Northshore Telecommunication Master Plan

GRAVELROAD

thinking beyond consulting

1 Contents

2 Background

Northshore Hamilton is to be developed as a mixed use area with high density residential, commercial and retail. The area to be developed has been or still is in use for a variety of purposes. There is a mixture of new and existing utility infrastructure which in some cases will continue to be in use for many years.

The North Shore Hamilton area is defined in Figure 1 below.

Figure 1 - Northshore Hamilton area

The current status of the site is a mix of existing industrial and newly developed mixed zone sites. There is a significant portion of the Northshore site still to be developed and detailed in the NSH PDA Development Capacity Assessment_20191028.

The aim of this Telecommunication Master Plan is to:

1. Provide an environment that promotes the supply of the best telecommunication services in terms of:
    a. Bandwidth,
    b. Innovation and,
    c. Accessibility (mobile, WiFi Services, etc.).
2. Enable open and equal access for telecommunication industry participants to promote competition,
3. Allow for the maintenance of a uniform and consistent streetscape in line with the development's standards.
4. Provision for future capacity within the network to accommodate services that may become available.

This Master Plan addresses the:

a. Infrastructure Requirements in terms of:
    i. Passive underground infrastructure,
    ii. Above ground telecommunication installations.
b. Recommended operational approach,
c. Potential commercial model.

All of the components above need to be considered in conjunction as changes to either model impact the requirements of the other models.

2.1 Limitations of Traditional Telecommunication Infrastructure Model

The current model for the development of fixed network telecommunication infrastructure within a new development is that the developer installs the underground "pit and pipe" infrastructure whilst other services such as electricity and water are being installed in the road corridor. The local government authority defines the alignment (distance from the property boundary) of underground infrastructure. The telecommunication underground "pit and pipe" is typically installed in the trench which is being provided for the electricity distribution infrastructure to minimise the excavation required. Due to this approach there is generally a strong alignment between the location of telecommunication and electrical networks.

The ownership of the pit and pipe infrastructure is then normally transferred to the first telecommunication carrier who installs cable into the pit and pipe infrastructure. This is now typically NBN, but it can be any other carrier.

Under the current regulatory regime other carriers can request access to use "pit and pipe" infrastructure owned by others and the owner cannot reasonably refuse access. However, the recurring charge applied for the use of the underground infrastructure is subject to negotiated agreement.

2.2 Streetscape

Historically the street scape was comprised predominantly of poles for street lighting (and sometimes electricity distribution), road signage, traffic lights and public transport items such as a seat or shelter.

Telecommunication infrastructure to support customer's requirements and the increasing penetration of "Internet of Things" to connect measurement and management devices will continue to impact the street environment.

For the last few decades telecommunication infrastructure for cellular services has provided significant community impact but generally not on public property with larger installations on dedicated poles or attached to buildings. However, more and more telecommunication assets, "small cells", are being installed on street poles originally installed for power, lighting or road signage. The introduction of 5G will require many more "small cell" type of installations than the current 4G networks due the frequency bands which will enable higher bandwidth to customers.

Some industry participants predicting that the 5G networks will provide a viable commercial alternative to fixed telecommunication infrastructure and if this proves true, the demand for installation of "small cell" infrastructure by multiple participants will be even greater.

The locations of small cells will be based on each carrier's particular requirements and dependent on both coverage and customer demand. The expected outcome is that carriers will require different locations and these locations may vary over time. Therefore, there is little ability to predict where carrier small cell installations will be required during the initial construction of telecommunication and electrical infrastructure.

With respect to 5G there are a number of potential solutions being considered for the management of this explosion in the number of “small cells”, including:

1. Carriers sharing 5G small cell equipment,
2. Carriers sharing built for purpose street poles,
3. Current approach of installations agreed between carriers and infrastructure owners on an adhoc basis.

The issues that need to be managed relate to the manageability of the street appearance for the public, carriers preferred asset location and the commercial framework to encourage the highest level of competition and best outcome for the businesses and normal customers within the area.

The best outcome is one that provides no restriction to competition, least cost and controllable street scape outcome. By considering the potential needs of multiple operators and providing a platform which is flexible.

2.3 Target Outcome

The ideal outcome for the telecommunication market and street environment would be a solution that:

1. Provides a safe and easily maintainable network asset,
2. Minimises the cost for multiple carriers to provide services,
3. Equal and open access for all telecommunication infrastructure providers,
4. Flexibility in the location and timing of telco infrastructure installation,
5. Controlled and uniform initial and ongoing appearance for the users of the area,
6. Sufficient infrastructure to allow for carrier and IoT scalability,
7. Reduced need for overbuild or remediation works of underground assets.

3 Northshore Existing Telecommunication Infrastructure

There are some areas of Northshore which have been recently redeveloped with other areas still accommodating the original usage of the land. The existing telecommunication infrastructure is comprised of:

1. Telstra pit and pipe,
2. NBN pit and pipe,
3. Opticomm pit and pipe,
4. Telstra copper cable,
5. Multiple carrier optic fibre cables (including NBN, Telstra, Opticomm, etc),
6. Private network – Oil and Gas operator network (while this is present in the development area it is not accessible by others and will not factored).

The map below shows the high level current state of infrastructure.

Figure 2 - Existing Infrastructure Distribution

Some of the existing passive infrastructure like Telstra 'Pit and Pipe' is shown to have spare capacity to cater for future requirements. There is currently a mix of infrastructure owners within the defined area including Telstra, NBN and Opticomm.

3.1 Wireless Infrastructure Installation

New infrastructure will be required to satisfy the requirements of the areas still to be developed. There is no current standard solution for the deployment of small cells, however the following figures (Figure 3, Figure 4, Figure 5) are design examples of how carriers are currently implementing 5G Small Cells onto Street Furniture into developments. These examples do not employ "Smart Poles" which could be used and provide a more aesthetically pleasing outcome albeit at an increase cost to the development, this is discussed further in Section 6 of this document.

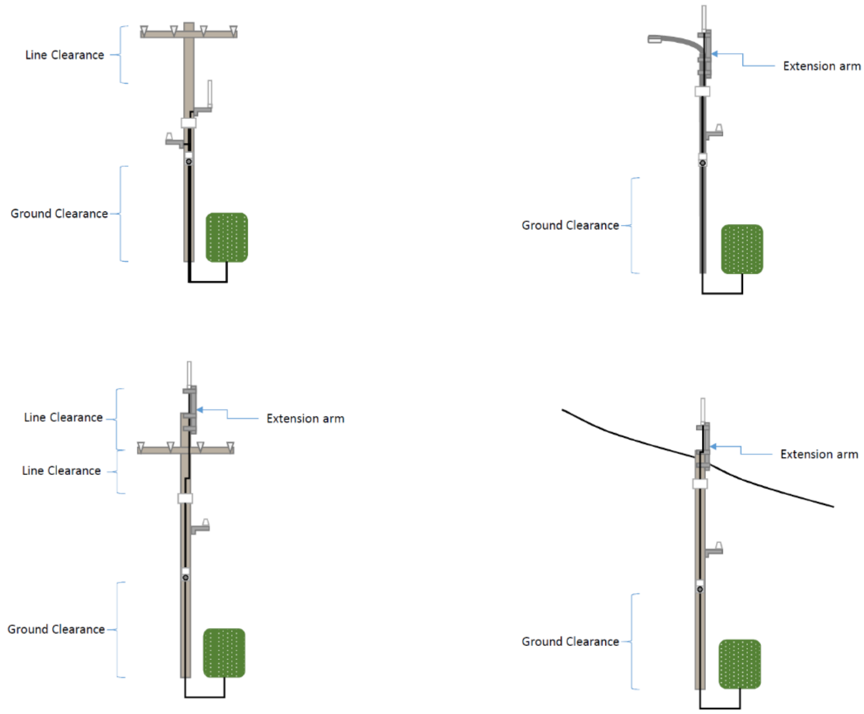

Figure 3 - Small Cell Design Examples

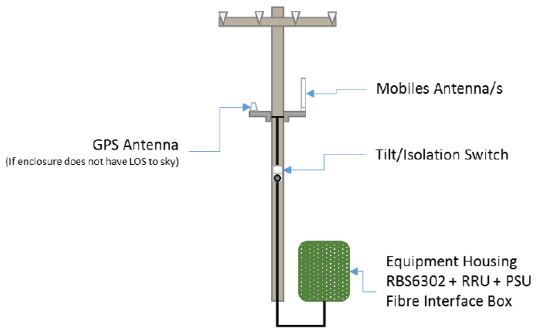

Figure 4 - Small Cell with Roadside Cabinet

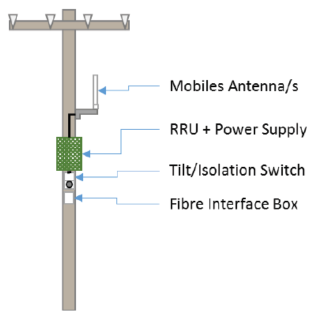

Figure 5 - Small Cell with Pole Mounted Cabinet

The total Northshore site will be developed over a period of many years and completed on a stage by stage basis with the requirements of the master plan generally being delivered whilst work is being completed for each stage.

The traditional model of developing telecommunication infrastructure has been developed on minimising the cost of delivery. The process in summary is:

1. The developer of the land installs telecommunication passive infrastructure along with other utility service infrastructure such as electricity, water and sewerage.
2. The first carrier who installs cable infrastructure into the area receives ownership of the passive telecommunication infrastructure and the responsibility for ongoing maintenance.

Historically this approach provided the least cost result and therefore the best outcome for customers. This is still typically true in residential developments where, due to the lower customer density and average revenue per customer, the NBN is installed as a shared infrastructure option.

