




Manual – Underground Distribution Schemes Manual

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1 PURPOSE

This manual sets out the requirements for every Underground Distribution Scheme (UDS) relating to a subdivision that is to be supplied with electricity from Horizon Power's network; and governs the relationship, between:

- Horizon Power (HP) as network operator, whose network a UDS will become a part of; and
- Every developer, as the proponent of a subdivision, who requires a UDS to provide a reticulated supply of electricity to the lots in a subdivision. This manual also informs land developers, designers and installation contractors of the policies, processes, practices and requirements and equipment relating to the provision of electricity services in all new subdivisions on Horizon Power's network.

This manual has not been compiled as a training resource nor a standard work technique document.

The most recent version of this document may be found at <http://horizonpower.com.au/contractors-suppliers/contractors/manuals-and-standards/> under the *Manuals* tab.

1.1 Scope

This manual covers the following broad topics related to subdivision:

- Objectives
- Land development and approval process
- Charges
- Design requirements
- Construction administration
- Construction requirements

The electricity infrastructure of subdivisions is integrated into Horizon Power's network. It is either built by Horizon Power, or built by the developer and subsequently gifted and owned by Horizon Power. Electricity infrastructure works consist of, but are not limited to the following:

- LV electricity reticulation (within a subdivision)
- HV network extension and distribution (within a subdivision)
- Street lights (within a subdivision)
- Distribution substations (within a subdivision)
- HV and LV head works installed, modified or removed outside a UDS boundary (to enable electricity to be supplied to the subdivision)
- Upgrade of existing distribution substations outside a subdivision (for that subdivision)
- Rebuilding or relocating existing HV power lines (that run through the proposed subdivision)

1.2 Application

This manual explains the administrative, design and installation requirements to provide electricity infrastructure for subdivisions. It is to be used by Horizon Power staff, developers, and parties contracted by the developer (designer, engineer, design organisation, and key construction personnel as described in section 9.1).

This manual shall be applied to:

- New subdivisions
- Changes to existing subdivisions (including amalgamations), and
- Network augmentation projects related to subdivisions.

2 REFERENCED DOCUMENTS

2.1 Horizon Power Documents

1. *Decorative Fixtures, Signs, Banners and Artwork on Horizon Power Assets A02-00-PG-0145-2011*, available at <http://horizonpower.com.au/contractors-suppliers/contractors/manuals-and-standards/> under the *Guidelines* heading
2. *Design Information Package Standard Template Form*, CS10# 1063402, (this is a Horizon Power internal document and may be provided on request)
3. *Distribution Construction Standards Manual*, available at <http://horizonpower.com.au/contractors-suppliers/contractors/manuals-and-standards/> under the *Distribution Construction Standards Manual* heading
4. *Distribution Design Catalogue HPC-1DC-07-00[01-16]*, available at <http://horizonpower.com.au/contractors-suppliers/contractors/manuals-and-standards/> under the *Distribution Design Catalogue* heading
5. *Distribution Design Manuals HPC-5DC-07-000[1-5]*, available at <http://horizonpower.com.au/contractors-suppliers/contractors/manuals-and-standards/> under the *Distribution Design Manuals* heading
6. *Distribution Commissioning Test Sheets HPC-4DL-07-00[01-34]*, available at <http://horizonpower.com.au/contractors-suppliers/contractors/manuals-and-standards/> under the *Distribution Commissioning Test Sheets* heading
7. *Distribution Substation Manual HPC-5DA-07-00[01-11]*, available at <http://horizonpower.com.au/contractors-suppliers/contractors/manuals-and-standards/> under the *Distribution Substation Manuals* heading
8. *Electrical Safety Standards*, available at <http://horizonpower.com.au/contractors-suppliers/contractors/manuals-and-standards/> under the *Field Practice Manuals* heading
9. *Guideline – Operations Requirements to Add Assets HPC-2NJ-01-0001-2015*, CS10# 1553347, (this is a Horizon Power internal document and may be provided on request)
10. *Guidelines for Excavation Work near Horizon Power's Underground and Overhead Electrical Network*, available at <http://horizonpower.com.au/contractors-suppliers/contractors/manuals-and-standards/> under the *Field Practice Manuals* heading
11. *Information – Electrical Design for Distribution Networks: After Diversity Maximum Demand HPC-3DC-07-0001-2012*, available at <http://horizonpower.com.au/contractors-suppliers/contractors/manuals-and-standards/> under the *Information* heading
12. *Horizon Power Environmental Conditions HPC-9EJ-01-0001-2013*, CS10# 2302921, (this is a Horizon Power internal document and may be provided on request)
13. *Horizon Power's Environmental Policy*, available at <http://horizonpower.com.au/about-us/overview/governance/environment/>
14. *Maximum Transformer Sizes for Non Interconnected Systems*, available at <http://horizonpower.com.au/contractors-suppliers/contractors/manuals-and-standards/> under the *Information* heading

15. *Network Testing and Commission Standards*, available at <http://horizonpower.com.au/contractors-suppliers/contractors/manuals-and-standards/> under the *Field Practice Manuals* heading
16. *Policy: Distribution Subdivision HPC-11AH-07-0002-2015*, available at <http://horizonpower.com.au/contractors-suppliers/contractors/manuals-and-standards/> under the *Policies* heading
17. Request to Work Near Horizon Power Overhead and Underground Electrical Networks (Work in the Vicinity) Application Form, available at <http://horizonpower.com.au/contractors-suppliers/working-near-powerlines/working-near-powerlines/>
18. *Standard – Distribution Power Lines in the Vicinity of Conductive Installations*, CS10# 2926006, (this is a Horizon Power internal document and may be provided on request)
19. *Subdivision Tracking Sheet*, CS10# 3094430, (this is a Horizon Power internal document and may be provided on request)
20. *Substation Installation Technical Requirements* available at <http://horizonpower.com.au/contractors-suppliers/contractors/manuals-and-standards/> under the *Substation Installation Requirements* heading
21. *Template Certificate of Completion Issued by Horizon Power*, CS10# 3337762, (this is a Horizon Power legal template document and will be provided on request)
22. *Template Certificate of Completion Issued by Customer*, CS10# 3338749, (this is a Horizon Power legal template document and will be provided on request)
23. *Template Handover Certificate Issued by Horizon Power*, CS10# 3338048, (this is a Horizon Power template document and will be provided on request)
24. *Template Handover Certificate Issued to Horizon Power*, CS10# 3337850, (this is a Horizon Power template document and will be provided on request)
25. *Underground Cable Installation Manual*, available at <http://horizonpower.com.au/contractors-suppliers/contractors/manuals-and-standards/> under the *Manuals* heading
26. *Unmetered Supply Policy*, available at <http://horizonpower.com.au/contractors-suppliers/contractors/manuals-and-standards/> under the *Policies* heading
27. Works Management Process (Operations Division), CS10# 1628325, (this is a Horizon Power internal document and may be provided on request)

2.2 Horizon Power Links

28. *Developer's Authorisation and DIP Request*, available at <http://horizonpower.com.au/contractors-suppliers/contractors/forms-fees-and-charges/>
29. *Enquiries and Contacts*, available at <http://horizonpower.com.au/contact/>
30. *Forms, Fees and Charges*, available at <http://horizonpower.com.au/contractors-suppliers/contractors/forms-fees-and-charges/>

31. *Map of Horizon Power's Service Area*, available at <http://horizonpower.com.au/about-us/overview/our-service-area/>

2.3 External Links

32. Australian Standards
- AS/CA S009 *Installation requirements for customer cabling (Wiring rules)*
 - AS 1289 *Methods for testing soils for engineering purposes*
 - AS/NZS 2053 *Conduits and fittings for electrical installations*
 - AS 2067 *Substations and high voltage installations exceeding 1 kV a.c.*
 - AS/NZS 3000 *Wiring Rules*
 - AS/NZS 3835 *Earth potential rise—Protection of telecommunications network users, personnel and plant*
 - AS/NZS 3845 *Road safety barrier systems*
 - AS/NZS 4026 *Electric cables—For underground residential distribution systems*
 - AS 4702 *Polymeric cable protection covers*
 - AS/NZS 4853 *Electrical hazards on metallic pipelines*
 - AS/NZS 7000 *Overhead line design—Detailed procedures*
 - AS/NZS 61000 *Electromagnetic compatibility (EMC)*
 - HB 264 *Power Quality*

The above are available at <http://www.saiglobal.com/online/>

33. *Utility Services in Road Reserves – Policy and Guidelines*, published by Main Roads Western Australia, available from <https://www.mainroads.wa.gov.au/OurRoads/Pages/WorksOnMainRoads.aspx>
34. *Energy Safety*, available at <http://energysafety.wa.gov.au>
35. *Dial Before You Dig*, available at <http://www.1100.com.au/>
36. *LVDESIGN* (Western Power software), available at <http://www.westernpower.com.au/land-developers-designers-software.html>
37. *Western Australian Distribution Connections Manual*, available at <http://www.westernpower.com.au/local-governments-guidelines-and-manuals.html>

2.4 Legislation

38. Electricity (Licensing) Regulations 1991
39. Electricity (Network Safety) Regulations 2015
40. Land Administration Act 1997
41. Occupational Safety and Health Act 1984
42. Occupational Safety and Health Regulations 1996
43. Planning and Development Act 2005
44. Planning and Development Regulations 2009
45. Strata Title Act 1985

46. Strata Title General Regulations 1996
47. Transfer of Land Act 1893
48. Work Health and Safety Bill 2014 (draft at time of writing this document)

