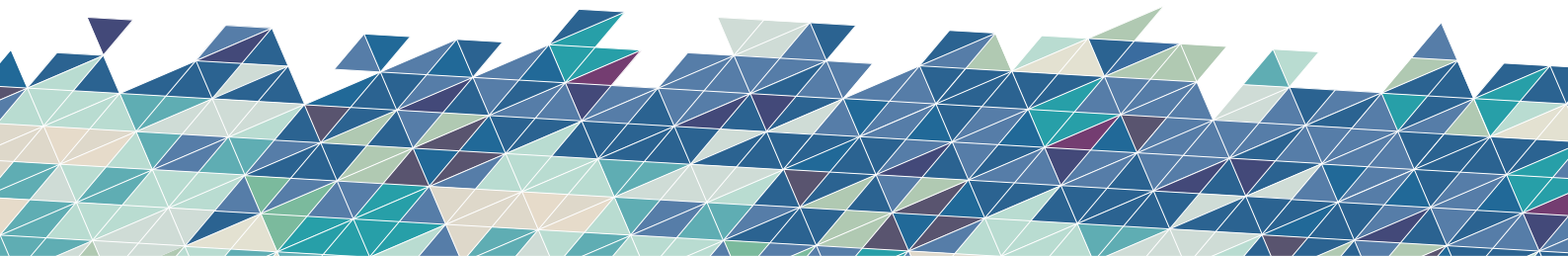
ALKIMOS COASTAL NODE
LOCAL STRUCTURE PLAN

Appendix 11
Engineering Servicing Report



ALKIMOS COASTAL NODE
LOCAL STRUCTURE PLAN

ENGINEERING SERVICING REPORT

FEBRUARY 2016

(Revision D)

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1. EXECUTIVE SUMMARY

This report has been prepared by Cossill & Webley Pty Ltd (CW) on behalf of LandCorp who are managing the development process for the Alkimos Coastal Node Local Structure Plan (ACNLSP). It summarises the results of a review of the civil engineering issues which have influenced the form of the structure plan and which are related to the future servicing of the developed land within the structure plan area.

This engineering servicing report provides details for each major infrastructure type and a servicing strategy for implementation required for the development of the Alkimos Coastal Node area. The level of detail is consistent with the requirements of a local structure plan and acknowledges further more detailed work will be required at the time of land subdivision.

The engineering review has covered siteworks, roadworks, stormwater drainage, sewerage, water supply and utility services.

The investigation has found the land is capable of development in accordance with the proposed local structure plan with logical progressive extension of infrastructure and base capacity.

The ground conditions and past uses (Unexploded Ordnance UXO) will not limit the proposed urban development.

The existing road access, via the Marmion Avenue and proposed development roads through Alkimos Beach and Shorehaven will provide road access with the external arterial road system being progressively upgraded to accommodate the expected regional traffic demand.

Waste water service can be provided through the provision of two permanent waste water pump stations to link the sewer flow from individual sites with the Quinns Main sewer and Alkimos Waste Water Treatment Plant consistent with WC waste water scheme planning.

Initial water supply can be provided by extension of the existing piped infrastructure in Alkimos Beach which receives supply through the Marmion Avenue 700mm diameter trunk main.

Initial electrical supply can be provided by extension of the existing high voltage HV underground infrastructure in Alkimos Beach which is fed via mains in Marmion Avenue from the Romeo Road (Yanchep) Zoned Substation. It is likely within approximately ten years (subject to individual dwelling loads and rate of development) the capacity of the Romeo Road (Yanchep) Zoned Substation will be exceeded and a new substation will be required to be constructed in Eglinton as planned through the Alkimos Eglinton District Structure Plan.

Telecommunications and gas are available from existing services in Alkimos Beach fed from Marmion Avenue mains, we understand there is capacity for the Alkimos Coastal Node development.

The investigations and preparation of the report are largely based on preliminary advice from the various service authorities. The information is current as of February 2016 and is subject to change as development proceeds in the Perth north-west corridor resulting in the extension of service infrastructure and the creation of new capacity.

2. INTRODUCTION

This report has been prepared by Cossill & Webley Pty Ltd for the Alkimos Coastal Node Local Structure Plan (ACNLSP) in response to a request by LandCorp who is managing the development process. It summarises the results of a review of the engineering infrastructure coordination, servicing and staging in relation to the ACNLSP site.

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The ACNLSP site is located approximately 40 kilometres north-west of the Perth CBD within the City of Wanneroo and the north-west sub-region of the Perth metropolitan region. It is located approximately 17 kilometres north of the Joondalup Strategic Metropolitan Centre and approximately 8 kilometres south of the Yanchep Strategic Metropolitan Centre.

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The ACNLSP site is located in the western area of the Alkimos locality, directly abutting the coast. It is situated approximately 1.5 kilometres west of the future Alkimos Secondary Activity Centre and Marmion Avenue.

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The ACNLSP site directly abuts foreshore reserve and the Indian Ocean to the west. Immediately to the north the land is designated as Regional Open Space pursuant to the Metropolitan Region Scheme and as reflected on the Alkimos Eglinton District Structure Plan (AEDSP). The land further to the north and south of the ACNLSP site is being developed for urban purposes in accordance with the AEDSP. The land to the east is reserved for Public Purposes (Water Corporation) as it contains the Alkimos Waste Water Treatment Plant and its associated buffer.

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The majority of the ACNLSP site is zoned 'Urban' under the Metropolitan Region Scheme (MRS) and 'Urban Development' under the City of Wanneroo District Planning Scheme No.2. An area of land within the ACNLSP site is reserved for 'Public Purposes (Water Corporation)' under the MRS for the Alkimos Waste Water Treatment Plant ocean outfall site. In addition, the foreshore area and a portion of the site to the north east are reserved for 'Parks and Recreation' pursuant to the MRS.

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The ACNLSP site is located within the south-west part of the Alkimos Eglinton District Structure Plan (AEDSP) area. The Agreed AEDSP was approved by the City of Wanneroo and endorsed by the Western Australian Panning Commission (WAPC) in 2010. The Agreed AEDSP nominates a mix of 'Urban' and 'Coastal Village Activity Centre' uses over the site and reflects the 'Regional Open Space' and 'Public Purpose' reserves in accordance with the MRS. The AEDSP also identifies a 'Secondary Public Transport System' traversing the centre of the site in a north-south direction.

Area and □and □se

The ACNLSP site covers a total area of approximately 86.91 hectares. The site is currently vacant and unimproved.

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The ACNLSP site comprises the following properties:

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9001	Water Corporation	Plan 69492 Volume 2771; Folio 785
Portion of 9010	Western Australian Land Authority	Plan 401026 Volume 2832 ; Folio 494
Portion of 9012	Peet Alkimos Pty Ltd	Plan 76574 Volume 2824 ; Folio 171
Portion of 9501	Western Australian Land Authority	Plan 400279 Volume 2819; Folio 691

This engineering review details the concept siteworks, roadworks, stormwater management, sewerage, water supply and utility services.

The engineering review has been carried out to ensure the ACNLSP responds as necessary to the engineering constraints and is capable of being serviced with common infrastructure. The level of detail provided is consistent with a local structure planning context and is not intended to provide all of the detail required at final land subdivision stage.