However, the model does not provide the optimum outcome where higher density and commercial value customer bases need to be serviced. Access to passive infrastructure should be open and equal to encourage multiple providers to install infrastructure without restriction. Further to this there is a further integration required between the infrastructure traditionally separately provided such as street lighting and other utilities and the telecommunication infrastructure. As passive infrastructure has typical operational lives in excess of 20 years and the technology future requirements are unknown, providing a solution which presents no barriers or restrictions is the optimum outcome.

4 Long Term Telecommunication Requirements

This master plan does not attempt to define how telecommunication carriers will deliver services or architect their networks over the next twenty or thirty years but rather assumes that optic fibre will be the preferred fixed access network technology and there will be an increasing deployment of wireless infrastructure including 5G, WiFi and IoT specific solutions. In addition, it is assumed that there will be multiple cable and wireless providers installing infrastructure which is likely to include roadside cabinets, wireless equipment and antennas, plus cameras for surveillance applications.

To calculate the capacity required within the infrastructure it is assumed that:

1. A single optical fibre will be required at each potential connection point,
2. Multiple infrastructure owners will install cables in a Passive Optic Network configuration.
3. Infrastructure owners may seek to provide fibre cable capacity on two paths to provide redundancy of service to customer.

The number of potential connection points has been based on the lot development information provided in the Development Capacity Assessment[1] provided. Using the calculation described below a total of 20,275 potential connection points are available. The chosen values for calculating potential connection points include an allowance for the expected connections to wireless and IOT infrastructure throughout the Northshore Precinct.

Development Type	Assumed number Connection Points
Residential	1 per Residential Unit
Hotel	12 per Hotel
Retail	1 per 50 sqm
Bulky Goods	1 per 400 sqm
Commercial	1 per 100 sqm
Light Industrial	1 per 200 sqm
Education	1 per 50 sqm
Community	1 per 200 sqm

Table 1 - Connection Point Calculation Inputs

The number of potential connection points were then summed based on the identified cable routes which are shown in Figure 6.

The proposed solution and selection of paths for the Primary Network was to choose a path that avoided wherever possible the excavation of already developed road corridors. However, due to the potential timing of some of the road development alternative routing may be required with excavation along existing developed roads. This is particularly applicable to the area between POI 1 and Nodes 2, 3 and 4. This document presents a primary option along with an alternate Primary Network option which would require conduit installation along existing developed road corridors.

[1] Northshore Hamilton PDA – Development Capacity Assessment Revision 1.1 October 2019

The alternative approach provides an option which controls the installation timeframe but will not be possible in a shared trench arrangement and will need to be installed as a standalone project.

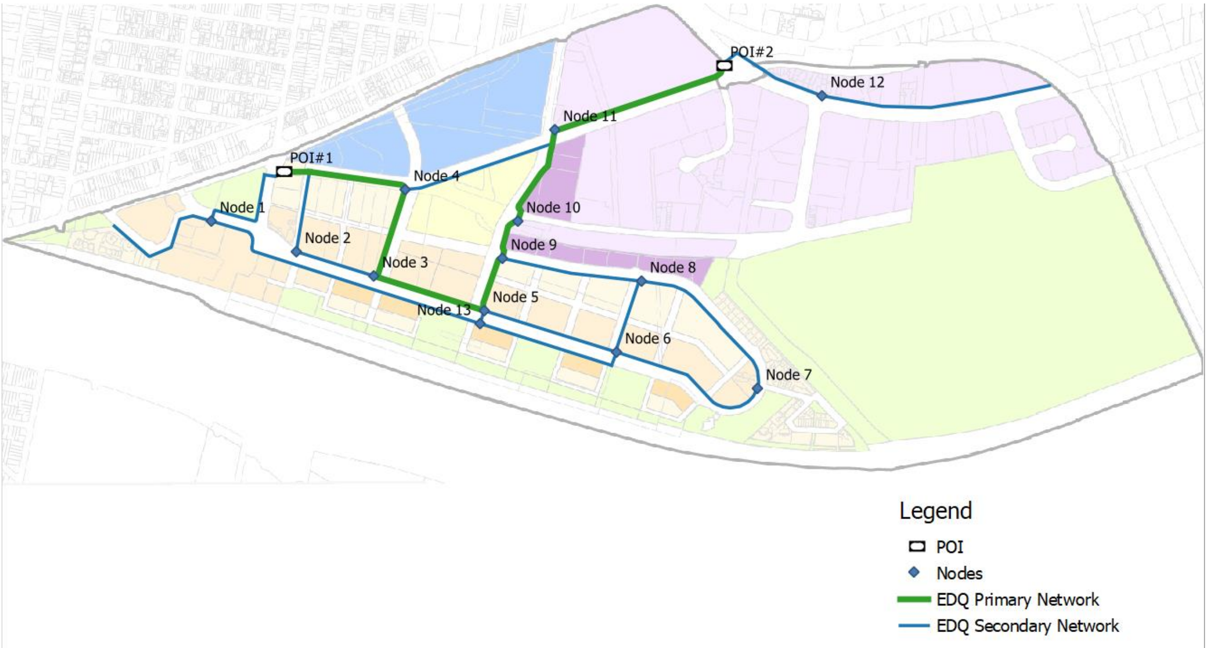

Figure 6 - Passive Telecommunications Network Plan

Using the number of connection points, the location of each lot and the proposed routes the number of potential services beyond each node was calculated and used to ascertain the number of conduits required to provide for the full usage of multiple carriers providing redundant paths.

The total number of Connection Points beyond each node based on the Primary Network route path from POI#1 are shown in Table 2.

Node	Potential Services (Beyond Node)
POI#1	20275
1	4946
4	15329
3	12883
5	12289
9	7932
10	3985
11	1357
POI#2	336

Table 2 - Long Term Potential Services beyond selected nodes (Primary Layout)

4.1 Infrastructure Capacity

The passive network needs to be dimensioned to not only ensure that current and short term needs are meet but also to provide a level of future proofing without over engineering. While we have seen and will continue to see significant advances in the active equipment within the Telecommunications industry, we are not likely to see the same for passive network infrastructure which. For this reason, with correct dimensioning of the passive network overbuild and remediation works should not be required for a number of decades.

5 Underground Telecommunication Infrastructure

To contribute to the long term provision of high quality, flexible, innovative and cost effective telecommunication services the following sections describe the proposed plan for underground passive infrastructure.

5.1 Principles Adopted.

To provide an environment suitable for a connected world a different approach is required.

A. Civil telecommunications infrastructure ("pit and pipe") will be provided to:
   1. Provide the ability to provide path diversity for a connection (for the majority of the route),
   2. Allow for the connection of all buildings, street furniture and meter locations with minimal to zero excavation,
   3. Provide sufficient capacity for:
      a. Multiple carriers to install optic fibre cables
         i. Each carrier to provide one fibre per potential connection point (premise, cell base etc)
         ii. Redundant paths
      b. All future proposed developments
   4. Allow for equal and minimal cost for use by all telecommunication infrastructure providers.

B. The provision of telecommunication wireless (cellular, IOT etc) infrastructure to be accommodated in a uniform, development specified, solution that is available at any location within the development area.

C. A network that is safe and supports efficient operation and maintenance.

To achieve the outcomes described above the ideal solution is to:

1. Install sufficient underground passive telecommunication infrastructure, pit and pipe, to cater for use by multiple service providers,

2. Provide a path with the passive infrastructure to all buildings and potential service points assumed to be anywhere electricity may be connected or measurement devices exist (meters). Examples include street furniture (e.g. bus shelter), streetlights and traffic lights,

3. Ensure there is no commercial restriction on access to
   a. telecommunication passive underground infrastructure,
   b. above ground shared items such as street poles,

4. Ensure that the type of street furniture, is controlled and standardised for the whole development and presents a safe, low cost option for the installation of telecommunication infrastructure.

The requirements above require not only engineering technical solutions, but also aligned operational methodologies. Technical requirements will dictate capacity to be installed, the paths to the required location and providing suitable infrastructure for the installation of wireless equipment. A customised operating model will be required which ensures that the outcomes are achieved and to promote competitive results for the customer that no provider gains an advantage from the physical infrastructure.

The features needed to deliver the required operational outcomes include:

1. Single management and maintenance of passive infrastructure and separate from any telecommunication service provider,
2. Single, installation and maintenance of street infrastructure including poles, seating etc.

Ideally both of these services should be operated as a breakeven or regulated financial solution to minimise the cost of access and encourage competition.

The aim of single management and maintenance of passive infrastructure is to ensure an environment where multiple infrastructure owners can install cable (predominantly optic fibre) incurring the same cost for use of the passive asset and equal access to all customers.

Above ground infrastructure elements, such as streetlight poles, are expected to be used as required by telecommunication providers for the installation of wireless equipment but this is typically the secondary use of the asset. The primary use will be for street lighting, information etc. The quantity and location of wireless solutions will vary over time as demand increases and new services are provided. Ensuring that there is equal access will further promote a controlled but competitive environment which does detract from the intended “look" of the area.

It is also unlikely that every street pole or piece of street furniture will be used for the provision of telecommunication services and making allowance for potential use of every item is unlikely to be the most economical outcome.

5.2 Construction Approach

The key considerations for deployment of core underground network are:

- Resource and Utility safety
- Environmental risk management e.g. Asbestos containing materials
- Optimised Build cost
  - Consideration of existing underground infrastructure and expansion of the capacity of a duct section
  - Co-construction of the network with other underground works, e.g. Electrical duct installation
- Provides sufficient core capacity to meet staged development communication and smart city infrastructure requirements without the need to overbuild at later stages

The overall plan for the underground telecommunication infrastructure includes two Points of Interconnect for linking beyond the Northshore precinct to provide flexibility for carrier networks and support the provision of dual path (diverse) services.