2.5 Government Department Documents

49. *Main Roads Lighting Design Guideline for Roadway and Public Space*, published by Main Roads Western Australia, available at <https://www.mainroads.wa.gov.au/BuildingRoads/StandardsTechnical/RoadsAndTrafficEngineering/RoadsideItems/light/Pages/lighting-design.aspx>
50. *Main Roads Utility Providers Code of Practice for Western Australia*, published by Main Roads Western Australia, available at https://www.mainroads.wa.gov.au/BuildingRoads/StandardsTechnical/RoadsAndTrafficEngineering/RoadsideItems/GuidelinesforRoadsideServices/Pages/Utility_Providers_Code_of_Practice_for_Western_Australia.aspx
51. *Model Subdivision Conditions*, available at <http://www.planning.wa.gov.au/Model-subdivision-conditions.asp>
52. *Utility Services in Road Reserves – Application and Approval Guidelines*, published by Main Roads Western Australia, available at <https://www.mainroads.wa.gov.au/OurRoads/Pages/WorksOnMainRoads.aspx>
53. *Western Australian Electrical Requirements*, available at <http://www.commerce.wa.gov.au/publications/wa-electrical-requirements-waer>
54. *Western Australian Planning Commission Development Control Policy DC 1.3 Strata Titles*, available at <http://www.planning.wa.gov.au/Development-control-policies.asp>
55. *Western Australian Planning Commission Development Control Policy DC 2.6 Residential Road Planning*, available at <http://www.planning.wa.gov.au/Development-control-policies.asp>
56. *Western Australia Planning Commission Planning Bulletin 33 Rights-Of-Way Or Laneways In Established Areas – Guidelines*, available at <http://www.planning.wa.gov.au/publications/1069.asp>
57. *WorkSafe Western Australia Code of practice – Excavation*, available at <http://www.commerce.wa.gov.au/publications/code-practice-excavation>
58. *WorkSafe Western Australia Guideline for Work in the Vicinity of Overhead Power Lines*, available at <http://www.commerce.wa.gov.au/publications/guidelines-work-vicinity-overhead-power-lines>

3 DEFINITIONS

Acceptance of Quote

This is the acceptance by the developer of the quote made by Horizon Power to provide electricity infrastructure. This takes place upon Horizon Power receiving a signed Quote Acceptance Form from the developer.

ADMD

After Diversity Maximum Demand is an estimate of electrical load (typically per customer) that accounts for the variability of peaks between customers. It allows summation of the load of a number of customers.

Approved

Granting of approval in writing.

Asset Handover

The process where Horizon Power accepts the assets installed under Option B into the Fixed Asset Register, and they become property of Horizon Power.

Asset Manager

The person responsible for the condition and performance of Horizon Power's supply infrastructure. Based in Esperance, Carnarvon, Karratha, Port Hedland, Broome and Kununurra.

Cable Jointer

A person approved by Horizon Power to undertake the type of cable jointing and termination described.

Cable Laying Supervisor

A person approved by Horizon Power to supervise cable installation work described.

Capital Works Management (CWM) process

CWM provides scheduling and works management of small customer funded or internally funded Capital projects. The solution makes use of standard Ellipse functionality.

Clear Zone

The horizontal width of space available for the safe use of an errant vehicle, which consists of the verge area. A more detailed definition may be found in AS/NZS 3845.

Contract

The formal agreement between the developer and the contractor for the execution of the required works.

Contractor

The person or organisation that has a contract with the developer for the installation of construction works.

Construction Project Manager (CPM)

The officer appointed by Horizon Power as Horizon Power's representative to whom all site contractual and technical matters are referred.

Contract Completion

Is the completion of works such that they can be used for the purpose for which they were designed, without restriction. Under many contracts, this is referred to as 'Practical Completion'.

Cross-sectional Area (CSA)

The cross-sectional area, typically of an electric cable. When used to describe multicore cables, this size description applies to one of the active conductors.

CSD

Cadastral Survey Data, a file containing cadastral records.

CS10

Content Server 10, a document management system used internally by Horizon Power for document control.

Distribution Design Catalogue (DDC)

This catalogue identifies how the majority of distribution structures are assembled for ordering purposes.

Design Conformance Review (DCR)

Review by Horizon Power to ensure all design documents and certificates are included in the engineer's submission; and all design parameters provided by Horizon Power through the Design Information Package have been incorporated into the UDS design.

Design Information Package (DIP)

A package of distribution network information unique to a UDS or development, provided by Horizon Power, that a developer shall use in the preparation of its design for the new electricity infrastructure.

Designer

The person engaged by the Developer or employed by a Designer organisation to design Electricity Infrastructure for a UDS.

Design Organisation

The organisation engaged by the Developer to design Electricity Infrastructure for a UDS.

Developer

The person or organisation that develops land as owner or by any other authority and provides electricity infrastructure for a UDS.

District Substation

A substation that has LV connections to the street mains. Horizon Power owns and is responsible for all electrical equipment within the substation.

Electricity Infrastructure

All existing electrical apparatus or proposed new equipment required to be installed in any new UDS or for extension and/or reinforcement of Horizon Power's supply network.

Electrical Supply Boundary

The area defined within regional towns and communities where Horizon Power has a license to supply electricity

Ellipse

Ellipse is an enterprise asset management and enterprise resource planning application suite for management of assets and works. It is used by Horizon Power.

ENA

Energy Networks Association.

Engineer

A professionally qualified engineer (as defined by the *Electricity (Licensing) Regulations* [38]), holding a power electrical engineering specialisation, and is eligible to be a member of Engineers Australia (excluding student membership).

Freehold

The form of land title that is the least restricted. Also known as 'green title'.

Head works

Electricity infrastructure outside a subdivision boundary that is required to be installed, modified or removed to enable electricity to be supplied to a new subdivision. This infrastructure may be transmission or distribution. Head works also include technical studies and design work associated with this electricity infrastructure.

Hectare

A unit of area equal to 10,000 m².

Heritage

Land sites that are sensitive to Indigenous Culture or have significant historical value, which may require a formal clearance before any site works can commence.

HP

Horizon Power as the license holder to supply power for Regional areas.

HV

High Voltage. A voltage greater than 1,000 Volts for alternating current.

IPP

Independent Power Producer.

LGA

Local Government Authority.

LV

A voltage of less than 1,000 Volts for alternating current.

LV Design

A software program to calculate voltage drops, line loads, kilowatt losses, transformer loads and fuse reach, in underground and overhead low voltage radial networks.

MEN

Multiple Earthed Neutral Installation.

MPS

Modular Package Substation.

Native Title

Land that maybe subject to Indigenous Title claim and may require clearance.

NPER

National Professional Engineers Register

NWIS

North West Interconnected System – the electricity network in the Pilbara region of Western Australia maintained by Horizon Power.

Offer, Quote

An offer by Horizon Power to the developer setting out the costs, terms and conditions upon which the Electricity Infrastructure of a subdivision will be constructed in a conformed design.

Operational Handover

The process where the commissioning and operating authority (Horizon Power or its nominated representative, which may be the same party as the construction party) assumes control of the assets (Electricity Infrastructure and Head works) for purpose of commissioning or energisation.

Option A

Process where the Developer engages the network operator to provide all materials and carry out the construction works.

The Developer may elect to do the following:

- Trenching
- Supply and installation of ducts
- Laying of cables
- Installation of street light poles

Option B

Process where the developer is responsible for all costs including approvals, materials and labour required for the construction or installation of infrastructure within a subdivision.

PAW

Public Access Way, laneways available for trafficable use.

POS

Public Open Space, open area available to public i.e. Parks

Practical Completion

See 'Contract Completion'.

Prefer

A choice to be adopted unless circumstances justify a variation.

QA

Quality Assurance.

Regulator

Controller of Network Policy.

Restrictive Covenant

An agreement which restricts a landowner in the use of the landowner's land, for the benefit of a public authority. It applies to all subsequent owners of the land.

RMU

Ring Main Unit.

Scheme

All equipment and components associated with distribution electricity services within a subdivision.

Service Pillar

Distribution enclosure provided on a customer's property which provides a connection point to Horizon Power's electricity network for the customer's electrical installation.

Service Connection

The final part of the electricity network provided on a customer's property to which the customer's electrical installation is connected to supply.

Shall

A mandatory requirement.

Should

A requirement to be adopted unless circumstances justify a variation.

Site

The developer's workplace, which includes all parts of the development site that, are the subject of the offer and acceptance between Horizon Power and the developer for the provision of electricity infrastructure for a subdivision.

Site Superintendent / Project Engineer

The person appointed by the developer to direct and administer the contract and site construction work on his behalf.

SPUD

Single Phase Underground Distribution. Single-phase distribution of high voltage (19.1 kV or 12.7 kV), by means of screened single-core cable. Where the distribution system starts, isolation transformers are typically required. For each customer, a single-phase transformer (typically 10 kVA or 25 kVA) is required. The HV single-phase cable is looped in and out of each customer transformer.

SPURS

Single Phase Underground Rural Supply. SPURS differs from SPUD in that it allows three-way joints of the HV distribution cable, rather than looping the cable through every single-phase load transformer.

SSSI

Surveying and Spatial Sciences Institute

Standalone Community

Isolated Indigenous Town site.

Strata Title

Land title where lot boundaries are defined by building dimensions, for example multi-storey building where each floor is a lot, or terraced housing where the boundaries are the vertical divisions between buildings. Strata title lots may include area outside the building (e.g. yards in terraced houses), and are typically accompanied by common property lots for the provision of vehicle access and services.

Subdivision

The total area of land to be developed, either as a whole or in stages, including the amalgamation of lots and adjustments to lot boundaries.

Substation

A collection of switchgear and/or transformer/s on a single site (which may or may not be screened or enclosed).

Survey Strata Title

Land title similar to Strata Title, however lot boundaries are defined by survey rather than building dimensions. Strata survey title lots are typically accompanied by common property lots for the provision of vehicle access and services.

UDS

Underground Distribution Scheme.

UMS

Un-metered Supply.

Variation

Where alterations are required on the original approved UDS design.

VLF

Very Low Frequency (a means of cable testing).

WAPC

Western Australian Planning Commission.

Will

A mandatory requirement.

Working Day

Any day from Monday to Friday excluding public holidays.

Works

The electricity works associated with the provision of electricity infrastructure to the development that is the subject of the offer and acceptance.