3. SITEWORKS

Topography

The existing topography within the ACNLSP is typical of the Perth north west corridor coastal area in general it comprises an undulating limestone and sand dune landform with younger dunes close to the coast and older more stable dunes further inland. The area contains a number of prominent east-west ridges, with elevations up to RL 35 metres AHD and lows in the area of approximately RL 7m.

The northern boundary of the ACNLSP area borders the northern arm of a large parabolic sand dune located across the broader Alkimos district. This distinctive landform has had a major influence on the layout and form of the adjoining Alkimos Waste Water Treatment Plant and Alkimos District Centre Structure Plan. As a result of its relative dominance in the local land form and reflecting the conservation value of the dune, this arm on the boundary, forms the boundary between the Peet Shorehaven development to the north and this Coastal Node residential area.

The southern boundary of the ACNLSP is also delineated by a 'green linkage' to form part of a regional green link across the broader Alkimos area.

Ground Conditions

The state geological map series indicates the arms of the parabolic dune around the site consists of underlying weekly cemented limestone with sand overlying limestone at varying depth in the remainder of the land holding. Coffey Geotechnics has carried out a number of geotechnical site investigations within the broader Alkimos area over the past ten years. Based on the results of these investigations and the experience gained from recent engineering works in this area, the ground conditions within the ACNLSP area are expected to be as follows:

The ACNLSP is within an area of coastal Quindalup sand dunes extending inland from the coastline. They are geologically younger than the Tamala Limestone which occurs at depth, and as outcrop, further inland. The dunes are comprised of fine to medium grained, light brown to white, calcareous sand. The natural density of the sand is predominantly medium dense to dense, however loose surface sand can occur on the lee (eastern) sides of dunes. The sand is comparatively high permeability (typically 2m/d to 20m/d), high void ratio, no shrinkage and low bearing capacity.

Areas of rock outcrop occur and are comprised of well cemented cap rock zones formed by the dissolution and reprecipitation of calcium carbonate within the weathering profile to form calcrete deposits, the well cemented high strength calcrete layers are relatively less developed within the Quindalup Dunes and generally less than 0.5m thick.

Surface rock is anticipated to occur predominately as cemented limestone cap rock outcrops along ridge lines within the Quindalup Dunes. Below the cap rock layers the limestone is generally of lower strength. Within the Quindalup Dunes, limestone is generally weakly cemented to form a low strength rock.

Excavation conditions within the areas of rock are highly variable and are largely affected by the thickness of cap rock development. Within the Quindalup Dunes where cap rock development is thin (-0.5m) it is generally easily ripped with a large dozer (~D10) and the underlying, weakly cemented material can often be excavated with a large excavator (~40t).

In very general terms excavation conditions are potentially more difficult with increasing age of the formation as the cap rock layers have had a greater length of time to develop. As a generalisation the potential for encountering difficult excavation conditions increases with further distance from the coast and with increasing depth of excavation due to the potential for encountering older cap rock formations.

Karstic Formations

Karstic ground formations are known to occur in the limestone rock along a band running north-south along the eastern side of Wanneroo Road, well clear of the ACNLSP area.

The Alkimos Water Alliance has excavated an area, east of the ACNLSP area, for the Alkimos Wastewater Treatment Plan. The excavation extends down to levels of 3 metres AHD, in some areas, in limestone rock, there has been no evidence of karstic ground conditions. Similarly, there has been limited evidence of karstic conditions identified in excavation at Peet's Shorehaven (to the north), at Satterley's Eden Beach to the south and Lend Lease / LandCorp's Alkimos Beach to the south east to date, or in the past works of Brighton, Trinity and Jindalee to the south of this LSP area.

Based on this evidence it is considered very unlikely that the ACNLSP area contains karstic ground formations.

Notwithstanding this, as there is always some potential in areas of underlying limestone to experience karst features to varying degrees, provision will be made in the construction specifications for earthworks at the time of subdivision of the land, to include progressive inspections of the works by qualified geotechnical engineers to confirm, or otherwise, the above and confirm the adequacy of the land for further development.

General Siteworks

Siteworks for urban development typically comprises the identification of areas of vegetation for conservation, protecting these areas (during and after construction) and in areas for commercial and residential development clearing of the existing vegetation to receive the built form and, where necessary, the earthworking of the existing ground to accommodate the required form of development.

In Perth it is often the case that the extent of siteworks is dictated by the density and nature of development and by the finished ground shape required for building houses, commercial buildings etc. Increased densities and decreasing lot sizes has led to a current trend for the development areas to be fully earthworked to create level lots which are terraced between retaining walls.

This approach has provided a number of positive outcomes in the past including:-

- Reduction in the total house building cost
- Rationalisation of retaining wall layouts and designs consistent with Local Authority specifications
- Enables lots to be terraced up natural slopes to maintain elevation and views while providing certainty between boundaries.

This approach assumes the home builder or commercial builder is unable to manage the level changes between allotments across each site within or around the building itself. LandCorp is currently trialling leaving the building sites graded at Alkimos Beach west of Marmion Avenue with their joint venture partner Lend Lease, if this method is successful it may be transferred to the Alkimos Coastal Node, meaning the sites will be left graded without retaining walls where the market and built form is able to manage these finished levels. In other areas retaining walls may be necessary to ensure the individual home sites maximise their potential for ocean views. The detail for these responses will be resolved at subdivision stage.

Siteworks Controls

There are a number of factors which need to be considered in reviewing the finished levels of the development of the ACNLSP. These are summarised as follows:

- The parabolic dune which is located to the north and south of the site will need to be accommodated in the earthworks design concept if significant dune retention at the boundary is to be achieved.
- Finished development levels within the LSP area are largely independent of the adjoining developments. However, the design of linking roads will need to match those of the adjoining development land to the north, the Shorehaven Development by Peet and south east Alkimos Beach by Lend Lease / LandCorp. A close liaison will need to be maintained therefore, with the developers of the land and their consultants to ensure the adopted designs of the linking roads maintain the least practical disturbance of the dune and green spaces through which they traverse.
- The eastern boundary is fixed by the extension of the Foreshore reserve linking across to the Conservation area protecting the dune and surrounding the Waste Water Treatment Plant.
- The western boundary is fixed by the foreshore reserve and the associated constraints of the coastal processes line, refer to separate advice prepared by MP Rogers.
- Siteworks within the Alkimos area may be subject to further investigation surveys for Unexploded Ordnance (UXO), in accordance with FESA requirements. However FESA advice suggests that sufficient surveys have now been completed for Alkimos, without any high explosive finds requiring further searching.

Proposed Siteworks

The ACNLSP has been designed in accordance with the following objectives:

- To maximise the preservation of the significant topographic features in specific conservation public open space areas, namely the dune linkages forming the southern and northern limits of the LSP area.
- To allow for roads and development sites to be graded to follow the existing topography where possible and to best reflect the coastal landscape.
- To minimise intrusion into the Alkimos Waste Water Treatment Plant site and not direct stormwater runoff into the WWTP site, but rather to be accommodated in drainage swales in areas of local public open space.

The approach adopted to achieve the above objectives is outlined as follows:

3.6.1 Significant Landscape Features

In the case of significant landscape features the ACNLSP includes the retention of high dune ridge within regional open space areas to the south.