For the purposes of description, the underground infrastructure is categorised as Primary, Secondary or Tertiary networks. The Tertiary network is the standard minimum street network requirement as defined within the design guidelines. The sections of network defined as Primary and Secondary require more infrastructure than the baseline Tertiary network to accommodate the overall sites requirements.

It should be noted that the underground asset records for the development area indicate that there are some conduits and pits that are constructed from Asbestos Containing Materials (ACM). Appropriate Occupational Health and Safety along with Environmental measures should be taken when interacting with these assets.

5.3 Head End or Point of Interconnect

A Point of Interconnect (POI) serves as the demarcation point for the shared assets and provides a common ingress point for all parties.

For shared network assets there is a requirement that the infrastructure will house all of the party's ingress equipment to the precinct because of this the asset needs to be quite large (Major Pit Type 1[2]) and so typically takes the form of a access-hole as per the below example. Figure 7

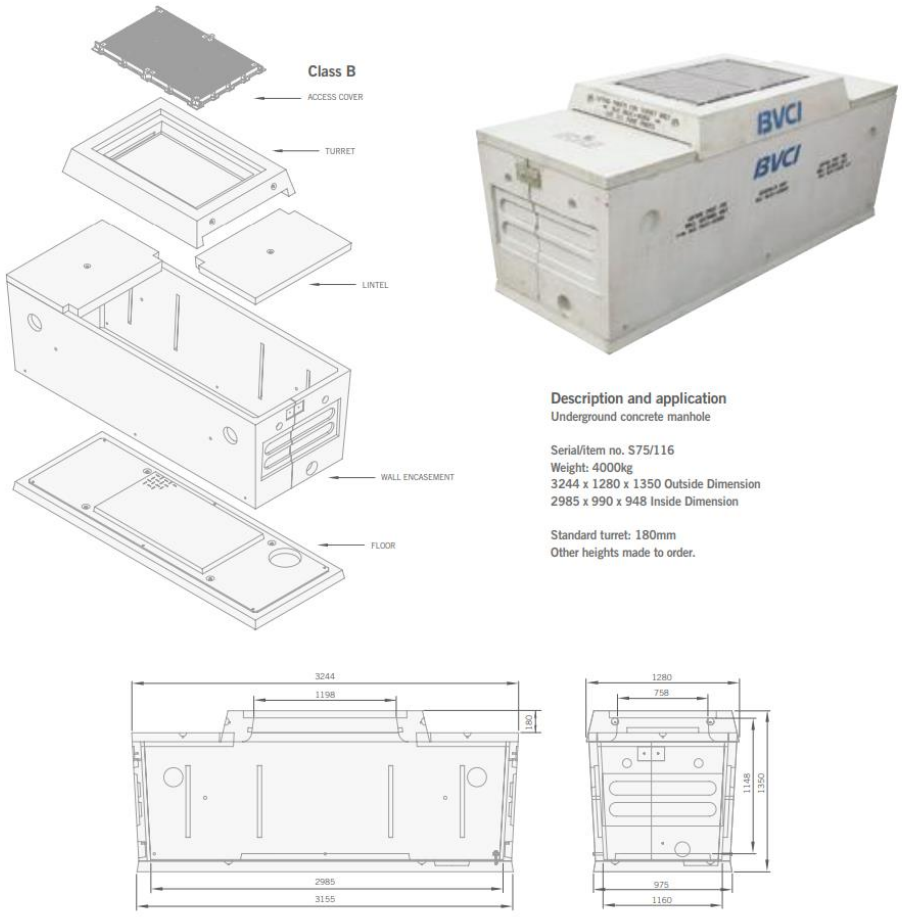

Figure 7 – Access-hole Infrastructure

A new Point of Interconnect (POI#1) is proposed to be established on the eastern corner of Remora Rd and Kingsford Smith Drive, in the existing road reserve as shown in Figure 8. The access-hole will

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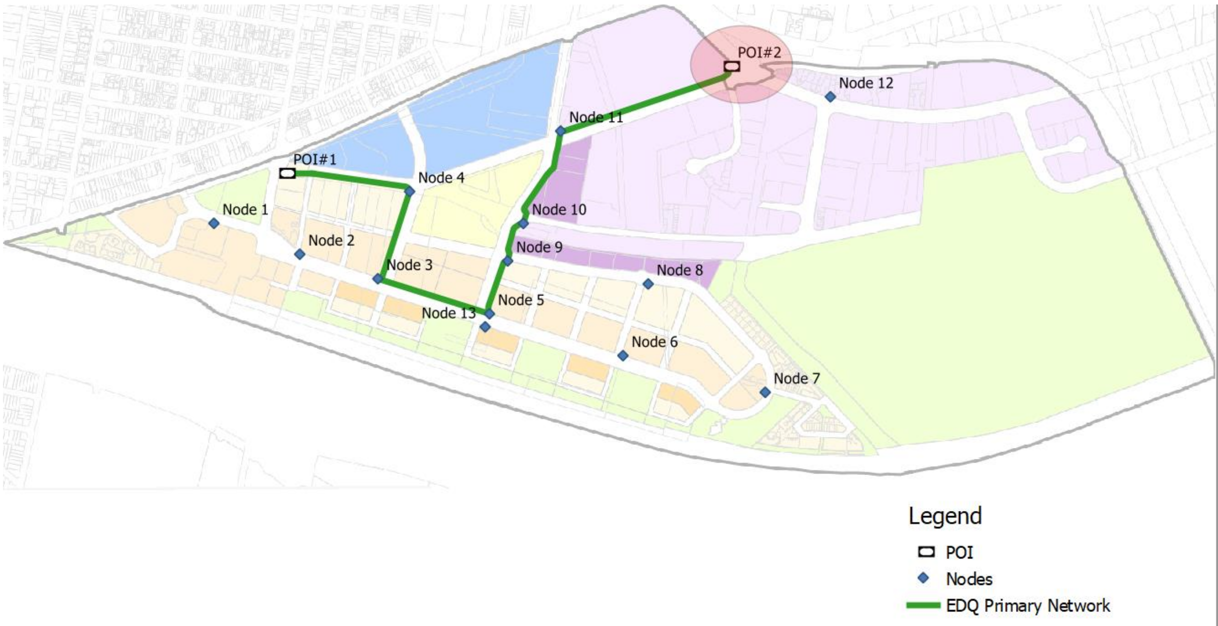
be the common point for carriers, government and other asset owners to access the Northshore passive telecommunication infrastructure and will need to have sufficient capacity to accommodate their assets as well as provide the safest accessible location with minimal environmental impact. The proposed access-hole location is provided in Appendix 1.

POI#1 will not initially be connected to any other carrier or other telecommunication network assets. This will mean that access to this network will require a formal request and approval process after which carriers will install link conduits to POI#1 which will allow access to the Primary Network.

Figure 8 - POI#1 Location

The second Point of Interconnect (POI#2) which will be established at a later stage of the development is proposed at the intersection of Fison Ave, Cullen Av and Eagleview Place, park side, within the road reserve as shown in Figure 9. POI#2 provides a physically diverse connection point to the network for opperators and carriers that what to establish a more robust network solution.