4 INTRODUCTION

4.1 Types of Subdivisions

Subdivisions in general can be categorised into residential, rural residential, commercial and industrial subdivisions. Rural-residential subdivision developments are generally approved on land zoned 'Rural' or 'Special Rural'.

These categories can be further broken down into:

- Freehold lot subdivision
- Survey strata subdivision (also called vacant subdivision)
- Strata subdivision (also called built or building subdivision)
- Indigenous Communities

It is common to have a mixture of residential, commercial and/or industrial freehold lots in a subdivision development. Multi-storey (vertical) vacant strata subdivisions, with a mixture of commercial units at lower levels and residential apartments on upper levels, are also becoming popular.

In indigenous communities the developer is the local council or a government department representing the council. These communities usually do not have freehold or strata identified sites. Though special subdivision requirements may need to be considered, these sites will still need to follow the guidelines within this document.

4.2 Subdivision Groupings

Horizon Power classifies subdivision types into two groups that require different processes and responsibilities.

- a) Small Residential Subdivision where:
 - i) the lots are residential, and
 - ii) the number of lots being created (or amalgamated) is three or less
- b) Large Subdivision where:
 - i) the lots are residential,
 - ii) the number of lots being created (or amalgamated) is more than three, and
 - iii) any of the lots are commercial or industrial

4.3 Roles and Responsibilities

4.3.1 Developers

The developer is responsible for the design, installation and payment of all Electrical infrastructure works within a subdivision and has to pay all costs incurred by Horizon Power up to the completion and handover of the subdivision to Horizon Power. This includes:

- Site safety for the whole subdivision site.
- Carrying out the requirements of this UDS Manual for electricity infrastructure works.
- Requesting a DIP from Horizon Power.
- Obtaining all Native Title and Heritage and Environmental clearances for the subdivision approval.
- Appointing and authorising an engineer, a designer organisation, cable laying contractor, a licensed electrical contractor and a site superintendent/project engineer to carry out the electricity infrastructure works in accordance with this manual.
- Installing Electricity Infrastructure to provide reticulated supply of electricity to subdivision developments.
- Ensuring a reliable and quality electricity network is designed and is constructed for the end user customers of electricity for the life of the asset. The life expectancy of the underground asset is 65 years.

4.3.2 Horizon Power

Horizon Power is responsible for:

- Site safety at locations where electricity infrastructure works are being carried out by Horizon Power.
- Advising the WAPC and the developer of the requirements of electricity infrastructure works needed to provide reticulated supply of electricity to each lot of a subdivision.
- Carrying out Horizon Power's part of works in accordance with the quote.
- Carrying out QA work in accordance with this manual. When Horizon Power carries out QA work, it will work on the developer's workplace in accordance with the developer's site safety requirements and will comply with the directions of the developer's site safety manager.

4.4 Dispute Resolution

A formal dispute resolution path provides a mechanism allowing developers and designers to raise complaints if they find Horizon Power's service unsatisfactory. It allows repeated escalation within Horizon Power. The Energy and Water Ombudsman is also available as an independent authority to investigate complaints.

Figure 1 shows the dispute resolution process within Horizon Power.

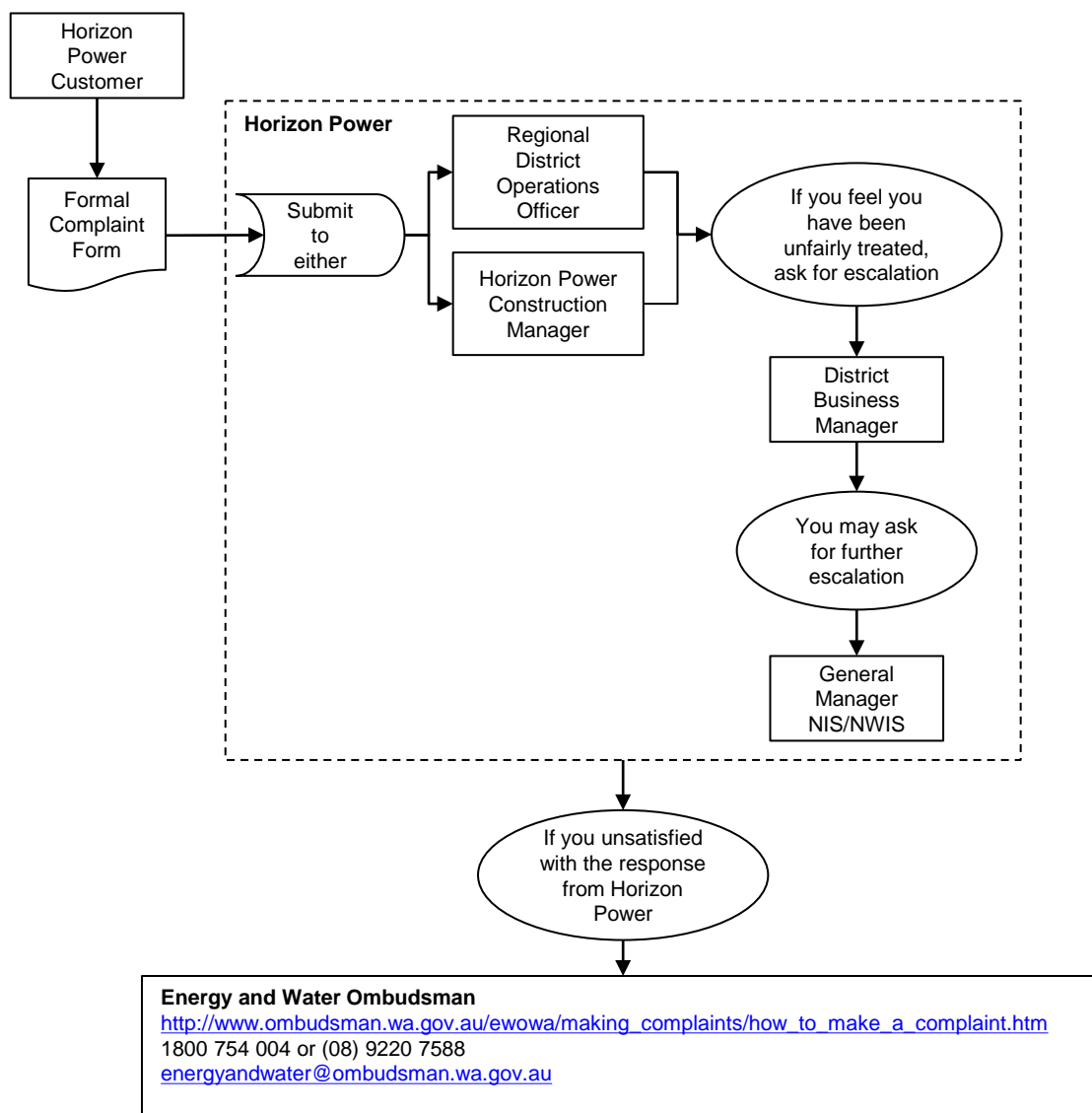


Figure 1: Dispute Resolution Process

4.5 Horizon Power Resource Centres

Broome

2 - 4 McDaniel Rd Broome WA 6725
PO Box 345 Broome WA 6725
Ph: (08) 9192 9900 Fax: (08) 9192 9901

Gascoyne and Mid West

Corner Iles Rd & Robinson St Carnarvon
WA 6701
PO Box 825 Carnarvon WA 6701
Ph: (08) 9941 6299 Fax: (08) 9941 6201

Esperance

143 Sims Street Esperance WA 6450
PO Box 148 Esperance WA 6450
Ph: (08) 9072 3400 Fax: (08) 9072 3401

Kununurra

Lot 228 Messmate Way Kununurra WA 6743
PO Box 916 Kununurra WA 6743
Ph: (08) 9166 4700 Fax: (08) 9166 4720

Port Hedland

18 Anderson St Port Hedland WA 6721
PO Box 314 Port Hedland WA 6721
Ph: (08) 9173 8281 Fax: (08) 9173 8222

Head Office

Stovehill Road
Karratha WA 6714
PO Box 817 Karratha WA 6714
Ph: (08) 9159 7250 Fax: (08) 9159 7288

Administration Centre

18 Brodie Hall Drive
Technology Park, Bentley WA 6102
PO Box 1066 Bentley DC WA 6983
Ph: (08) 6310 1000 Fax: (08) 6310 1010

5 OBJECTIVES

The Underground Distribution Scheme shall be planned, designed and constructed in a manner consistent with the objectives of safety, meeting community expectations, and creating a reliable and economic electricity network.

5.1 Safety

Safety is one of Horizon Power's core values and treated above all other values. Horizon Power is required to ensure that its network is safe, fit to supply electricity to consumers and the quality of supply meets statutory requirements. In order to fulfil the statutory requirements, the design and construction of the network extension and electricity reticulation for subdivisions shall comply with the following major design principles:

5.1.1 Safety in Design

The design scheme of a subdivision shall provide for the safe and efficient connection of all consumers' installations to Horizon Power's network. It shall meet all applicable written laws and standards particularly the requirements of *Western Australia Electrical Requirements* [53], *AS/NZS 3000 Wiring Rules*, *Underground Cable Installation Manual* [25] and the *Western Australian Distribution Connections Manual* [37]. A 'Safety in Design' process shall be followed (described in Appendix L).

5.1.2 Safety during Construction

Subdivision construction work shall be carried out in a safe manner and conform to the *Occupational Safety and Health Act* [41] and *Regulations* [42] and all applicable written laws and standards. Detailed requirements are provided in section 9.3.

5.1.3 Operational Safety

All subdivision electricity infrastructure design and construction shall conform to the *Occupational Safety and Health Act* [41] and *Regulations* [42] and all applicable written laws and standards to enable Horizon Power employees to carry out operation and maintenance in a safe manner.

5.2 Meeting Community Expectations

The developer shall ensure the network in the subdivision is designed and constructed to meet all formal and informal community expectations, such as visual and physical impact.

5.2.1 Underground Power

Underground power is typically more reliable and aesthetically pleasing to the community. It is Horizon Power's policy that all new subdivisions are required to have underground power. Exceptions are made in some circumstances, details are provided in section 8.12.