Road levels adjacent to these areas will be designed, therefore, to minimise the extension of earthworks batters, into the ridges, to maintain their natural form.

3.6.2 Roads and Development Sites

The preparation of the ACNLSP has involved a review of a number of options for the grading of roads and development sites. This has comprised a number of iterations of the review of development levels, between Cossill & Webley, the Town Planning and Landscape consultants, aimed at identifying a plan which best balances the grading objectives with the other objectives for economics, engineering design, development land uses, traffic planning etc.

The ACNLSP promotes the adoption of lower road design and operating speeds, in accordance with Liveable Neighbourhoods objectives, through the road layout and the urban design of streetscapes. The engineering design standards which suit these lower speeds provide greater flexibility, therefore, to follow the existing topography through the adoption of steeper grades, shorter sight distances, etc.

The approach to the grading of residential development sites for the ACNLSP is as follows:

- For gently sloping sites it is proposed that where possible minimal siteworks be carried out as a part of subdivision and that the existing grades within the allotments be dealt with as a part of building works. This should not require complex or special building forms.
- Medium and steeply sloping sites would be earthworked as a part of subdivision but only to the extent where resultant grades allow building works as above for gentle sloping sites. This may involve the construction of some retaining walls as a part of the subdivision siteworks.
- In areas where ocean views can be realised and the provision of retaining walls will increase the number of sites which will have views retaining walls will be provided.

In areas where medium and higher density development is proposed the subdivision siteworks would be minimal. Existing slopes and topography would be dealt with as a part of building design and construction. This would be the same as larger commercial and retail sites which would be left graded between adjoining development roads.

Similarly in some special design areas the existing steeper topography may be left for single residential houses where special building forms, like split levels, framed construction, under croft garages, etc. could be employed to suit the existing grades.

In practice the final choice of subdivision siteworks and building typologies will be dependent on a range of factors including, affordability, product mix, economics, etc.

It is considered, however, that the ACNLSP, as proposed will provide flexibility for the consideration of the range of options, in ongoing development, to maintain the landowner's objectives for the project.

A balanced cut to fill is proposed for the site with the use of 500,000m3 of material which was surplus to the needs of Alkimos Water Alliance when they constructed the Alkimos WWTP. This material previously stockpiled on Alkimos Beach has been transported and placed in ACNLSP area under a development approval from the City of Wanneroo with works completion during May 2015. A further 300,000m3 has been planned to be sourced from offsite to complete the balanced earthworks based on the preferred grading concept, the source is subject to negotiation and will likely be from the adjoining Alkimos Beach (LandCorp / Lend Lease) project. Should the 300,000m3 not become available to the ACNLSP area the earthworks concept will be modified to achieve a balance of material from within the site, this will have a minor effect on the finished levels and aspect from allotments. There will be no significant change to the engineering servicing and drainage strategies.

4. STORMWATER DRAINAGE

Integrated Urban Water Management

The ACNLSP Local Water Management Strategy (LWMS) has been prepared by Emerge Consultants. This provides a basis for ongoing development to ensure that appropriate allowances are made for total water management including the minimisation of scheme water use, the maximisation of recharge of stormwater runoff etc.

Stormwater drainage management is a major component of an overall LWMS for which the achievement of the principals of the plan may be facilitated through the application of Water Sensitive Urban Design (WSUD) techniques. Objectives of WSUD include:-

- Detention of stormwater rather than rapid conveyance;
- Use of stormwater to conserve potable water;
- Use of vegetation for filtering purposes; and
- Water efficient landscaping.

For the ACNLSP and broader Alkimos area, the main WSUD practices which should be incorporated into the ongoing implementation of the ACNLSP proposals are as follows:-

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The maximisation of stormwater recharge of the shallow aquifer is through the adoption of 'Best Management Practices', which promote the dispersion and infiltration of runoff. These include the use of porous paving for roads and car parks, the diversion of runoff into road medians and road-side swales, drainage soakwells to infiltrate runoff from building rooves and private open space areas and the disposal of road runoff into infiltration basins within areas of public open space POS.

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The maximisation of the quality of recharge water through the adoption of "Best Management Practices', which promote the disposal of runoff via water pollution control facilities (including vegetated swales and basins, detention storage and gross pollutant traps) and the implementation of non-structural source controls (including urban design, street sweeping, community education, low fertiliser landscaping regimes, etc.).

Stormwater Collection and Management

The Alkimos land is generally free draining with no low-lying areas with high groundwater levels or defined watercourses. The existing limestone and sandy ground is permeable and the depth from the ground surface to groundwater is relatively significant.

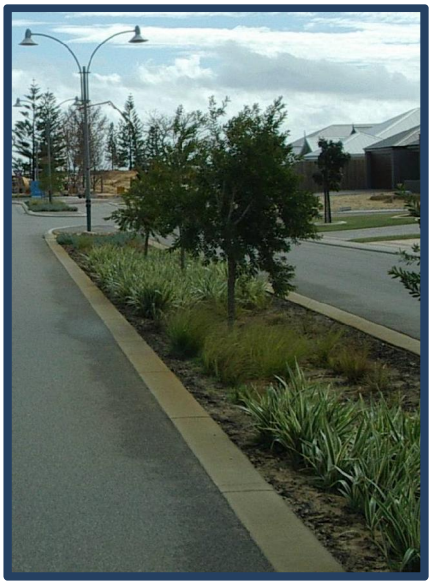
Overall, therefore, the land is highly suited to the implementation of the WSUD management practices outlined above.

In all areas of development low residential densities, it is expected that runoff within developed sites will be contained within the lots. Stormwater disposal will be via soakwells or other infiltration facilities which form a part of the building and private open space development. In areas of high urban density allowance has been made in the stormwater model to manage a proportion of the runoff in the council controlled street drainage network. This provides a more practical response for higher density sites and allows the runoff from larger storms to be managed away from buildings in areas of public open space.

Drainage from public roads and lanes can be managed in a number of ways depending on the nature of the adjacent land uses, the extent of traffic and pedestrians and the objectives for drainage management.

For the development of the ACNLSP it is proposed to adopt the WSUD approach recommended by the Department of Water where this approach provides an improved environmental outcome. DOW's target of infiltrating storms up to 1 in 1 year ARI at source (dispersed throughout the drainage catchments) may be difficult to economically achieve throughout the catchment where there are highly urbanised roads, as a consequence runoff will likely be conveyed to the local low points where stormwater runoff infiltration areas will be co-located with areas of public open space. Stormwater runoff will soak efficiently into the ground and return a significant proportion of the runoff to the unconfined aquifer.

Infiltration could also be via swales within or adjacent to road reserves, via gully pits with permeable bases, slotted drainage pipes, porous road pavements, under road storages etc. subject to the City of Wanneroo approval and consideration of whole of life costs including the ongoing maintenance.



Runoff from storms up to 1 in 5 years ARI would be conveyed in an underground pipe system to low point infiltration basins consistent with the requirements of the City of Wanneroo.

Roads and POS would be designed to cater for the surface overflow for more severe storms with building pads constructed at least 300 millimetres above the 1 in 100 year ARI flood or storage level at any location.

The dispersion of stormwater disposal will maximise the area of recharge down through the soil profile to the shallow aquifer, thereby, maximising the potential for nutrient stripping and water quality improvements.