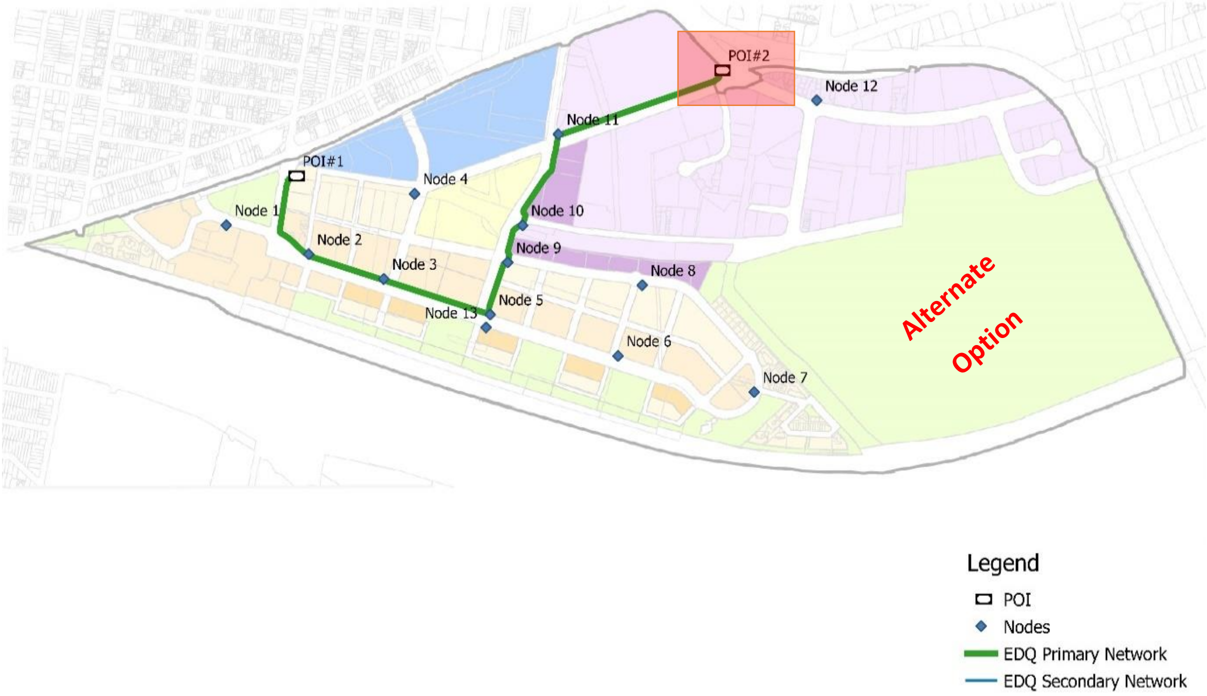
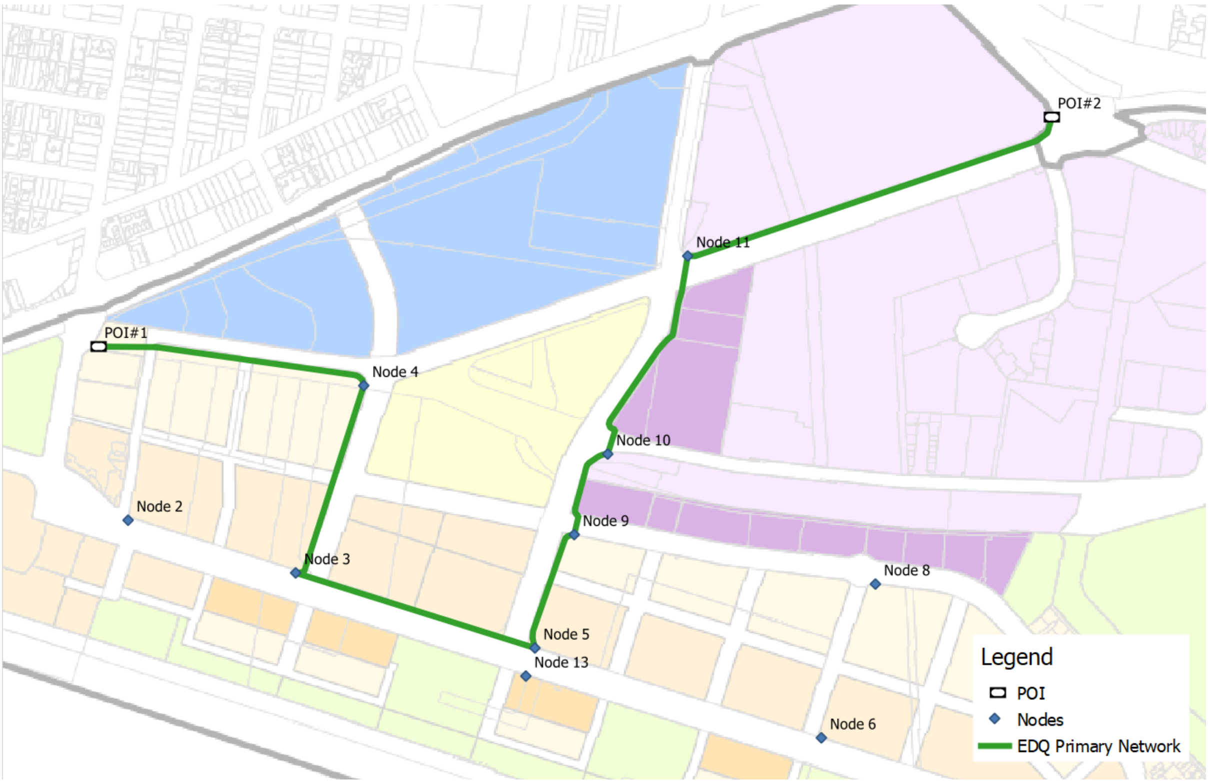


Figure 9 - Proposed Location of POI#2

5.4 Primary Network

The Primary Network infrastructure is defined by the number of premises served from it and beyond it in the network, as shown in Section 4 of this document and prescribed in the 'Design Guidelines Version 1' document section 5.3.2, this defines the number of conduits required to support the major Fibres that would service the area. The Primary Network should be built with a level of future proofing to reduce the need to overbuild with additional infrastructure as this would adversely impact on the areas aesthetics and disrupt the area during construction.

Based on the number of potential Connection Points the Primary Network will require of 4 x P100 conduits. The Primary Network route is shown in Figure 10 and extends from POI#1 to POI#2 allowing for all services to be supplied from either connection location when the Primary Network is complete.



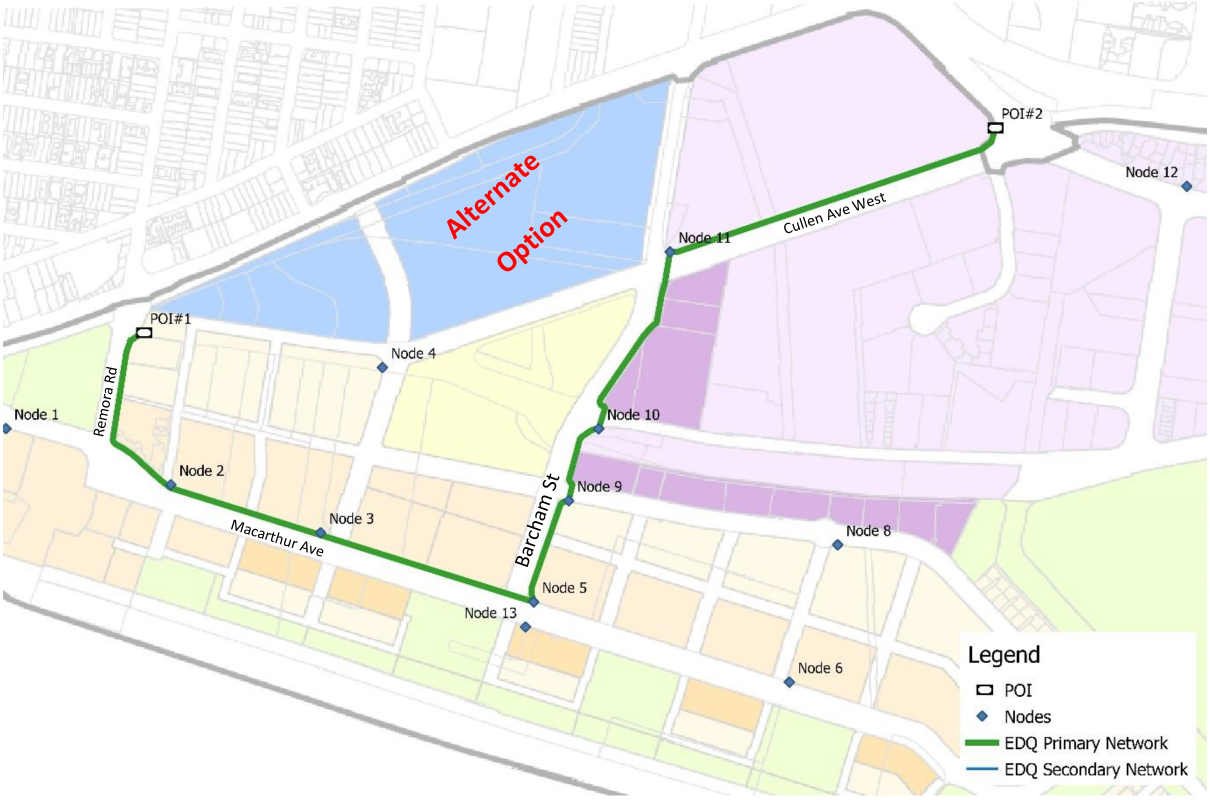
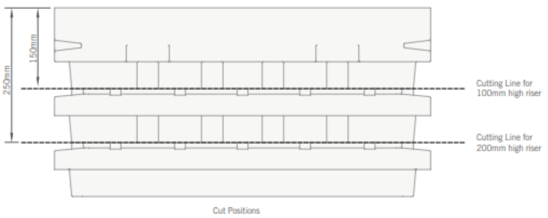


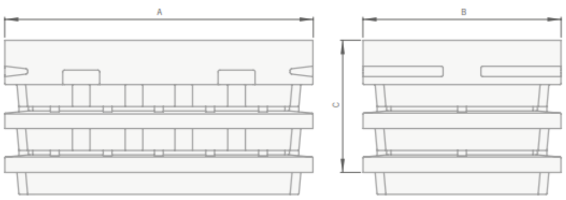
Figure 10 - Primary Network from POI#1 - POI#2

Based on the roads currently constructed and those still to be reconstructed the initial Primary Network follows the route, from POI#1 through Nodes 4, 3, 5 and 9 to supply the areas currently being developed. The conduit capacity considers the current and forecast future requirements.

There are opportunities to utilise existing carrier underground network infrastructure to service some of the identified network needs and minimise cost however along this route the existing infrastructure is not sufficient and records indicate that some existing conduit assets are constructed from Asbestos Containing Materials (ACM), so have been deemed unsuitable. The green lines indicate the sections where new infrastructure is required to satisfy the long-term requirements, that is from POI#1 through Nodes 4, 3, 5 and 9.

Primary Network will typically consist of four (4) parallel plastic conduits and Pits of sufficient size (Major Pit Type 2[3] - 8 Pit in Figure 11) to accommodate Optic Fibre Joints and cables, and example of which is provided in Figure 11 below.





Product Code	124225	124226	124228
Plastic Riser	P4	P5	P6/P8
A	700	700	1366
B	396	450	553
C	300	300	300

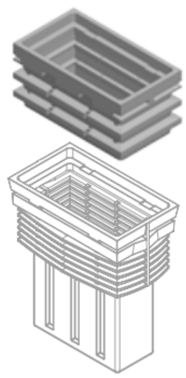


Figure 11 - Primary Node asset Pit (P8)

5.4.1 Primary Network Summary

To achieve the most cost effective outcome of a Primary Network with a minimum capacity is 4 x P100 conduits it is recommended to use a mix of existing and new infrastructure. This is summarised in Table 3.

The existing carrier infrastructure between POI#1 through Node 2 to Node 3 is not being used for this solution, and the indicative cost to install 560m of new 4 x P100 conduit for the alternate Primary Network option in the same location is estimated at $140,000. The cost is high due to the construction

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methods required for the area and the remediation works needed to restore the existing footpath surfaces.