5.2.2 Three phase power

Provision of three-phase power at each customer's point of supply contributes to network versatility. Some customers may require three-phase power for high powered equipment, while others may install grid-connected inverters, requiring a rebalancing of load across the phases.

It is a requirement that all new subdivisions supply three phase power to each lot, though exceptions are made in some circumstances (as described in section 8.6.5).

5.3 Creating an Effective and Economic Network

5.3.1 Environment Management

The developer shall ensure the network in the subdivision is designed and constructed to comply with all written laws that govern environmental and Horizon Power requirements etc. This includes but is not limited to noise, clearing, soil, management, rare flora, fauna, fire safety, Native Title, Native Heritage etc.

5.3.2 Network Maintainability

The developer shall ensure that all electricity infrastructure is designed and constructed as per Horizon Power's design standards to minimise the cost of maintaining the asset for the term of its life. Important drivers to meet this objective include adherence to Horizon Power standards, and provision of complete and accurate as-constructed documentation.

5.3.3 Economic Extension

The HV network is not only extended or reinforced to meet the requirement of a subdivision, but also to meet any planned future growth over the operational life of the asset (HV cables have an operational life of 65 years). This minimises abortive or redundant works (such as replacing assets early in their life due to insufficient capacity). In this way, better value is achieved for the community served by the network.

6 LAND DEVELOPMENT PROCESS

The process of subdividing land (or modifying an existing subdivision) requires both planning approval and also cooperation from utilities. This section describes these processes and Horizon Power's involvement.

6.1 Subdivision Planning Approval

The *Planning and Development Act* [43] requires plans of subdivisions to be approved by the WAPC. Some residential strata subdivisions are exempt by the *Strata Titles Act 1985* [45], and LGA approval is instead required. Table 1 below provides the criteria for which approval is required.

Table 1: Subdivision Approval

Subdivision Type	Criteria	Approval Required
Residential Strata Subdivision	Lots are residential, and are no more than five Entire parcel of land must not exceed 2500 m ² Within a town planning scheme or gazetted town site [46], [54]	LGA, see section 6.4
Indigenous Community	No actual change to land title	LGA, see section 6.4
Large Subdivision	All other freehold, survey strata, and strata subdivisions	WAPC, see section 6.3.

6.2 Provision of Electricity for Subdivisions

For Small Residential Subdivisions, Horizon Power designs and constructs the electricity infrastructure. This is referred to as 'Option A'.

For Large Subdivisions, the developer designs and constructs the electricity infrastructure (with the exception of head works). This is referred to as 'Option B'.

For clarity, the criteria for Options A and B are shown below in Table 2.

Table 2: Subdivision Groups for Electricity Supply

Subdivision Group	Criteria	Process
Small Residential Subdivision	Lots are residential, and are no more than three	Option A, see section 6.5
Large Subdivision	Lots are residential, and are more than three, or Lots are commercial or industrial (of any quantity)	Option B, see section 6.6

6.3 Western Australian Planning Commission Approval

The *Planning and Development Act* [43] requires plans of subdivisions to be approved by the WAPC. Under the Act, the Registrar of Titles shall not create or register a Certificate of Title for land within a subdivision plan unless it has been endorsed with the approval of the WAPC.

The high level land development process for subdivisions that require WAPC approval is given in Figure 2 for the Option A process, and Figure 3 for the Option B process.

For both Option A and Option B subdivisions the WAPC process is identical. However, as discussed in Table 3 the responsibilities and internal Horizon Power processes however are different.