The WSUD approach has yet to be fully adopted by the City of Wanneroo and, therefore discussions will need to be held with Council in this regard.

The LWMS prepared by Emerge details the stormwater drainage plan for the ACNLSP. The plan shows the approximate location of stormwater disposal sites based on a preliminary assessment of finished development levels. As indicated in Section 3 the preliminary assessment has been based on road alignments and grades reflecting the existing topography as far as practical. This approach results in a number of natural 'low points' throughout the development area which will need to be designed, with drainage infiltration sites and flood storage areas to accommodate runoff for up to 100 year ARI storm events.

The LWMS also includes tabulated data for areas required at each low point infiltration swale to cater for the 1 in 1 year, 1 in 5 year and 1 in 100 year ARI storms.

5. ROADWORKS

5.1 Traffic and Transportation

An assessment of the traffic planning aspect of the ACNLSP proposals has been carried out by GTA Consultants (GTA).

The results of this investigation include a recommended hierarchy for the roads within the ACNLSP and the future subdivision development together with recommendations for public transport services, pedestrian and cyclist facilities.

In all cases the engineering review has taken account of the above recommendations.

5.2 Regional Roads

Marmion Avenue is complete to a first stage rural standard arterial road between Butler and Yanchep and the land the subject of this ACNLSP is a party to the agreement through LandCorp with Capricorn Village Joint Venture for repayment of the proportional share of the stage 1 road construction on agreed terms. The construction of the stage 1 road extension was completed in November 2008.

Main Road WA has no programme for the extension of the Mitchell Freeway beyond Hester Avenue. A design and construct tender process is currently underway for the extension of the Mitchell Freeway between Burns Beach Road and Hester Avenue, construction of this section is expected to be completed in 2017. It is likely without Government intervention the freeway north of Hester Avenue will not be extended to the Alkimos area and the Romeo Road or Alkimos Drive interchange for at least fifteen years.

On this basis, Marmion Avenue will be required to provide a regional road access function for the development of the ACNLSP land until the freeway is further extended in the longer term and access to the freeway via Romeo Road will ultimately become the second region linkage. Marmion Avenue therefore in the interim provides the only direct primary distributor function in the absence of the freeway.

There are no district distributor roads within the ACNLSP and no roads which will exceed 20,000 vehicles per day. Hence there should be no roads for which State Planning Policy 5.4 Noise Considerations will need to be applied.

5.3 Development Roads

The ACNLSP comprises a network of development roads including; integrator arterial (B), neighbourhood connector and local access roads and laneways.

The ACNLSP includes an urban design hierarchy for the development roads, which is an expansion of the traffic hierarchy, to better reflect the intended functions of the roads and their corresponding streetscape characters. Typical road cross-sections are documented in the traffic report.

In all cases the road cross-sections will be designed to cater for utility services, street trees, parking embayments, etc. as required.

The engineering design of roads will be carried out to comply with the Department of Planning Liveable Neighbourhoods recommendations for design speeds, sight distances, etc. and with the requirements of the City of Wanneroo, Main Roads WA and other relevant Australian Standards where applicable.

In particular, it is proposed that the development roads be designed to suit lower vehicle operating speeds to ensure safer operation and to provide more flexibility to better follow the existing topography with road alignments and grades. The lower speeds on local roads will also support initiatives to adopt smaller street truncations and associated intersection curve radii.

The ACNLSP includes some short sections of development roads located adjacent to the boundary of the dunes and Regional Open Space network. The existing topography along these sections is such that to achieve appropriate road alignment it may be necessary to extend the road earthworks batters into parts of the reserve. The extent of this would be minimised as an objective of the road design and would be detailed through relevant environmental approval processes.

Initial road access to the site will need to be via extension of roads from Shorehaven, or one of LandCorp's land holdings Alkimos Beach to the south or Alkimos Central to the north. Ultimately there are four public roads (two in the north and two in the south) which link the ACNLSP to the broader Alkimos area. The two access roads to the north require the roads to be constructed across the land designated Parks and Recreation and Bush Forever on the Metropolitan Region Scheme. These roads are documented on the Alkimos Eglinton District Structure Plan, consideration will need to be given to minimising the impact of cut and fill batters from the roads at the detailed design and construction stage. Funding for the construction of these roads needs to be resolved between the adjacent development entities. The road connection to the northwest through Shorehaven provides the connection from the ACNLSP for the planned Secondary Public Transport System, which we understand may take the form of a high frequency bus service.

Vehicle access to the existing Alkimos Waste Water Treatment Plant site is currently provided through the ACNLSP site on temporary limestone access tracks. It is planned the permanent access will be provided off public roads in the ACNLSP area when completed. The Water Corporation is investigating options for providing a purpose built exclusive access road to the treatment plant. Provision has been made with the ACNLSP layout to accommodate this possibility, although a final decision has not been made if this option will proceed. Both access options can be provided and meet appropriate engineering standards.

6. WASTEWATER

6.1 Wastewater Collection and Treatment

The Water Corporation (WC) has commissioned the first stage of the Alkimos Wastewater Treatment Plant WWTP and the associated Quinns Main Collector Sewer for collection of flows from the south. To the north, there is a planned 1350mm diameter gravity main to collect flow from as far north as Yanchep and deliver it by gravity to the WWTP.

The WC's strategy for the ACNLSP area is to collect waste water from the individual allotments and convey the flow via local waste water gravity sewers to one of two proposed permanent waste water pump stations, pumping the flow south east to the gravity network feeding the WWTP.

The Alkimos WWTP and associated main gravity sewers has been funded by the WC, although prefunding by developers may be required for other headwork items, such as permanent waste water pumping stations and other trunk gravity branch sewers depending on the WC's five year capital works expenditure program and the timing of development. The waste water strategy for ACNLSP includes two permanent waste water pump station near the foreshore reserve, to be located in or adjacent to areas of public open space, refer to the schematic Figure 1 drawing 6100-LSP-Fig1.

6.2 Wastewater System and Staging

The staging of the initial waste water scheme for the ACNLSP requires the construction of the Alkimos Pump Station 'K' for stage 1. There is no opportunity to grade any of the ACNLSP into the existing adjoining sewer systems to the south in Alkimos Beach.

Alkimos PS 'K' will provide capacity for the majority of the site with development likely to progress from the southern limits near the pump station with other services also extended from the south in Alkimos Beach. Alkimos PS 'K' pressure main discharges to gravity sewers to be constructed as part of the Alkimos Beach development, which will connect to the Quinns Main Sewer. This requires a 300mm diameter gravity sewer to be constructed by the Alkimos Beach development, this reticulation sewer is under construction and should be completed by mid 2016.

The northern portion of the ACNLSP area is proposed to be serviced by a second permanent waste water pump station, Alkimos PS 'L'. The WC has this pump station on their conceptual scheme. There is some potential, depending on final development levels in ACNLSP and the adjoining Shorehaven project to the north that all of the Alkimos PS 'L' catchment may be graded out eliminating the need for this pump station. The WC considered this option during 2015, it decided if Peet wanted to subdivide their portion of the ACNLSP then based on ground levels on the site a waste water pump station would be required. If Peet decides their site will be developed as a single strata allotment it is possible a private pump unit could be adopted to eliminate the requirement for the permanent pump station PS 'L'. This can be investigated further at subdivision stage and during the scoping and detailed design of Alkimos PS 'L'.