Description	Start	Finish	Distance (m)	Timing
New Primary Route	POI#1	4	390	New installation, may coincide with construction of other utilities.
New Primary Route	4	3	280	New installation, may coincide with construction of other utilities.
New Primary Route – Short to Medium Term	3	9	530	See Discussion Below
New Primary Route	9	POI#2	1000	New Installation, to coincide with construction of other utilities.

Table 3 - Primary Network Summary (Option 1)

The Primary Network between POI#1 and Node 4 is proposed to be constructed on the southern edge of Curtin Avenue West within the existing verge, as noted above there are existing assets along this section which may contain asbestos and care should be taken to avoid these. The proposed Primary Network Route path from POI#1 towards the east to Curtin Ave W will traverse an area of land which is not currently a road reserve. An easement will be required through this section for the network installation and the alignment of the route should be confirmed prior to construction.

The Primary Network section from Node 4 and Node 3 is along a proposed new road and it is recommended this new Network (4xP100) is constructed in conjunction with the road and electrical works.

The passive network infrastructure between Node 3 and Node 9 is required in the short to medium term as the existing available underground network routes have limited capacity. The preferred option is to install the Primary Network conduit infrastructure whilst other utility construction activity is being completed such as electrical network to share the cost of excavation. It has not been possible to ascertain the exact timing of other works between Node 3 and Node 9. Consideration to installing the Primary Network between Node 3 and Node 9 as a separate construction project may be required to enable services to be delivered in the medium term. If installing this Primary Network section is required prior to the availability of a shared trench, the indicative estimated cost is $60,000.

Primary network sections from Node 9 to POI#2 are required to satisfy the demand in the surrounding areas and provide the ability for service providers to delivery high reliability diverse path connections. It is currently assumed that the sections from Node 9 to POI#2 will be installed in shared excavation as the areas are developed but conduit infrastructure could also be installed as a standalone project providing the option of diversity much earlier.

5.5 Secondary Network

Similar to the Primary Network the capacity of the Secondary Network infrastructure is defined by the number of potential connections to be served. The Secondary Network route capacity is defined as a minimum of 2 x P100 conduits. The Secondary Network is shown in Figure 12 and will consist of two parallel 100 mm conduits and multiple Pits (Minor Pit Type 2[4]) which will need to be of sufficient size to accommodate optic fibre joints and cables. If the alternate Primary Network option is chosen, the alternate Secondary Network applies.

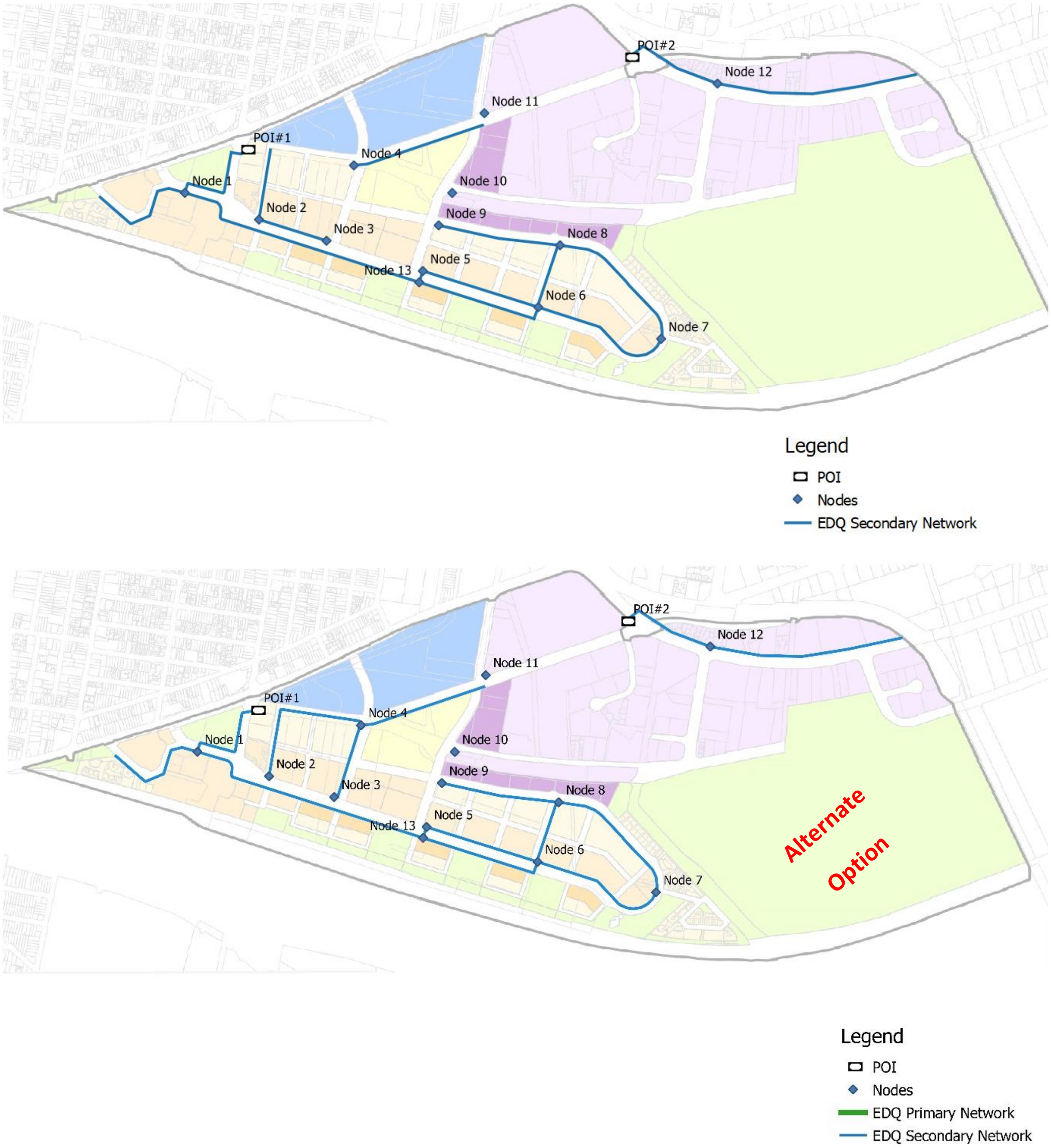

Figure 12 - Northshore Secondary Network

5.5.1 Nodes 6, 7 and 8

This portion of the Secondary Network is proposed as shown in Figure 13, from Node 5 through Nodes 6, 7, 8 and terminating in Node 9 to service the existing and remaining areas to be developed.

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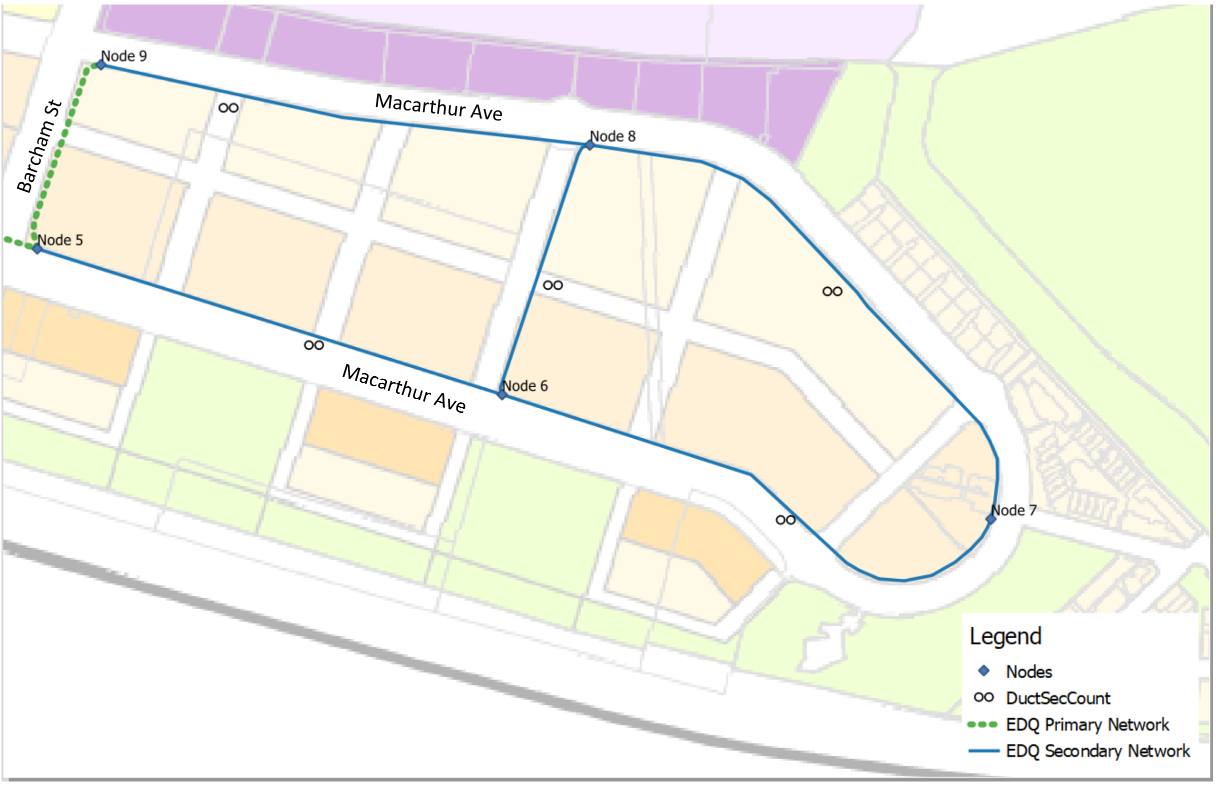


Figure 13 - Initial Secondary Network path

The opportunity to utilise existing underground carrier network infrastructure is shown in Figure 14. The solid blue lines indicate the sections where existing available carrier network has sufficient available capacity to meet the area's requirements, that is from Node 9 through Node 8 and past Node 7. The dotted blue lines indicate the areas where new infrastructure is required to meet the developments requirements, that is from Node 5 through Node 6 and into Node 7. A Secondary Network link is also recommended between Node 6 and Node 8 to provide network distribution flexibility and accommodate the potential number of cables.