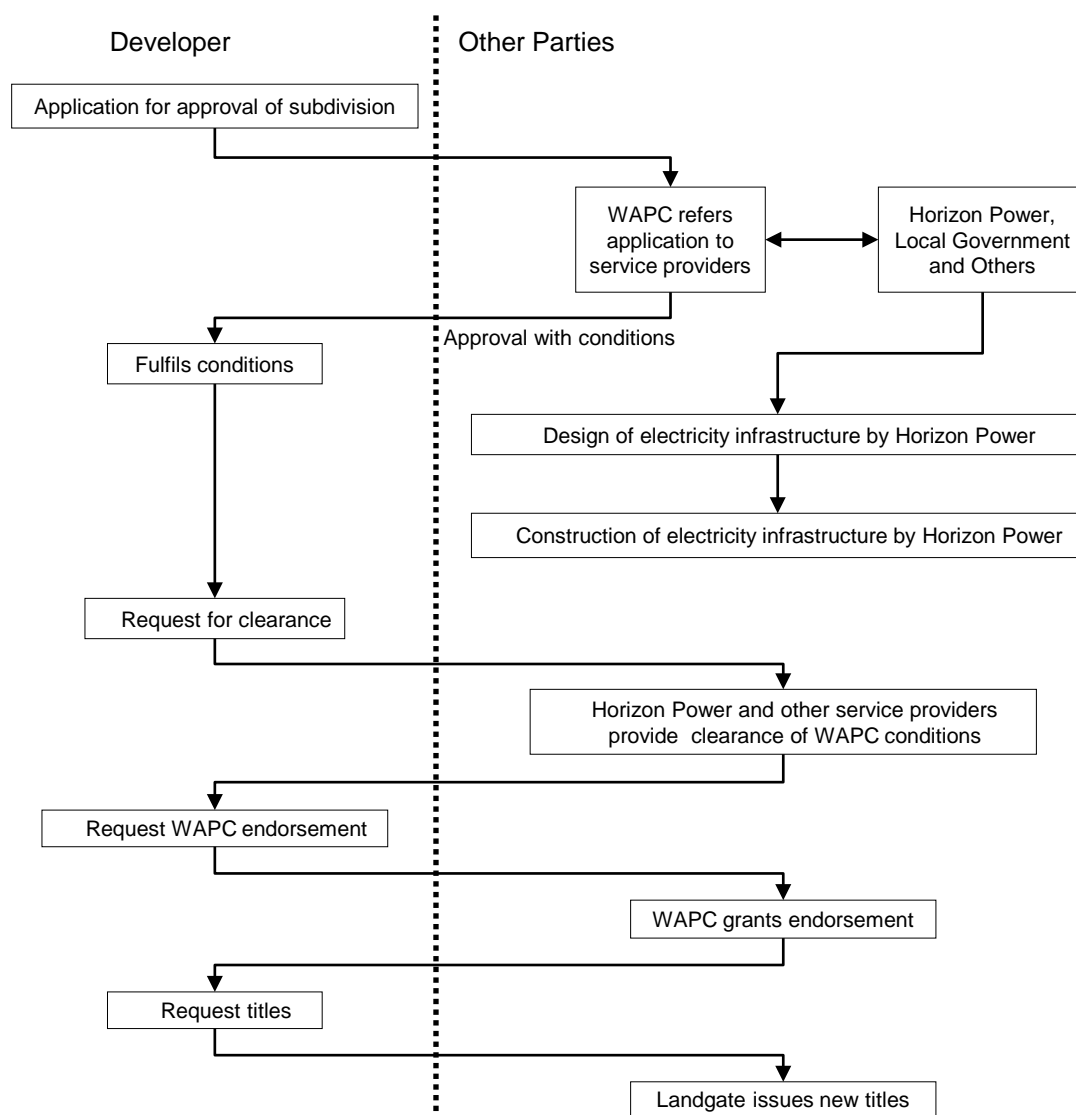


Figure 2: Land Development Process Option A

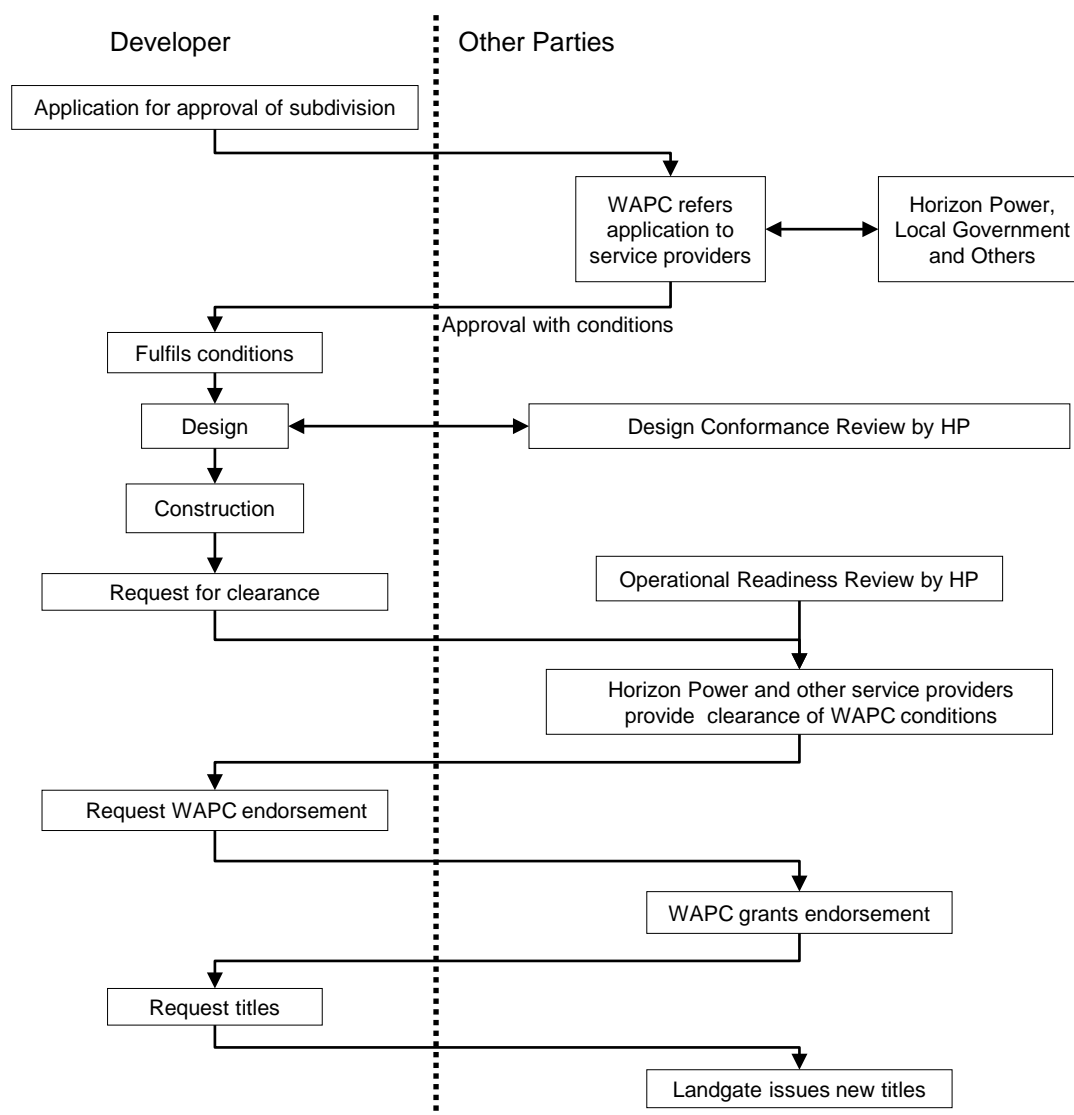


Figure 3: Land Development Process Option B

Table 3: Process Detail for WAPC Approval

Step	Action	Responsibility
Application for Approval of Subdivision	The developer submits an application form to WAPC for a subdivision development with subdivision plans and supporting documentation.	Developer
Referral for Conditions	WAPC refers the application to Horizon Power, other service providers and the relevant local government for recommendations of relevant servicing requirements.	WAPC

Step	Action	Responsibility
Setting Conditions	Horizon Power will recommend conditions on reticulation, removal of asset and easements etc. as required. Conditions set by others may also impact electricity infrastructure, for example road widening.	Horizon Power
Approval of Subdivision with Conditions	WAPC issues a consolidated set of conditions, including Horizon Power's for the subdivision to proceed.	WAPC
Fulfilling Conditions	The developer is responsible for fulfilling all conditions in the WAPC approval, including those associated with Horizon Power. The developer has a time limit for WAPC Endorsement: four years for subdivisions creating more than five lots, and three years for subdivisions of five lots or less.	Developer
Option A Design of Electricity Infrastructure	Horizon Power completes the design for electrical infrastructure.	Horizon Power
Option B Design of Electricity Infrastructure	The developer engages an electrical designer to design the electricity infrastructure to serve the subdivision development in accordance with the requirements of this Manual. The engineer or the designer will submit the design drawing to Horizon Power for Design Conformance Review (DCR).	Developer, Designer and Engineer
Option A Construction of Network	Horizon Power will construct the electrical infrastructure. The developer may elect to do trenching and/or laying of cables, and if so should advise Horizon Power of this intention.	Horizon Power
Option B Construction of Network	Upon completion of the Design Conformance Review, the developer will construct the electrical infrastructure. (Horizon Power will be responsible for interface works only.)	Developer
Request for HP Clearance	When all Horizon Power conditions have been met and all required documentation has been received by Horizon Power, the developer then sends a request for clearance to the Horizon Power Asset Manager at the local district office.	Developer, Developer's Surveyor

Step	Action	Responsibility
HP Clearance of Conditions	Horizon Power will approve clearance and endorse the plans submitted to WAPC, provided all conditions and requirements are met. A clearance certificate letter, along with the endorsed deposited plans, will be forwarded to the developer's surveyor. In a case where clearance is not provided, the surveyor will be advised of the reasons by Horizon Power.	Horizon Power
Request for WAPC Endorsement	The developer will submit plan(s) to the WAPC after collecting clearance certificates from Horizon Power, other service providers and the relevant Local Government Authority (LGA).	Developer
WAPC Endorsement	The WAPC will grant its approval of submitted plans ('deposited plans') if satisfied they are in accordance with the approved plans and all the conditions are met.	WAPC
Issuing of New Title	The developer can then apply to Landgate for new titles.	Developer and Landgate

6.3.1 Rationale for Horizon Power Conditions

As a responsible network operator and a public utility, Horizon Power may impose conditions on any subdivision application to ensure the following:

- Lots being created will have adequate underground electricity services.
- Any potential impact on Horizon Power's network, for now and the life of the subdivision is addressed.
- The extension of the network will meet all safety and legal requirements and standards.
- Suitable quality electricity supply is provided to any customer connected to the network.
- The reliability of the network is maintained or improved.

6.3.2 Model Conditions

Horizon Power will generally impose conditions on subdivision applications in accordance with Table 4 summarises the *Model Conditions* [51] available from the WAPC.

Table 4: Summary of Conditions of Subdivision Development

Subject of Condition	Summary of Conditions
Freehold title subdivision	Provision of underground electricity supply, one connection per lot
Freehold title subdivision	Provision of overhead electricity supply (where underground power is inappropriate), one connection per lot
Survey strata title subdivision	Provision of underground electricity to survey strata lots (and vacant strata lots), one connection per strata plan
Existing or future transmission/distribution network asset	Provision of electricity service supply easement.
Network infrastructure on or near to subdivision being affected	Relocation/removal/replacement of Electricity Infrastructure.
Substation sites required	Provision of land (to become Crown reserve), ceded free of cost.

When underground power is required, Horizon Power may also require conversion of existing overhead mains and consumer services to underground. Such conditions will be in accordance with Horizon Power's *Distribution Subdivision Policy* [16]. Horizon Power may recommend restrictive covenants around substations, to preserve fire safety zones from encroachment by future building activity.

In the development of subdivision conditions for approval, WAPC takes recommendations only from Horizon Power but may add or delete conditions as it sees fit after consultation with Horizon Power.

The complete schedule of model conditions may be obtained from the WA Department of Planning website [51].

6.3.3 Requirements for Clearance

Horizon Power's conditions on approved subdivision plans are only cleared after the following requirements are met:

- Submission of two copies of the deposited plan of the subdivision showing substation sites and easement required
- Compliance with other easement and/or special requirements
- Successful completion of Operational Readiness Review by Horizon Power

6.3.4 Clearance of Special Subdivision Lots

Developers will usually develop subdivisions in progressive stages. The creation of new lots in stages will result in balance lots of substantial size without underground power supply.

6.3.4.1 Balance lots in residential subdivision

Residential balance lots that can be used 'as is' shall be serviced and electricity infrastructure installed. These lots are of a similar size to those within the subdivision. Design drawings shall show servicing, and payment for the electricity infrastructure shall be made.

Where lots are substantially bigger and in Horizon Power's opinion will not be sold as is, a Letter of Undertaking shall be submitted to Horizon Power stating the developer's intention for further subdivision and development for any balance lot that is not to be serviced.

6.3.4.2 Balance lots in commercial/industrial subdivision

All commercial and industrial balance lots require financial provision for an appropriate supply as explained in section 8.5.2.

In certain situations where specific supply requirements are unknown, Horizon Power may only require the cables to be installed for clearance (where prudent, and safety can be maintained). Transformers, switchgear and other infrastructure will not be installed until the customer's requirements are known and they are ready to construct their premises.

6.3.4.3 Homestead lots

Homestead lots are part of a proposed residential subdivision development. They are usually being serviced with overhead electricity supply. In general, they should only be cleared with the whole subdivision as they will obtain underground supply via the network that will be constructed in that subdivision.

In some instances, a developer may require the clearance of homestead lots prior to the construction of the subdivision. Horizon Power will provide clearance to homestead lots subject to the following conditions being met:

- The homestead lots front an existing road where existing network connection is available.
- A *DIP Request* [28] for the subdivision has been received by Horizon Power.
- The developer provides a letter of undertaking that the underground supply of the homestead lot will be incorporated into the design of the subdivision and converted as part of the subdivision.
- The developer is to provide an undertaking as in section 6.3.4.1 for the balance of lot.
- The existing aerial supply of the homestead lot shall be converted to underground power at full cost to developers prior to clearance being issued.

6.3.5 Early Clearance for Installation Option B Project

Horizon Power does not accept Partial Bond Clearances for subdivisions on its Network.

If the developer requires early clearances for a subdivision they are to contact the District Asset Manager to discuss the issue to see if a resolution between parties can be agreed upon.

6.4 Residential Strata Subdivisions and Local Council Approval

Residential strata subdivisions (as described in section 6.3) that do not require WAPC approval instead require LGA approval (refer to WAPC development control policy No. 1.3 *Strata Titles* [54]). The simplified process is given in Figure 4 below.

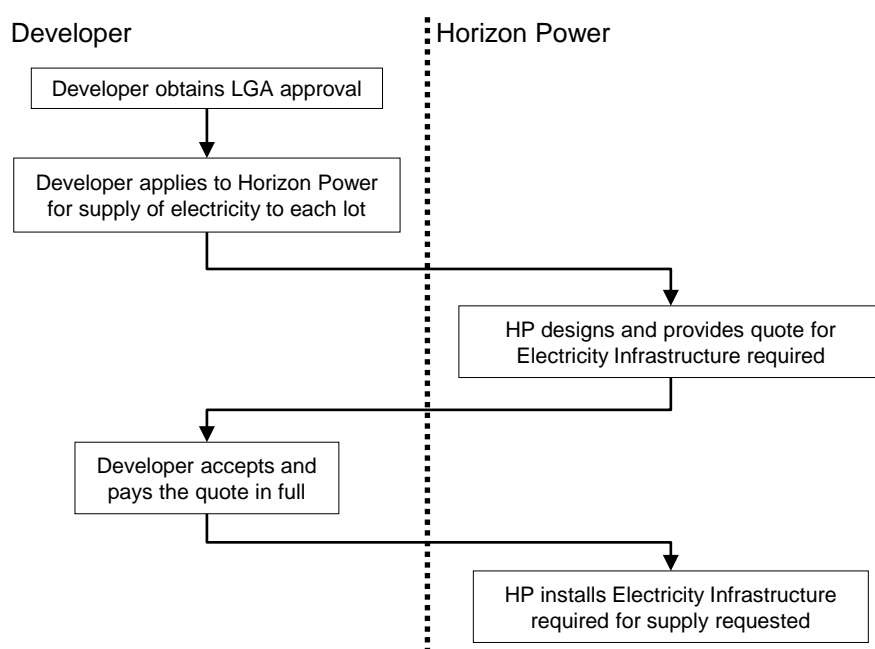


Figure 4: Residential Strata Subdivision Process Where LGA Approval Is Required

6.5 Development of Small Residential Subdivisions

For small residential subdivisions (as defined in section 4.2), the process is referred to as Option A, and Horizon Power designs and constructs the UDS. The process varies slightly depending on whether WAPC or LGA approval is required.