On the assumption the Alkimos PS 'L' is required, the catchment cannot be developed without Alkimos PS 'K' firstly being commissioned or additional developer funded 'throw away' temporary pressure main being built to link Alkimos PS 'L' directly to the Quinns Main gravity sewer system.

6.3 Alternative Wastewater Treatment and Reuse

The WC is reviewing alternative options for the potential reuse of treated waste water effluent at the Alkimos Waste Water Treatment Plant. At present we understand the WC's preference is to pursue the indirect reuse of treated effluent. One method being considered is the recharge of ground water aquifers by treated effluent injection as is being trialled and further expanded at the Beenyup Waste Water Treatment Plant.

We understand there is limited support in government for direct reuse of treated waste water effluent and consequently a non-drinking water system is unlikely to be promoted for Alkimos Coastal Node.

7. WATER SUPPLY

7.1 Water Resources

The ACNLSP is located within the WC's future Eglinton ground water source area for potable water supply. Provision has been made for some time for the development of this ground water resource.

Water supply to the ACNLSP area will ultimately be via a series of groundwater bores, located throughout the Alkimos Eglinton area, linked by collector water main's to a central treatment plant and reservoir. Areas of urban development will be serviced by a network of distribution water mains, from the reservoir, connected to reticulation systems within those areas.

ACNLSP is near the boundary of the existing Neerabup treatment and reservoir scheme and the Carabooda reservoir service areas and at ultimate development may receive water from either source at different times in the demand cycle although most water will more likely be from Carabooda reservoir.

The WC developed a new reservoir at a site located in Carabooda, east of Wanneroo Road during 2011/12. A second ground water treatment plant (Eglinton Ground Water Treatment Plant) is proposed to be developed adjacent to the Regional Open Space in Alkimos east of the Alkimos Central area near the corner of the interchange between the Mitchell Freeway and Alkimos Drive, this site was identified through the Alkimos Eglinton District Structure Planning process. The site has been created and transferred to the WC for water supply, public purposes.

The first stage of the Carabooda reservoir has been completed by the WC. Initially the reservoir is supplied by a 1200mm diameter trunk water main from the Neerabup scheme which distributes water from the Neerabup groundwater treatment plant and reservoir. The water main will in the interim function as both and inlet and outlet water main, receiving water from Neerabup in off peak times through the distribution mains in Butler and supplying water as an outlet main from the Carabooda reservoir back to the Butler / Alkimos areas. The ACN will receive some of its water from this system when it is integrated in the overall water supply scheme.

The Carabooda reservoir will continue to receive water from the Neerabup scheme until the Eglinton GWTP is operational, current expectations are this will be required in 2022, although the actual date will be dependent on the rate of development in the Perth north west corridor, the public drinking water demand in the broader Perth metropolitan area and availability of other suitable water sources.

Preliminary WC planning for the Eglinton GWTP and abstraction bores indicates groundwater bore sites will be located along Marmion Avenue and nearer to the GWTP and Freeway. Therefore, there are no bore sites in the immediate vicinity of ACNLSP.

7.2 Water Supply Network

Supply to ACNLSP will be via extension of the reticulation network from Alkimos Beach (250mm diameter pipe) and linked north through to Shorehaven with the same size main, refer to Figure 2 drawing 6016-LSP-Fig 2. The reticulation network in Alkimos Beach receives its supply via the existing 700mm diameter trunk water main in Marmion Avenue.

There are no trunk or headworks size water supply mains proposed in ACNLSP area.

WC has a long term distribution network plan that includes a 900mm diameter water main required in Romeo Road (Alkimos City Centre), linking the 1200mm diameter main in east Romeo Road and the Carabooda reservoir with the other trunk distribution mains south into Butler and along Marmion Avenue.

The WC is currently reviewing the latest date the trunk water main linking Marmion Ave and Carabooda reservoir along Romeo Road (from its present limit at the Freeway Reserve) is required. The timing for this main had previously been estimated to coincide with approximately

8,000 to 10,000 allotment creations in the Alkimos Eglinton area, a time when the security of supply and capacity of the single Marmion Avenue trunk main would require augmentation, this is likely to be around 2022 depending on the rate of development. The timing may now also be influenced by Eglinton North (Satterley/LandCorp JV) development, which may require the Romeo Road trunk water main in order to satisfy head loss and pressure requirements at the far northern extremity of the Carabooda Reservoir supply area where the LandCorp Eglinton land holding is located. The WC regularly reviews the timing requirements of the external trunk mains and will liaise with the relevant land owners when needed.

The balance of the trunk water main network as shown on Figure 2 will be progressively expanded by the WC directly or through Developer Constructed Works agreements with negotiated pre-funding arrangements. The WC is currently planning to fund capital works associated with the orderly development of urban areas identified on the WC's five year program without prefunding by the developers.

8. ELECTRICAL POWER SUPPLY

Existing Electrical Power Network

There is no existing electrical power at the ACNLSP. As with other services ACN will rely on the extension of services from Alkimos Beach. Alkimos Beach is progressively extending the underground 22kV high voltage cable from Marmion Avenue west towards the coastal foreshore. The existing cable in Marmion Avenue was installed by Western Power to reinforce the electrical power supply into Yanchep in 2009/10. This same feed has been used to supply the initial developments at Shorehaven, Eglinton (Amberton) and Alkimos Beach; it will also be used indirectly for the supply for the ACNLSP area.

There is a second independent 22kV high voltage underground feed in Marmion Avenue (western verge) installed as a dedicated supply for the Alkimos WWTP.

The 22kV HV cable in Marmion Avenue follows an alignment from Marmion Avenue to Romeo Road east via a temporary alignment in the WC's 'access track' (used during the Alkimos WWTP construction). The cable receives its feed from the "Yanchep Zone Substation" on Romeo Road near the intersection of Wanneroo Road.

The Yanchep Zone Substation is a three transformer outdoor 132/22 kV zone substation. There are currently six 22 kV feeders out of this site. These feeders supply residential developments to the north along the coast and semi-rural loads north and to the east of the substation. The capacity expansion of the Romeo Road site is limited as the site already contains three 132/22 kV transformers. Western Power, Transmission Section is currently looking into the matter. We understand the substation is expected to be able to supply some 9,500 allotments in the Alkimos Eglinton area.

Initial Electrical Power Supply

We expect the local network will be incrementally extended through Alkimos Beach from south east of the ACNLSP and from further south in Eden Beach and north from Shorehaven.

A series of HV feeds, switch stations and transformers will be required throughout the ACNLSP to meet individual site requirements, large high density residential, commercial and public purposes sites (such as school sites) usually require a direct HV feed and have a sole use transformer to meet their power requirements. At subdivision it is likely these sites will be provided with access to a HV feed only and will install a transformer at building stage after the power demand is better understood through building design.

Ultimate Electrical Power Network Requirements

As the available capacity in the 22kV high voltage feeders in Marmion Avenue are exceeded additional feeds from the Romeo Road (Yanchep) Zone Substation will be required to meet the broader district demand. It is anticipated over time the developments of LandCorp's Alkimos City Centre will provide new feeds which will link directly back to the Romeo Road substation. Preliminary advice from Western Power and independent electrical consultants suggest up to six 22kV feeds may be required ultimately in the Romeo Road reserve at its eastern limit near the Freeway.