The recommended option is to construct the 2 x P100 from Node 5 to Node 7 in conjunction with other the installation of other utility infrastructure along with road development as shown in Figure 14. There may be a requirement to construct these sections earlier to satisfy the demand in the surrounding areas and provide the ability for service providers to delivery high reliability diverse path connections, if the existing carrier infrastructure cannot support interim service requirements for the development's initial stages.

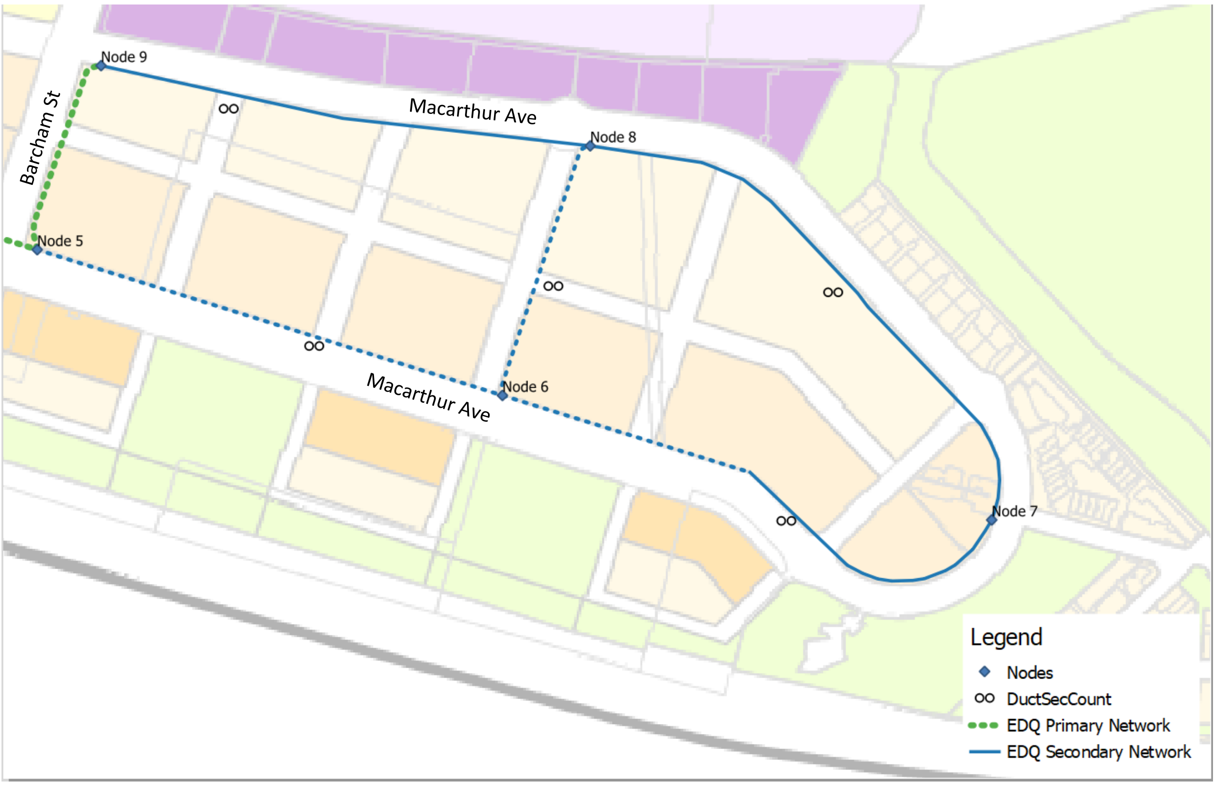


Figure 14 - Initial Secondary Network utilising Carrier assets

Section from Node 6 to Node 8 is along a proposed new road and it is recommended that new Secondary Network (2xP100) is constructed in conjunction with the road and electrical works.

5.5.2 Nodes 1, 13 and 6

This portion of the Secondary Network is proposed as shown in Figure 15, from POI#1 to Node 1 and to the South West and then from Node 1 through Node 13 and terminating in Node 6 to service the existing and remaining areas to be developed.

Figure 15 - Secondary Network Southern Section

The Secondary Network requirement from POI#1 to Node 1 can be serviced by the existing infrastructure and utilising this will negate the need to perform costly road crossings and remediation works. Link conduit will need to be installed from POI#1 the existing infrastructure to provide access to the network.

The Secondary Network route from Node 1 West along Hercules St and Harbour Rd is within an area that appears to be fully developed, there is expected to be low growth in the number of new services and there is extensive existing cable infrastructure. The primary requirement for further cable installations will be from new service providers offering competitive services. The previous audit has identified that there is some, but limited, capacity available for the installation of new cables and this capacity should be consumed prior to any investment in new conduit infrastructure in considered.

The Secondary Network route from Node 1 East along Hercules St to Node 13 is in an area that appears to be partially developed and the use of existing infrastructure where practical is recommended. This approach will minimise total costs by only extending from the existing fit for purpose network infrastructure towards Node 13.

The Secondary Network route that extends from Node 13 to Node 6 along the Southern edge of Macarthur Ave will need to be new infrastructure as the existing assets will not accommodate the forecast capacity. This section also requires a road crossing across Macarthur Ave to interconnect with Node 6. It is recommended that the road crossing (2xP100) be constructed when the proposed Macarthur Road upgrade, refer to Figure 16 below, and the corresponding land areas are developed to minimise cost and disruption.

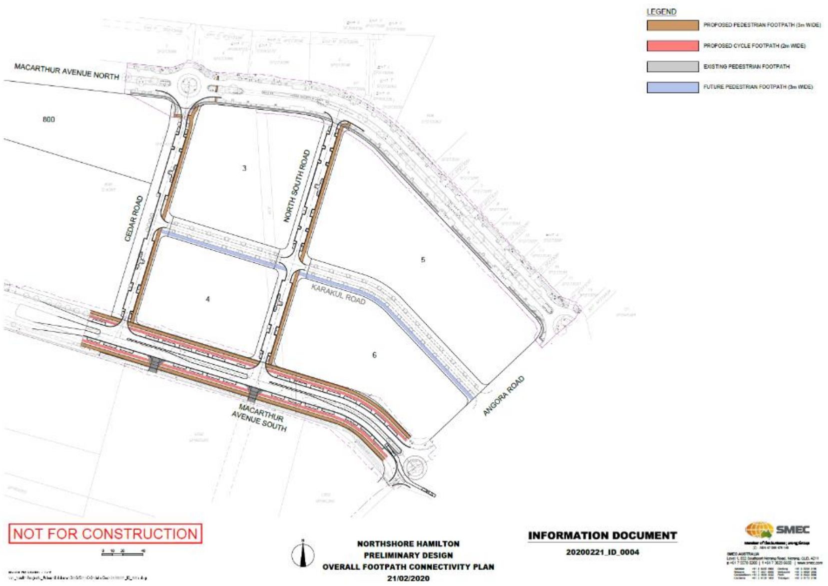


Figure 16 - Proposed Road development

5.5.3 Nodes 4, 11 and 12

This portion of the Secondary Network is proposed as shown in Figure 13, from Node 4 to POI2 to Node 12 to service the existing and remaining areas to be developed.

Figure 17 - Secondary Network Northern Section

The route from Node 4 is along Cullen Ave West to Node 11. The audit and asset records show that there is currently no telecommunication infrastructure along the southern side of Cullen Ave West and it is recommended that the construction of the secondary network 2xP100 is completed in conjunction with other utility service installations.

From POI2 to the east via Node 12 further Secondary Network is proposed to accommodate the potential demand and interconnection beyond Northshore. This section of infrastructure is recommended for installation in conjunction with other utility infrastructure installations.

5.5.4 Nodes 2 and 3

The audit and asset records show that there is currently no telecommunication infrastructure along the east side of Finnegan Street and it is recommended that the construction of the secondary network 2xP100 is completed in conjunction with other utility service installations from Curtin Avenue West to Node 2.

From Node 2 to Node 3 there is existing carrier assets that can accommodate the Secondary Network capacity requirements, however records indicate that these assets contain asbestos and while these are acceptable to use for passing cables through, any overbuild activities are not permitted. It is recommended that using these assets is considered as an interim until the installation of utility infrastructure is completed at which time new 2xP100 can be installed to remove the environmental risk or if the alternate Primary Network is selected 4xP100 will be installed

An optional road crossing from Node 2 heading south across Macarthur Avenue could be constructed to remove the need to install link conduit from POI#1 to Telstra's Network on Remora Road. This construction would be advantageous, however not essential and would only be practical to install if the road is being upgraded due to the high cost and disruption.

5.5.5 Secondary Network Summary

The Secondary Network is comprised of minimum capacity on the route of 2 x P100 conduits with the use of existing assets and routes extended as land is developed. This is summarised in Table 4.

