where the Cactus Channel enters it to capture water that is in either of the watercourses through natural events, run off and water purposely released into the Cactus Channel from the Collie North Supply Channel.

A pump station would be installed adjacent to the check structure that could transfer the required amount of water.

A pipeline would be constructed from the pump station to the holding dam in a central location within the KIP near where there are already potential customers.

A holding dam would be constructed, much the same as a compensating basin, with a capacity of say, 2ML. Several offtakes would be included in the dam during the construction phase which would allow existing and future customers to install their own pumps and associated infrastructure to supply water to their facility.

This type of system has the potential to grow over time as the number of customers increase and further holding ponds can be constructed in different sectors, all linked to the main pump station by a supply pipeline.

The pump station has been designed to cater for more users than currently exist however it is a modular type system so if more users require the service other pump units can be added.

The watercourses have a large storage capacity and the main supply channel has sufficient spare capacity to meet any future demand

Kemerton Industrial Supply - Cactus Main extension to storage dam