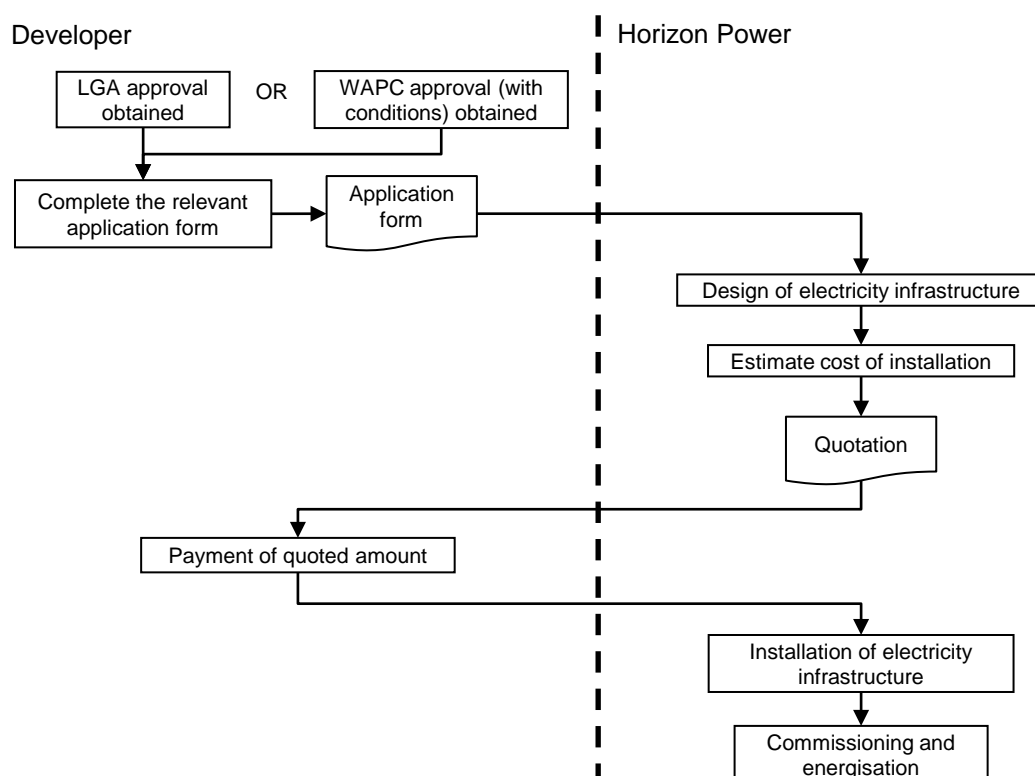


Figure 5: – Development Process for Small Subdivisions (Not more than three lots)

Table 5 explains the steps in detail.

Table 5: Process Detail for Small Residential Subdivisions

Step	Action	Responsibility
LGA approval for subdivision obtained, or WAPC approval granted with conditions	Developer to seek approval from LGA (as described in section 6.3) or approval with conditions from WAPC (as described in section 0). If applicable, Native Title and Heritage clearance is also required.	Developer and LGA/WAPC
Complete the relevant application form	The developer shall complete the <i>Application For Underground Supply in an Overhead Area</i> form or the <i>Connection Application</i> form which can be obtained from Horizon Power [30]. Return the completed form to the Horizon Power Administration Centre for processing. The application will not be processed unless the subdivision is approved by either WAPC or the LGA.	Developer

Step	Action	Responsibility
Design of electricity infrastructure	Horizon Power will create a design project and advise the developer of the reference project number. Horizon Power will carry out the design of underground power to allow cost estimation.	Horizon Power
Estimate cost of installation	<p>Horizon Power will provide a quote on the work required to meet the LGA approval, or clearance conditions of WAPC approval (as appropriate). Horizon Power provides the Developer one option to pay for the work, if the developer decides to proceed.</p> <p>Horizon Power does not charge for the initial quote. However, if requirements change or if the quote expires past the validity date for acceptance shown on the quote details, Horizon Power reserves the right to charge for any additional time spent in the preparation of a re-quote.</p>	Horizon Power
Payment of quoted amount	Developer to pay the full amount as an up-front payment.	Developer
Installation of electricity infrastructure by Horizon Power	<p>Horizon Power installs electricity infrastructure, including trenching, laying of cables and installation of pillars for the provision of underground power. Horizon Power may require up to 12 weeks from receipt of payment for the work before starting work. Once payment is received, Horizon Power will issue payment acknowledgment and appoint a CPM to schedule and oversee the construction work.</p> <p>Horizon Power will provide a service connection point in the form of a service pillar at property boundaries. Any electrical installation beyond service pillars (e.g. consumer mains) is the responsibility of landowners or the developer.</p>	Horizon Power

Step	Action	Responsibility
<i>Installation of electricity infrastructure by Developer (optional)</i>	<p><i>In some cases the developer may elect to carry out the trenching and laying of cable or cable duct.</i></p> <p><i>The developer should advise Horizon Power of its intention when requesting a Quote. This work must be in accordance with section 9 of this manual.</i></p> <p><i>Within ten working days of receipt of payment, the developer shall provide the construction program to the CPM to enable Horizon Power to program any works to be undertaken.</i></p> <p><i>Construction documentation (see section 9.4) related to the work done by the developer shall be provided to the CPM, prior to Horizon Power conducting interface works.</i></p>	<i>Developer</i>
Commissioning and energisation	Horizon Power will commission and energise the installation, and inform the Developer when the network is energised.	Horizon Power

6.5.1 Developer's Responsibility

The Developer/customer's scope of work and expenses include the following:

- a) The accurate pegging of all subdivision and lot boundaries.
- b) Prior to the commencement of any work, the developer shall ensure the finished levels at each service pillar and substation site are set and all final survey boundaries pegs are in place.
- c) Any verge reinstatement, the clearing or pruning of vegetation to Horizon Power's required safety profiles and relocation of other services, such as gas or water. Developers should liaise directly with the local council or service utility with regard to the cost of this work or repairs.
- d) Obtain all necessary and relevant clearances required, including environmental clearance, native title, aboriginal heritage, etc.
- e) Where easements or restrictive covenants are required by Horizon Power, the developer shall provide these at no cost to Horizon Power.
- f) Advise potential land purchasers of all easement locations and their proposed use and restrictions.
- g) Notify all affected parties, including other Horizon Power customers affected by the development. Where existing aerial mains are to be removed as part of the subdivision work, the developer will also be responsible for the reconnection of existing Horizon Power connected customers to underground power electrical installations beyond service pillars including consumers' main cables between service pillars and meter boards.
- h) Coordination of all other services work.

- i) Ensure the site is safe, in accordance with the *Occupational Safety and Health Act* [41] and *Occupational and Health Regulations* [42] and other Acts of Parliament, during the construction phase.

6.6 Development of Large Subdivisions

For large subdivisions (as defined in section 4.2), the process is referred to as Option B, and varies slightly depending on whether WAPC or LGA approval is required.