Description	Node A	Node B	Distance (m)	Suggested Timing
Reuse existing infrastructure	9	7	1,200	Existing conduit (Telstra)
New Secondary Route	6	8	230	New Road, construct network when adjacent land parcels are developed
New Secondary Route	5	7	640	When adjacent land parcels are developed
Reuse existing infrastructure	POI#1	1	240	Existing Conduit (Telstra)
New Secondary Route – West along Hercules St and Harbour Rd	1	-	400	Only constructed if no further space is available in the existing infrastructure
New Secondary Route – East along Hercules St and Harbour Rd	1	13	850	When adjacent land parcels are developed
New Secondary Route	13	6	450	When adjacent land parcels are developed
New Secondary Route	2	3	490	Use existing Carrier infrastructure and upgrade when adjacent land parcels/road are developed
New Secondary Route	4	11	520	When adjacent land parcels are developed
New Secondary Route	POI#2	12	1030	When adjacent land parcels are developed

Table 4 - Secondary Network Summary

5.6 Tertiary Network

The Tertiary network interconnects with the Primary and Secondary Network in multiple locations and provides the final path to the service connection points.

For the Tertiary Network, consideration of above ground infrastructure location, e.g. Poles, Lights, etc. should be given in addition to the various Northshore's property requirements to establish the best possible passive network coverage.

The Tertiary Network (P100 and pits) is expected to be constructed whilst the various roads and land parcels are developed as this network layer only supports connection of those locations there is no requirement to build this infrastructure any earlier. Any telecommunication passive underground network infrastructure that is deployed whilst the adjacent land parcels are being developed is assumed to be installed in a shared trench with the electrical distribution network. The architecture, such as single side or both sides of street deployment will be dependent on the approach chosen by the electrical design.

An example plan of a fully developed area in the precinct is shown in Figure 18.

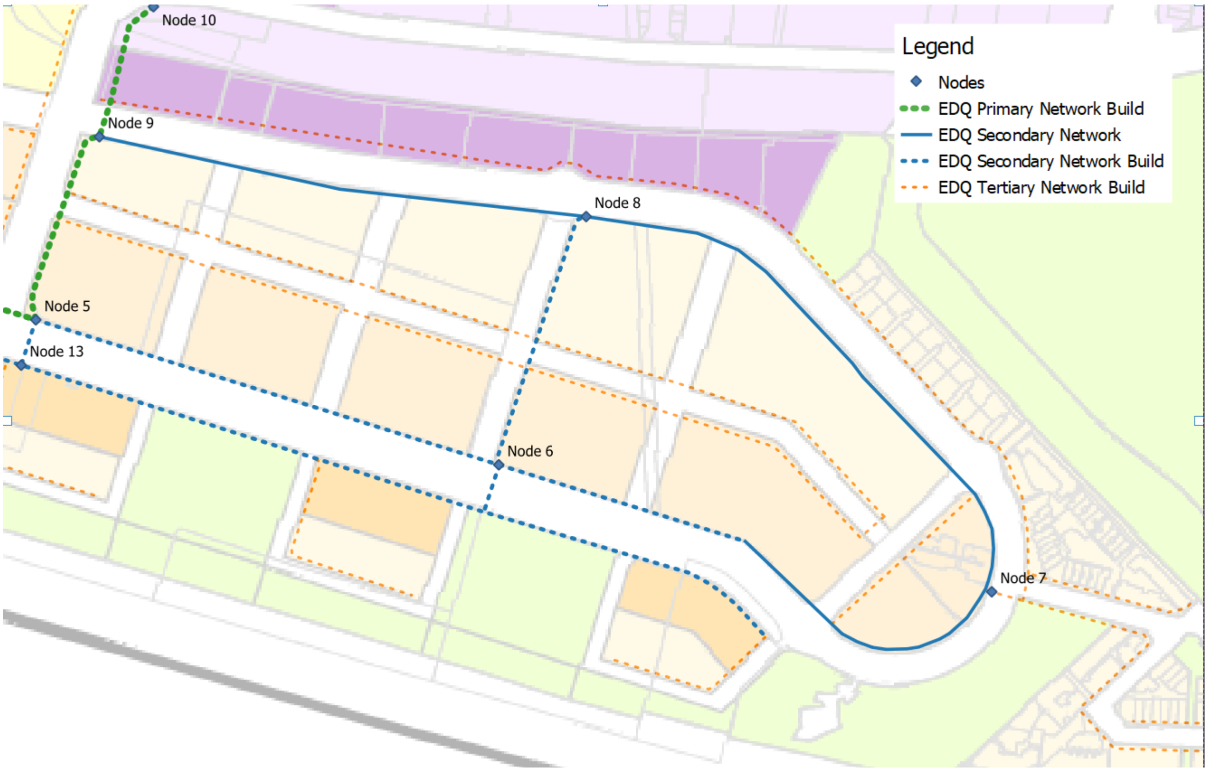


Figure 18 – Primary, Secondary and Tertiary Network plan

6 Above Ground Infrastructure

Whilst underground passive telecommunication's infrastructure is dedicated to telecommunication requirements and often shared by multiple Carriers, the above ground infrastructure used for installations is predominantly installed for non telco requirements. The exception is the installation of Carrier above ground cabinets which are typically used to allow for connection and changes to customer services and house any active equipment such as, network repeaters.

For the deployment of future wireless network infrastructure, it is considered unlikely that new dedicated structures will be built, but that equipment will be installed on either buildings or existing structures such as street light poles. The installation of wireless equipment on existing street poles can be completed in multiple configurations as shown in section 3.1.

The impact of 5G, IOT and Smart City initiatives is commonly accepted to be an increasing requirement for wireless telecommunication infrastructure.

The solution to installing wireless telecommunication equipment in an inconspicuous fashion in many locations is to use specially designed street poles to provide the street light functionality but also house equipment internally and present a better visual appearance. These poles are often referred to as Smart Poles.

Many variations exist for Smart Poles in terms of appearance and features but most typically accommodate the installation of two wireless bases and antennas. The wireless bases can be any combination of WiFi, 4G or 5G, an example of a Smart Pole is provided in Appendix 2 of this document.

Only a portion of the street poles within Northshore are likely to be selected by Carriers as locations suitable for the installation of equipment with the exact location unknown until the Carrier is ready to install. Furthermore, the locations are likely to change over time depending on the implementation of new technology or growth in demand.

To cater for the long term outcome of wireless equipment to be installed at multiple street poles in currently unknown locations within Northshore the telecommunication network Design Guidelines require that every pole location has a path for the connection of a telecommunication cable without new excavation.

Similar to the wireless equipment, any security/video installations will only be on selected poles and will need to be planned in a similar fashion to that described for wireless infrastructure.

6.1.1 Street Poles

There are a number of scenarios with respect to how the installation of telecommunication equipment is installed and managed with respect to street pole infrastructure. Each scenario has a different outcome in terms of the visual impact and the work required to complete the installation. The broad scenarios, have assumed underground electricity distribution, are described Table 5.

Option	Scenario	Visual Impact	Disruption
1	Poles are provided without consideration of future requirements and wireless equipment attached externally (see Section 3.1)	Variable installations and visually unappealing. May include roadside cabinets.	Limited disruption with generally no civil works required.
2	Carriers permitted to replace existing poles with their own "Smart Poles" as required.	Mix of pole types throughout the area. More poles required due to limited sharing by Carriers.	Civil works to upgrade foundation and install.
3	Unified pole solution with central control. Poles to be used standardised and mandated for use. Standard and Smart poles have similar look and use the same foundation.	Almost no visual impact. Equipment disguised within pole.	Limited disruption with pole swap out as required using existing foundation.

Table 5 - Street Pole Options

Options 1 and 2 do not readily accommodate the sharing of poles whilst option 3 allows for two installations at one location. Options 1 and 2 can reasonably expect to require more installation locations than option 3 due to the resistance to sharing by Carriers.

By maintaining control of the pole infrastructure within Northshore the appearance and installation practices can be standardised and produce a more visually pleasant outcome in the long term. To further review this model further work is recommended to:

- Develop a commercial model,
- Develop specifications (in line with the overall visual approach for development),
- Establish how/who would be the long term manager,
- Identify potential suppliers of poles.

7 Further Considerations

The optimal outcome for the development is one that provides Government , Business and Residential users with the maximum choice with regards to carriers and services whilst providing an economical shared passive infrastructure which carriers and utilities can use to connect to end users, thus benefitting customers and carriers alike.

7.1 Network Operation and Maintenance

The underground network in this Master Plan is proposed as a mix of existing infrastructure where capacity exists and new infrastructure where required to achieve the most cost effective outcome.

Under the traditional industry model for developments, ownership of the newly constructed underground passive infrastructure (pit and pipe) would be transferred to the first carrier that installs cable. Any subsequent carriers would need to arrange and pay for access to that conduit and this may be a constraint to open competition.

Under the current Australian Telecommunication’s Legislation there is no requirement for passive infrastructure, including underground access-holes, pits and conduits, to be owned or controlled by a Carrier. An independent non carrier entity can own passive telecommunication’s infrastructure and make this available for use by all Carriers. To promote competition the provision of access can be done on a uniform and cost recovery basis.

As this Master Plan promotes the establishment of underground telecommunication infrastructure that has the capacity and is suitable for use by multiple service providers any restraints to access should be minimised.

7.1.1 Hybrid Solution

This plan proposes to minimise the additional cost of installing suitable telecommunication infrastructure by using any existing assets that are suitable. Installing new conduit infrastructure in already developed areas with paved footpaths, with no access to shared trench, is very expensive and disruptive to the current occupants / users of the area and is only proposed if no suitable infrastructure is available irrespective of current infrastructure ownership.

The outcome of this approach is that the installation of a new cable to serve customers within Northshore is likely to pass through more than one organisation’s infrastructure. For the installer of the cable this will require commercial agreements with multiple parties for the use of the different sections of underground infrastructure. For example, a new optic fibre cable from POI#1 to Node 7 would pass through Telstra conduit, new conduit (owner unknown) and then Telstra conduit.