Each 22kV feed has capacity for approximately 8 MVA (depending on distance and other factors), with individual allotments using approximately 4.7kVA each, this indicates a likely capacity per feed of 1,700 residential allotments. However, Western Power is finding recent trends in housing types (smaller individual buildings with less load per household) and uptake of solar panels is reducing the average power demand per dwelling by as much as 50% in some areas. Hence, as the power demand per dwelling is better understood for the Alkimos Eglinton area, Western Power may find

the number of dwellings it can supply per feed and from the Romeo Road (Yanchep) substation in total may increase substantially.

Depending on the actual power demands per dwelling experienced in Alkimos - Eglinton and the rate of development, Western Power expects the new Eglinton zone substation (proposed in the Alkimos District Structure Plan south of Eglinton Drive and between the Railway reserve and the Mitchell Freeway reserve) to be required in approximately year 2021.

The funding of individual HV feeds (for broader network capacity), the upgrade to the Romeo Road (Yanchep) Zone Substation and provision of the Eglinton Zone Substation will potentially be subject to system reinforcement investigations where a business case is put to the Economic Regulatory Authority to consider state funding.

A schematic representation of the proposed major HV electrical network is provided on Figure 3 drawing 6100-LSP-Fig 3.

9. TELECOMMUNICATIONS

Telecommunications

Telstra has an existing exchange building adjacent to Marmion Avenue approximately four kilometres south of Alkimos. Telstra and now the National Broadband Network (NBN) has been providing fibre to the home services for Butler (Brighton) and other developments in the Alkimos Eglinton area. Alkimos Beach (Lend Lease / LandCop) has chosen to proceed with a private telecommunications provider, in Opticomm providing a similar service standard.

We understand Telstra / NBN is currently the provider for the Shorehaven development north of the Alkimos Central.

Broadband Communications

The change in Federal Government has modified the previous plans by NBN for full roll out in all existing suburbs and brownfield sites. However, in green field new land developments the fibre to the home will continue through developer funded installation.

Through the NBN the ownership issues of delivering the wholesale fibre to the home system have been transferred to the Government with a number of retail service providers offering services over the network. There are other private telecommunication providers which can also offer similar services.

Developers of new residential estates then have the option to pay NBN or an alternative service provider for provision of a high speed broadband network. In either case the developer will install pit and pipe infrastructure that can accommodate a future high speed broadband network.

Design Specification

Broadband is a term used to refer to ‘always on’ high speed Internet. In the past, broadband services and technologies were defined in terms of a capability to transfer information at higher rates than traditional dial-up services. Today broadband is more commonly associated with the speeds equal to or greater than those provided by Asymmetric Digital Subscriber Line (ADSL), that is, a minimum download speed of 265 kbps and minimum upload speed of 64 kbps. The current strategy for the NBN is targeting 100 megabits per second (Mbps) technology to be delivered in new estates with fibre to the home networks. The detailed design of the network will be to meet the specifications of the NBN.

Capacity to Receive Broadband Network in the Urban Design

The current design practice for road reserves, pavement and verge provisions will make adequate allowance for services including broadband in accordance with the agreed Utilities Service Providers handbook. There will be some local land requirements for equipment sites, similar to current provisions which will be accommodated at detailed subdivision stage.

At Alkimos Coastal Node, provision will be made for all allotments, to receive pit and pipes which will allow the installation of a broadband network through the service provider chosen by the developer.

The broadband network will have potential to carry services such as:

- Internet
- Free to air television services both analogue and digital (without the need for an antenna)
- Pay television (no dish required)
- Telecommunications Services (multiple fixed line services)

10. GAS

The existing high pressure gas network has been extended from Butler to Yanchep by the gas supply operator, Atco. The same gas network extension has provided branch service connection to the Shorehaven development, Amberton (Eglinton) development to the north and Alkimos Beach to the south. Atco the gas service provider has indicated the high pressure main installed in Marmion Avenue will have capacity for all development in the Butler, Jindalee, Alkimos and Eglinton area.

In general terms it is expected the gas reticulation network will be progressively extended from Marmion Avenue through Alkimos Beach and linked north and south into the adjoining developments as they proceed. There are not expected to be any gas supply capacity issues.

FIGURES

Drawing LCPAC-2-007A - Local Structure Plan, Alkimos Coastal Node, Creative Design and Planning 17 February 2016

Figure 1 - Alkimos Coastal Node Proposed Sewer Concept
Figure 2 - Alkimos Coastal Node Water Supply Scheme Concept
Figure 3 - Alkimos Coastal Node Electrical Power Network Concept

LEGEND

Structure Plan Boundary

ZONES

- Commercial
- Residential
- Mixed Use

RESERVES

- Parks and Recreation
- Public Purpose (Subject to Further Planning)

MOVEMENT

- Integrator Arterial (B)
- Neighbourhood Connector
- Coastal Road
- Secondary Transit System (STS Route)
- Pedestrian and Cyclist Route
- Regional Foreshore Shared Path
- Public Open Space (Conservation)
- Strategic Open Space (Indicative Location)

OTHER

- RMD 25 — R-Codes Residential Density
- Areas Subject to Future MRS Amendment
- Indicative Surf Lifesaving Club
- 100 Year Coastal Process Line (as per digital data from MP Rogers)
- Indicative Waste Water Pumping Station location
- 30m Waste Water Pumping Station Buffer
- Indicative Future Marina Layout

(1) To rezone from MRS 'Urban' Zone to 'Public Purpose' Reserve.

(2) To rezone from MRS 'Parks and Recreation' Reserve to 'Urban' Zone.

(3) To rezone from MRS 'Urban' Zone to 'Parks and Recreation' Reserve.

9016

9501

RMD 25-40

RMD 25-40

RMD 25-40

1012

Alkimos Waste Water Treatment Plant

R-AC1

9001

RMD 25-40

R-AC1

R-AC1

RMD 60-80

RMD 25-40

9019

RMD 40

9019

15450

Indian Ocean

ALKIMOS COASTAL NODE LOCAL STRUCTURE PLAN

NORTH

Scale 1:3750 @ A1 | 1:7500 @ A3

0 40 80 120 160 200m

DATE:	22/01/2016	DRAFTEE:	JP
REVISED:	17/02/2016	PLANNER:	KB
PROJECTION:	PCG 94	CHECK:	KB
DATUM:	AHD	PLAN NUMBER:	LCPAC-2-007A