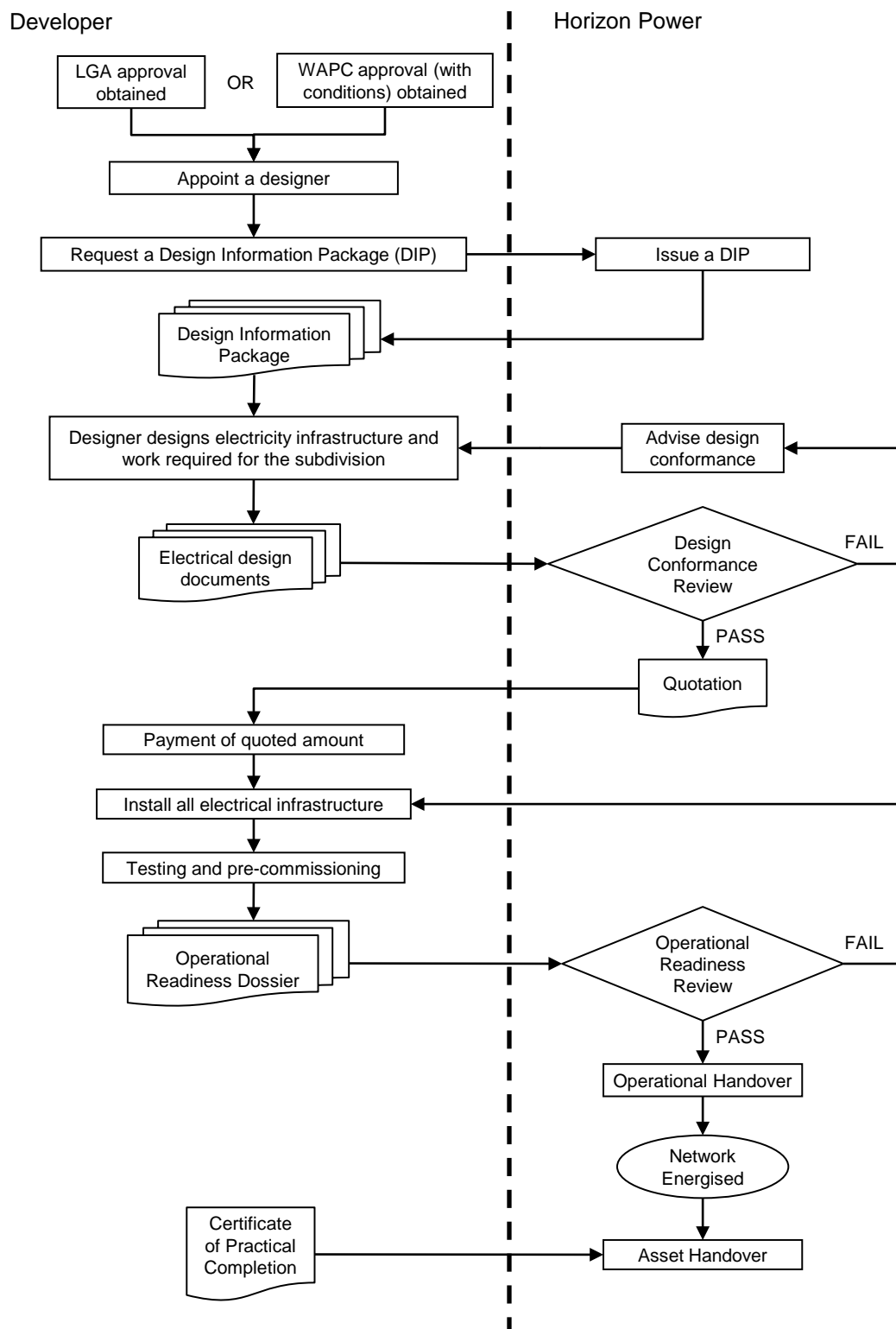


Figure 6: – Development Process for Large Subdivisions

Table 6 explains the steps in detail.

Table 6: Process Detail for Large Subdivisions

Step	Action	Responsibility
LGA approval for subdivision obtained, or WAPC approval granted with conditions	Developer to seek approval from LGA (as described in section 6.3) or approval (with conditions) from WAPC (as described in section 0). If applicable, Native Title and Heritage clearance is also required.	Developer and LGA/WAPC
Developer appoints a designer	Developers are responsible for providing UDS designs by engaging designers to develop them. The developer shall appoint an engineer to check and certify that UDS designs meet the requirements of this Manual.	Developer
Developer requests a Design Information Package (DIP)	<p>The developer will contact Horizon Power to register responsibility for the design of an UDS for a subdivision and request a Horizon Power DIP through the electronic mailbox, in accordance with the requirements in section 8.3. This contact may follow feasibility studies undertaken by the developer based on information provided by Horizon Power.</p> <p>The developer shall complete the <i>Developer's Authorisation and DIP Request</i> [28] that provides details of the appointment of the design organisation, the designer and the engineer of the UDS design; and authorises Horizon Power to directly deal with them.</p>	Developer
HP issues a DIP	Horizon Power will review the proposed subdivision, prepare the DIP, and issue it electronically to the designer organisation. The DIP will inform the designer of the District and the District contact for all enquiries. The DIP is described in greater detail in section 8.3.	Horizon Power
Design electricity infrastructure required for the subdivision	On receipt of the DIP, the designer will proceed to prepare the UDS design. At this stage, it may be necessary for the developer to negotiate with the Horizon Power District contact to specify which, if any, part of the work is to be undertaken by Horizon Power, e.g. headwork extensions. The designer will then incorporate this into the design. This work will be reflected in the final Quote from Horizon Power.	Designer

Step	Action	Responsibility
Designer submits an electrical design documents for Design Conformance Review	When the UDS design is completed, the engineer will check and certify that it meets the requirements of this manual and all applicable written laws. The engineer or designer will then electronically submit the design to the Horizon Power District contact for a DCR in accordance with section 8.4.	Designer
Design Conformance Review	<p>Horizon Power will perform a DCR to ensure all design parameters have been incorporated into the design process and all required design documents and certificates have been submitted.</p> <p>Note: This review does not constitute approval of the design. Horizon Power takes no responsibility for the accuracy or correctness of the UDS design or associated Bill of Materials.</p> <p>Horizon Power will advise the designer whether the design is accepted or rejected. If it is rejected, Horizon Power will give the reasons of non-conformance, the designer is then required to redesign and resubmit the scheme.</p>	Horizon Power
HP issues quote	<p>Once the design has passed conformance, Horizon Power will issue a quote for Option B Installation to the Developer of the UDS design.</p> <p>This Quote will include DIP fees, DCR fees, network interface work costs and quality assurance charges.</p> <p>The formal offer from Horizon Power in the form of a quote is valid for a period of sixty (60) calendar days from the date of issue. If payment has not been made within that validity period, the project file will be closed unless a request is received from the developer to have the project deferred for a defined period. If the developer advises the project is to be reactivated within this period a revised quote will be prepared for acceptance.</p> <p>If the developer fails to respond within this period the project file will be closed and the developer will be responsible for payment to Horizon Power for all fees incurred prior to the quote being submitted.</p> <p>The developer is required to make a new submission if the project is re-activated beyond this period.</p>	Horizon Power

Step	Action	Responsibility
Developer accepts and pays for quote	<p>If the Developer accepts the Quote, and provides full payment up-front.</p> <p>Errors in design that affect Horizon Power works which result in under-ordering of materials and under-quoting for the installation of equipment will result in Horizon Power issuing an amended quote or additional quotation to the developer.</p>	Developer
Installation of electrical infrastructure	<p>The Developer is responsible for advising all other authorities or groups involved in the underground services e.g. Telstra, NBNCo, local councils, etc., and issuing drawings as necessary.</p> <p>Installation will be coordinated through the nominated Horizon Power resource centre.</p> <p>Construction of electricity infrastructure in accordance with this manual and the approved design documents.</p> <p>The developer will be responsible for purchasing materials, except those required for the work agreed to be undertaken by Horizon Power. Horizon Power will order the materials for infrastructure works that it is to provide, after payment of the quotation.</p>	Developer
Testing and pre-commissioning	The Developer shall carry out tests and pre-commissioning, such that equipment is ready for commissioning. The Developer shall compile the Operational Readiness Dossier in preparation for the Operational Readiness Review.	Developer
Operational Readiness Review	The electricity infrastructure is inspected, and relevant as-built documentation is reviewed for completeness. It is then commissioned and energised for normal operational use. This is described in greater detail in section 9.11.	Horizon Power
Operational Handover	The electricity infrastructure is energised and is operated for normal use by Horizon Power. This is described in greater detail in section 9.12.	Horizon Power
Asset Handover	The electricity infrastructure assets become Horizon Power assets. A Certificate of Completion is issued, and the defect liability period starts. This is described in greater detail in section 9.14.	Horizon Power

6.6.1 Developer's Responsibilities

The developer's scope of work and expenses include the following:

- a) The developer shall engage and appoint a design organisation to design the electrical reticulation of the subdivision and represent the developer in all matters relating to the design. They shall meet the requirements described in section 8.1.
- b) The developer shall appoint an engineer, with the qualifications and responsibilities described in section 8.1.
- c) The developer shall appoint a site superintendent/project engineer, to assume the responsibilities described in section 9.1.1.
- d) The developer shall engage qualified personnel to carry out construction of the subdivision, as described in section 9.1.
- e) The developer is fully responsible for ensuring that the designer and designer organisation, the site superintendent/project engineer and installation contractors fulfil their responsibilities during the design and construction phases. The developer has the ultimate responsibility for meeting Horizon Power's requirements.
- f) Where easements or restrictive covenants are required by Horizon Power, the developer shall provide these at no cost to Horizon Power.
- g) All necessary and required civil works.
- h) Advise potential land purchasers of all easement locations and their proposed use and restrictions.
- i) The developer is responsible for notifying, negotiating with and obtaining agreement and approval from all parties, including other Horizon Power customers affected by the subdivision work. Where existing aerial mains are to be removed as part of the subdivision work, the developer is responsible for reconnecting existing Horizon Power customers to underground power and all associated costs. Where Electricity Infrastructure is to be installed in a road reserve, the developer shall obtain the approval of the relevant road authority.
- j) The developer is responsible for all Native Title and Heritage clearance required for the installation of the subdivision and proposed Horizon Power head works.
- k) The developer shall notify, negotiate with and obtain agreement of the parties affected on the removing of vegetation from neighbouring properties and/or road reserves arising from the work associated with a UDS in a subdivision.
- l) Providing Horizon Power with 'As Constructed' drawings and 'As Constructed' records.
- m) Supply, installation and testing of all cables, joints, terminations and equipment within in the subdivision, including jointing and termination to existing Horizon Power cables and equipment, in accordance with this manual.
- n) Providing equipment that meets Horizon Power's technical requirements.
- o) Supplying and installing street lights.

- p) Providing required documents for Operational Readiness (these documents make up the Operational Readiness Dossier)
- q) Providing Horizon Power, in writing, with a 12 month warranty for all equipment, installations and civil works. This period begins at Asset Handover.

6.6.2 Horizon Power's Responsibilities

Horizon Power is responsible for:

- a) Providing a DIP (and if appropriate, information for preliminary feasibility studies) necessary to allow the developer's designer to design the UDS scheme.
- b) Reviewing the developer's DCR submission.

Note: This is not an approval or endorsement of the design. That is the responsibility of the Engineer.

- c) Handling technical and construction matters with the developer's representatives through the Construction Project Manager (described in section 9.1.2).
- d) Carrying out quality assurance audits at key stages of installation and testing.
- e) Horizon Power may witness any tests performed by the developer's installation contractor and/or perform its own tests prior to take over of the works.
- f) Carry out head works for connection to the Horizon Power Network.
- g) Conduct the Operational Readiness Review.
- h) Take over control of the installation (Operational Handover).
- i) Take ownership of the asset (Asset Handover).

7 CHARGES

7.1 Head works

All Head works required to supply power to a subdivision shall be fully funded by the developer.

Head works are all works required to be undertaken by Horizon Power on/to the existing supply network outside of a UDS boundary in order for the UDS to proceed.