If the new conduit is installed as proposed in this plan and then transferred to the first carrier that installs a cable, there is the possibility of many more conduit owners within the Northshore precinct over time. This does not prevent the installation of cable by other infrastructure owners, but it does complicate the process and could become a deterrent to service provision in the future. There is always an inherent reluctance to install cable within a competitor’s infrastructure and a level of resistance for a conduit owner to allow access, although the process is a requirement of the Telecommunications Act.

If the new installed conduit was owned and controlled by a non-carrier organisation it is expected that the access and use by multiple providers can be improved by simplifying the engagement process, standardising the recurrent charges to cost recovery and providing a uniform outcome for all users.

If all new underground infrastructure is transferred to the same entity over time the proportion of underground network supplied through this entity within the area would increase.

To further simplify access for competitive service providers a single provider of conduit access across the Northshore area would be preferred. Although possible, it is not considered likely that the current dominant infrastructure providers, Telstra or NBN, would consider transferring their underground network to a new entity without significant cost. From Telstra's perspective the current asset is a sunk cost and it continues to generate revenue through the lease of access.

Although ownership transfer of underground infrastructure is unlikely there may be an opportunity to establish an agreed approach that a single independent entity provides the interface with cable providers on behalf of all underground infrastructure owners. From a potential service provider's perspective this would simplify the process and for the passive infrastructure owners it would minimise effort and allow revenue to continue. The value may be diminished when most cable owners will still have to make arrangements with other parties to install cable from their current network to the edge of Northshore (i.e. to POI#1 or POI#2). However, having a single source of information with respect to infrastructure routes and available capacity would make access simpler for any potential user.

8 Recommendations

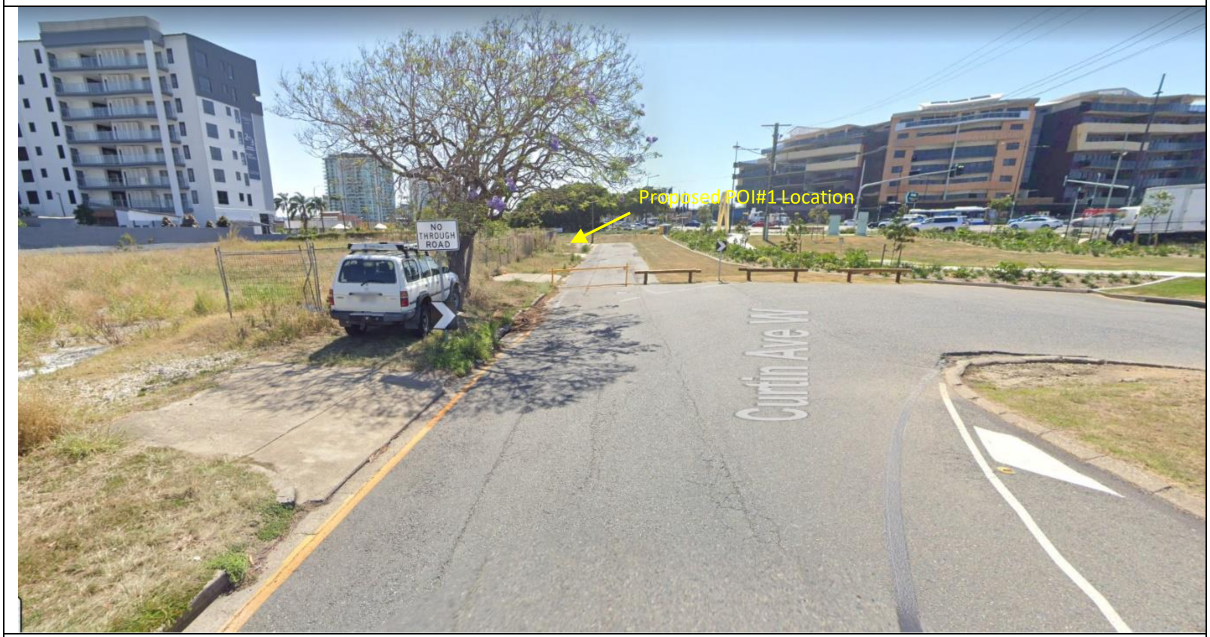
This Northshore Telecommunication Master Plan provides an approach which is focussed on the provision of suitable infrastructure that supports and promotes the delivery of competitive and innovative services and minimises future disruption due to construction activity. There are a number of recommendations arising from the development of the concept plan:

1. Install telecommunication conduit whenever a suitable shared trench is available with the capacity to be installed as specified in this plan and the Northshore Design Guidelines. Install conduit path to all locations where electricity is supplied.
2. In limited locations, consider the construction of a new conduit path prior to the adjacent land parcel development to provide connectivity to areas under development. (e.g. Node 3 to Node 9),
3. Investigate and resolve the option to transfer constructed underground passive telecommunication infrastructure to a single non-carrier entity for future maintenance and management of open access,
4. Investigate and resolve the retention of ownership and control of street furniture such as light poles to a single entity to manage usage for original purpose but also the installation of telecommunication infrastructure,
5. Investigate the opportunity to create an environment for street poles that simplifies the implementation of “Smart Poles” when and where required. Consideration should be given to the establishment of specifications for both standard and smart poles, including foundations, to minimise future disruption and costs, visual appearance, ownership and the commercial models for request and ongoing usage.

Appendix 1 – Details of POI#1

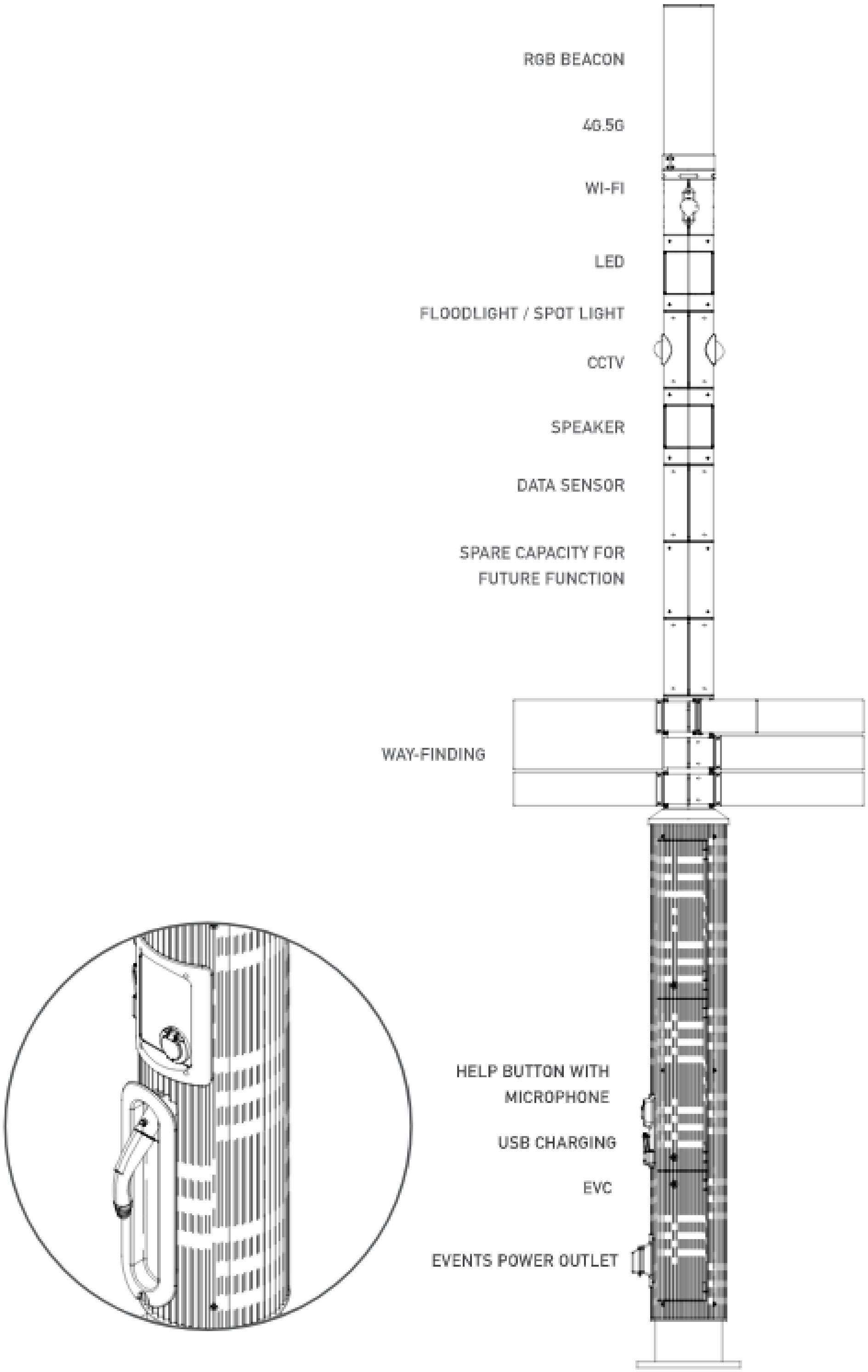
POI#1 access hole to be installed on Remora Road.

Proposed location located on the corner of Remora Rd and Kingsford Smith Drive



View looking towards Proposed access-hole from Curtin Avenue West.

Appendix 2 – ENE-HUB Modular Smart Node



http://ene-hub.com/smartnode/

Figure 19 - Example of Smart Poles


POI#1
POI#2
Legend
POI Locations
Duct Count Primary New (4 x P100)
Duct Count Existing Carrier (2 x P100)
Duct Count Secondary New (2 x P100)
Primary Network Path New
Secondary Network Path Existing Carrier
Secondary Network Path New


POI#1
POI#2
Alternate Option
Legend
POI Locations
Duct Count Pri
Duct Count sec carrier
Duct Count Carrier
Duct Count New
Primary Network Path New
Secondary Network Path New
Secondary Network Path Existing Carrier