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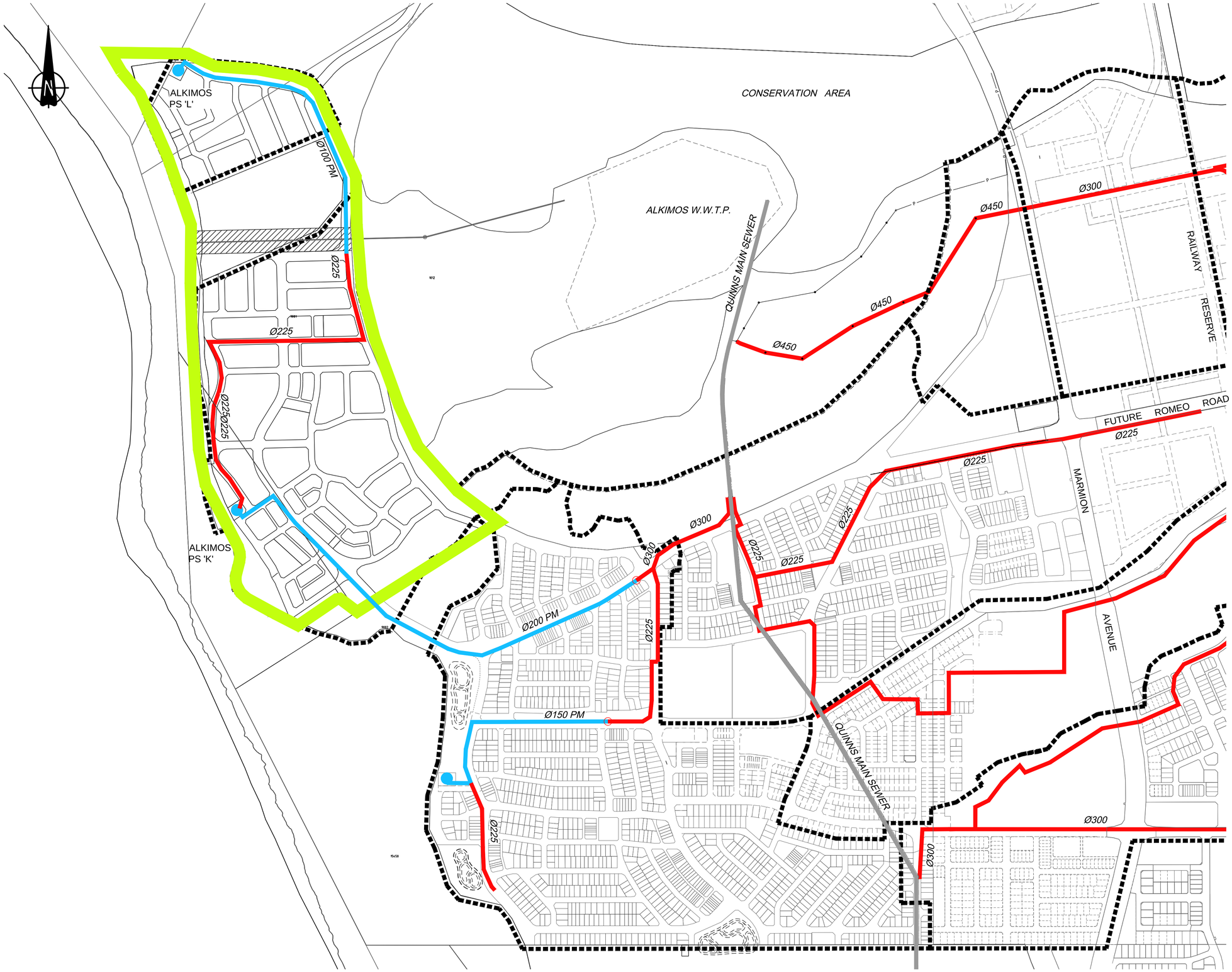

LEGEND

- LOCAL STRUCTURE PLAN BOUNDARY
- SEWER CATCHMENT BOUNDARY
- Ø225 — PROPOSED GRAVITY SEWER MAIN
- ALTERNATIVE GRAVITY OUTFALL
- Ø200 PM — PROPOSED PRESSURE MAIN
- Ø300 — EXISTING GRAVITY SEWER MAIN
- Ø300 PM — EXISTING PRESSURE MAIN
- PUMP STATION SITE

REV	DATE	DRN	CKD	APP	AMENDMENT
C	25.02.16	EL			NEW LSP BASE ADDED AND PUMP STATION 'K' LOCATION AMENDED
B	08.01.15	JV	CH	C HANSEN	NEW LSP BASE
A	26.11.12	JV			ISSUED FOR APPROVAL

Cossill & Webley CONSULTING ENGINEERS
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Street Address: B12 (Level 2) 431 Roberts Road, Subiaco WA 6008
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CLIENT: LEND LEASE COMMUNITIES (ALKIMOS) PTY LTD

APPROVED: 25.02.16 — DESIGNED: GD — SCALE: 1:10000

PROJECT: ALKIMOS COASTAL NODE

TITLE: PROPOSED SEWER CONCEPT

WAPC No.

DRAWING No.: 6100-LSP-Fig1

REVISION: C

ORIGINAL SIZE: A1

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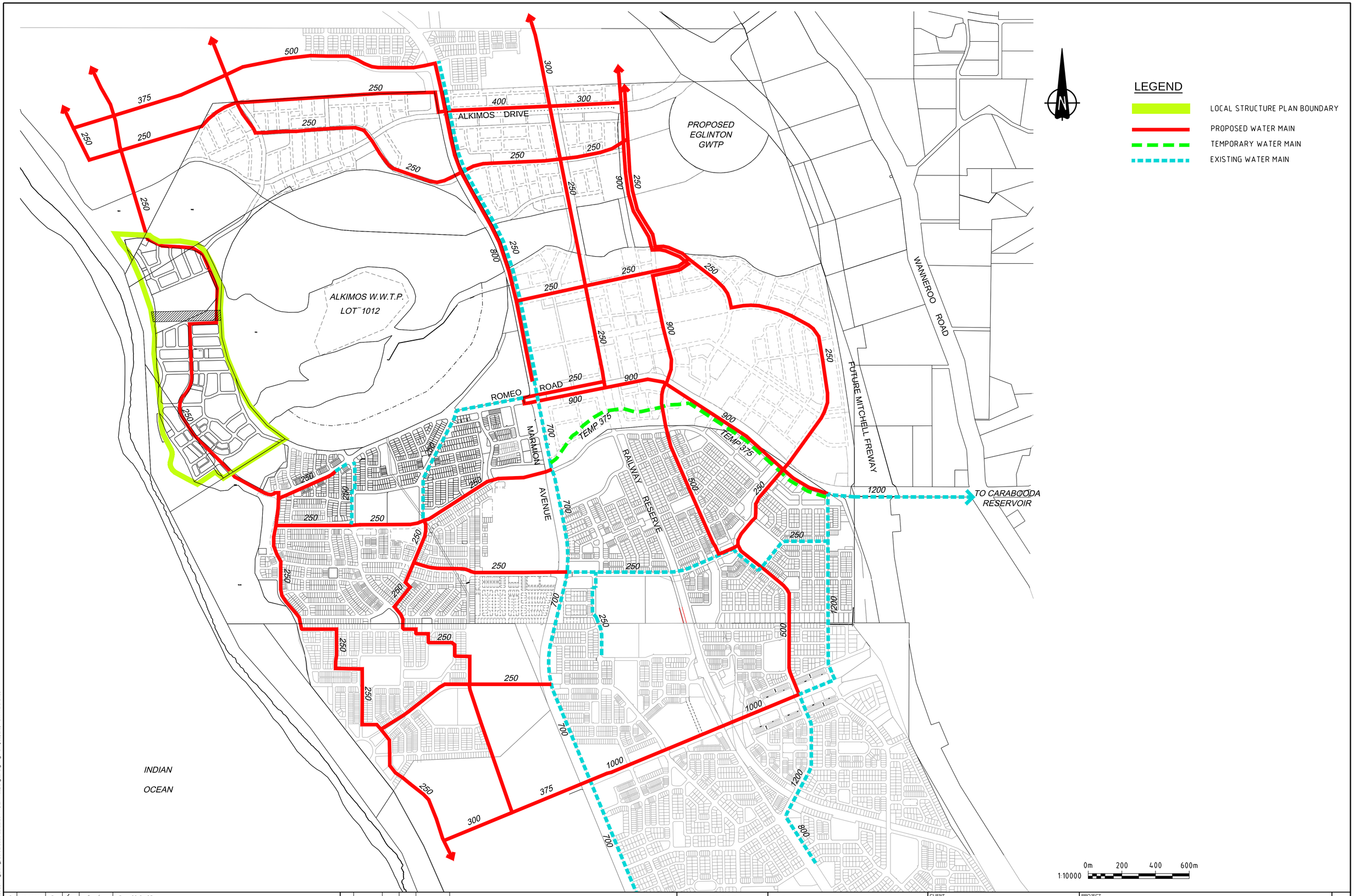
FIGURE 1



REV	DATE	DRN	CKD	APP	AMENDMENT
C	25.02.16	EL			NEW LSP BASE
B	08.01.15	JV	CH	C. HANSEN	NEW LSP BASE
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APPROVED: 25.02.16 | DESIGNED: GD | SCALE: 1:10000

PROJECT: ALKIMOS COASTAL NODE

TITLE: WATER SUPPLY SCHEME CONCEPT

WAPC No. 145429 | DRAWING No. 6100-LSP-Fig2 | REVISION C

ORIGINAL SIZE A1

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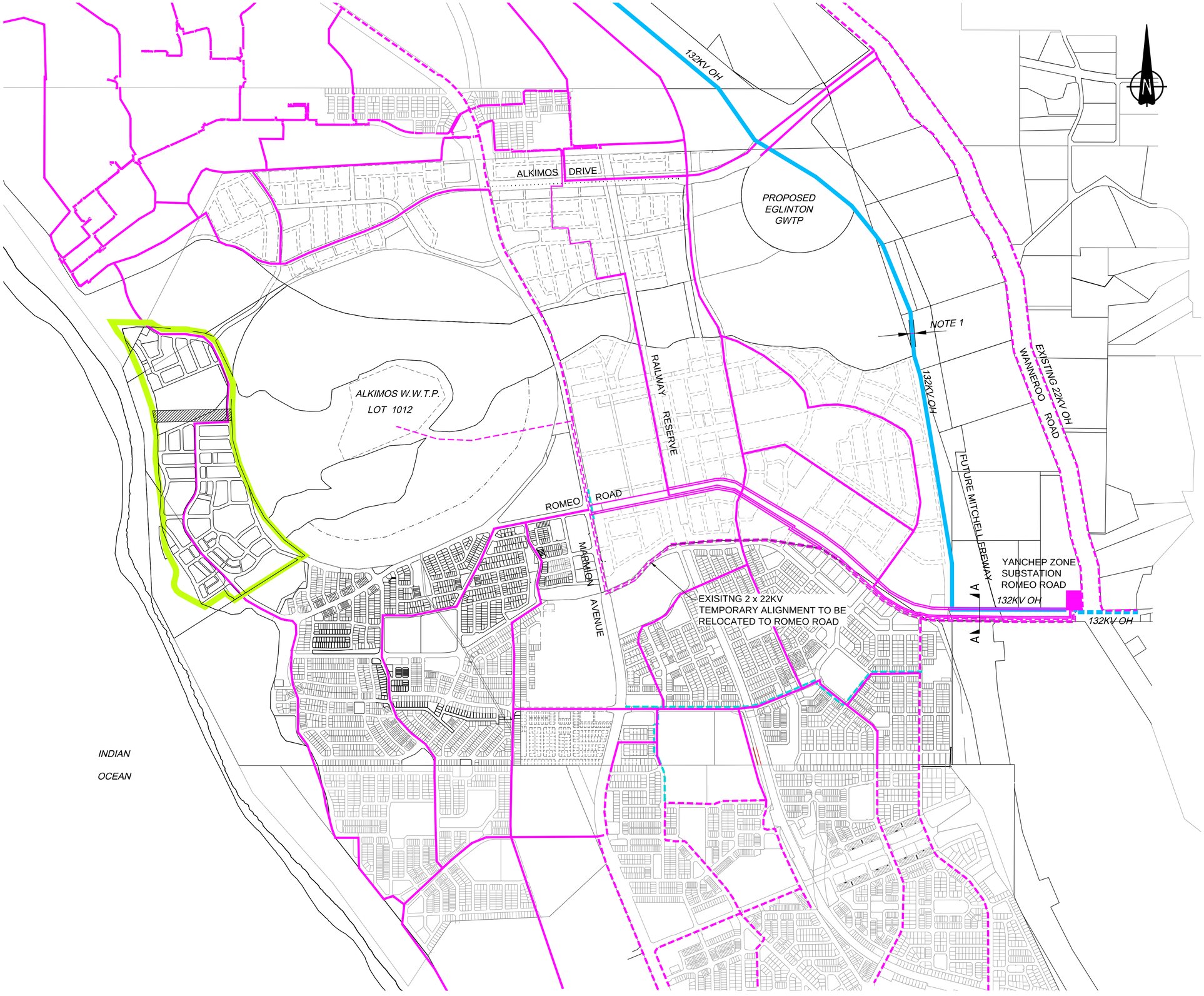
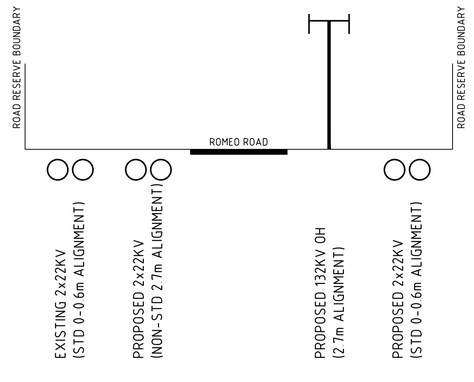
FIGURE 2





SECTION A-A

DIAGRAMMATIC

LEGEND

- LOCAL STRUCTURE PLAN BOUNDARY
- EXISTING 132KV OH POWER LINE
- PROPOSED 132KV OH POWER LINE
- PROPOSED 22KV ELECTRICAL CABLE
- EXISTING 22KV ELECTRICAL CABLE

NOTE

1. TYPICAL EASEMENT 24m WIDE

1:10000 0m 200 400 600m

REV	DATE	DRN	CKD	APP	AMENDMENT
C	25.02.16	EL			NEW LSP BASE
B	08.01.15	JV	CH	C HANSEN	NEW LSP BASE
A	17.04.14	JV			ISSUED FOR APPROVAL

This plan is not to be used for construction unless issued as revision 0 or higher

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CLIENT: LEND LEASE COMMUNITIES (ALKIMOS) PTY LTD

APPROVED: 25.02.16

DESIGNED: GD

SCALE: 1:10000

PROJECT: ALKIMOS COASTAL NODE

TITLE: ELECTRICAL POWER NETWORK CONCEPT

WAPC No. 145429

DRAWING No. 6100-LSP-Fig3

REVISION C

ORIGINAL SIZE A1

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FIGURE 3