Head works include but are not restricted to the following:

- a) The relocation of existing assets, being transmission or distribution assets, from their current location.
- b) The modification of existing assets, being transmission or distribution assets, at their current location.
- c) Technical studies and design works associated with new transmission or distribution lines.
- d) The installation of new assets (transmission or distribution).

The developer is advised to consider these additional costs in the feasibility study stage of developments.

Note, in urban fringe, remote and country areas, there may be constraints on the existing network such as network capacity and geographical distance from a zone substation and Native Title & Heritage issues. These can have a significant effect on the cost of extending and reinforcing distribution networks. These costs can be substantially higher than would be experienced for a similar level of reinforcement within a Regional Network.

7.2 Subdivision Charges for Option A Schemes

Small Residential Subdivisions (as defined in section 4.2) are Option A schemes, and the developer will be charged the full cost of the design and construction of all electricity infrastructure extensions.

Where no extension is required and the subdivision is to be supplied off an existing underground or overhead network, a pole-to-pillar installation fee will apply. There may however be instances where such subdivisions are beyond this scope, i.e. existing supply needs to be extended to supply the subdivision and an actual cost applies. The developer is to contact Horizon Power to confirm pricing arrangements and to obtain the latest pole-to-pillar charge form [30].

Horizon Power will not accept:

- a) The same developer/owner submitting a pole-to-pillar application (which is titled *Application for Underground Supply in an Overhead Area*) for an adjacent lot within the previous three years
- b) A company, organisation, person or group of persons progressively seeking pole-to-pillar connections for an area that should be developed as a standard underground residential subdivision.

7.3 Subdivision Charges for Options B Schemes

Large Subdivisions (as defined in section 4.2) are Option B schemes. The full cost of electricity infrastructure, head works, to supply the subdivision is charged directly to the developer. The developer is responsible for trenching, cable laying and civil works in accordance with the installation requirements within the subdivision (Option B) (refer to section 9).

The latest subdivision charges are shown in Horizon Power Charges [30].

The charges indicated in the above document are minimum charges assuming designers use Horizon Power's software and standard presentation of designs. Horizon Power reserves the right to charge additional sums for designs, drawings, and calculations and study results not presented in the format as given in Table 9.

7.4 Existing Overhead Distribution Lines

The cost of all work associated with relocating or undergrounding distribution power lines, including vegetation clearing and the cost for provision of easements, etc., is the responsibility of the proponent. However, in some cases the replacement of an aging overhead line with underground construction may result in a partial cost benefit to Horizon Power. Where Horizon Power determines that this is the case it will contribute to the cost of underground construction, equivalent to the partial cost benefit.

7.5 Clearance Charges

There is no charge on the initial submission of a request for clearance of conditions. However, resubmission of a request for clearance, resulting from insufficient or incorrect detail in the original application, will incur a charge [30].

7.6 Additional Charges and Conditions

The charges contained in the formal offer are provided on the basis that all necessary information has been provided by the developer and unless otherwise specified, the following assumptions have been made on work to be carried out by Horizon Power:

- All Horizon Power work will be undertaken within normal working hours unless otherwise specifically stated in the quote. The developer may request Horizon Power to carry out quality assurance inspections and witness any tests after hours (additional costs will apply).
- The site is readily accessible by a two wheel drive vehicle.
- Site plans without contours marked shall be assumed to be level.
- Site access is on a continuous basis. Site access and conditions are not detrimental to Horizon Power employees' or contractors' ability to work in an efficient, productive and safe manner.
- The work-site is a green field site and clear access is available to trench on the allocated alignment without obstruction from other services, vegetation, Utilities etc.
- All trenching is carried out in sandy soils free of rock. Additional costs apply if found to be in hard soils, rock etc.
- All trenching is able to be carried out by machine.

- Reinstatement is based on minimum green field reinstatement to contour level. All other reinstatements are the responsibility of the developer.
- Trenches are level and accurately follow the allocated alignment resulting in minimum cable lengths.
- All survey information, including boundaries, is accurate.
- Lot boundaries as shown on the pre-calculated plan are correct.
- Electrical demand allocations are as shown on the design drawings. These are calculated on the basis of either information provided by the developer or Horizon Power standard values.

Any additional costs arising from deviations in these assumptions will be charged to the developer. If any of the above assumptions are not applicable, Horizon Power shall be notified in writing to enable the calculation of new charges and avoid delays.

Changes to the original subdivision layout, land use, zoning or the project staging may result in design changes and will incur additional charges to the developer.

7.7 Redesign Charges

The amount of additional expenses incurred by Horizon Power will reflect the design changes being requested and the time that these changes occur with respect to the development. The developer should refer to the appropriate Horizon Power contact in writing as soon as possible to ascertain the impact on the project costs. If installation has started the developer will be responsible for all costs incurred by Horizon Power including all administration costs as a result of a design change.

7.8 Project Cancellation Charges

Should the developer decide not to proceed with the project after receiving an official quotation from Horizon Power, the developer will be required to reimburse Horizon Power for services rendered. These costs include but are not limited to:

- DIP fees
- Conformance fees
- Administration costs

7.9 Refunds

If a project is cancelled at the developer's request during construction, full payment made will be refunded less all non-recoverable costs (including material, administration and/or labour incurred) by Horizon Power.

Once a project has been completed, a refund is not available.

8 DESIGN REQUIREMENTS

This section informs designers of Horizon Power's policies and requirements for the design of the Electricity Infrastructure in underground distribution network in subdivisional developments.

All UDS designs shall comply with the *Electricity (Network Safety) Regulations* [39], Horizon Power's requirements, this manual, any other relevant standards and information given in the DIP.

8.1 Requirements for Design Expertise

Designer organisations shall employ or engage engineers and designers with the following minimum qualifications and experience:

8.1.1 Engineer Qualification, Experience and Responsibilities

- a) Shall be in the discipline of Electrical Engineering with proven experience in subdivision electrical distribution design and shall be registered as a professional engineer on the National Professional Engineer Register (NPER).
- b) Shall be appointed by and responsible to the developer.
- c) Shall have Professional Indemnity (PI) insurance of no less than \$10 million. Where the Engineer's PI insurance is already covered by the policies of professional liability insurance of the designer organisation a separate PI insurance is not required.

The engineer is responsible for:

- d) Approving and overseeing the design of all electricity infrastructure in each UDS.
- e) Certifying UDS designs comply with the requirements of this manual and all applicable written laws, and
- f) Ensuring that a UDS design is safe to construct and connect to Horizon Power's network.

8.1.2 Designer Qualification, Experience and Responsibilities

A designer shall have the following qualification and experience:

- a) Formal training in electrical engineering with at least a certificate in Electrical Engineering from a nationally accredited institute in Australia or suitable electrical trade qualification.
- b) Experienced in electrical distribution design.
- c) Proficient in drafting skills, preferably Micro station.
- d) Shall also be competent in the application of design software, of LV Design and Flick Plus available on Western Power's website.

The designer is responsible for:

- e) Designing the UDS in accordance with all applicable written laws and the requirements of this manual.

- f) Providing any information required by Horizon Power to process the DIP and DCR, including site formation and design information from the developer's civil engineer and surveyor.
- g) Preferably attend pre-start meeting on site and resolve any site issues arising from the construction of UDS in a subdivision development.

8.1.3 Design Organisation Requirements and Responsibilities

The Designer Organisation:

- a) Shall employ an engineer and designer/s to design the electrical reticulation of subdivisions.
- b) Shall be authorised in writing by the developer to represent it in all matters relating to the design of electricity infrastructure for subdivisions.
- c) Is responsible to the developer.

This section has been written so that either the designer or engineer within the organisation can represent the developer of a subdivision development in all matters relating to the design and construction of the UDS. This authorisation shall be signed by the developer. This includes but is not limited to:

- d) Representing the developer of a subdivision development in all matters relating to the design and construction of UDS. This authorisation shall be signed by the developer.
- e) Inspecting the site prior to designing the UDS to check any particular site requirements are included in the UDS design
- f) Communicating the requirements of the developer to Horizon Power
- g) Communicating the requirements of Horizon Power to the developer
- h) Notifying all concerned parties, including other Horizon Power customers affected by the development of a subdivision
- i) Obtaining all relevant clearances and approvals required for the UDS including the works to be carried out by Horizon Power, including environmental, Native Title, Aboriginal Heritage etc., and providing them to Horizon Power
- j) Obtaining approval from local government, other service providers (such as Main Roads WA, NBNCo, and Telstra) and other affected parties (such as other Horizon Power customers)
- k) Providing Horizon Power with electronic 'As Constructed' drawings of the UDS (in Microstation format, or PDF prints of Microstation drawings) along with all completed/filled out datasheets for the equipment (e.g. RMU, cable, pillar, transformer etc.)

8.2 Information for Feasibility Studies

Consultants or designers may request information to allow them to carry out a preliminary feasibility study. An Electric Office map of the existing surrounding HV and LV networks may be sufficient for this rather than a DIP.

Horizon Power will provide an Electric Office map and charge the fee shown in section 7.3. If more information is required, the standard DIP will then be prepared and the appropriate fee charged.

Due to the nature of electricity distribution systems, the surrounding HV and LV network can change significantly with time. The change of the network may result in variation of the cost of providing supply extensions to subdivision developments. This variation may be significant. Accordingly, Horizon Power will not accept any responsibility for variations between the developer's budget estimate and firm quotations, nor for any direct or indirect consequent impact on the developer's costs. Costs estimated by Horizon Power shall not be taken as actual costs.

8.3 Design Information Package (DIP)

8.3.1 Request for DIP

When requesting a DIP, the developer shall provide all of the information shown in Table 7, in electronic format:

Table 7: Required DIP Request Information

TITLE	DESCRIPTION
Project Name	Name of the subdivision, e.g. Thomson's Lake Stage 1
Developer's Name	Who is the developer?
Location Plan	Showing nearby roads and map number, town and grid reference for the development site from a cadastre survey data.
WAPC Number	If the WAPC number is not available at the time of requesting a DIP, the developer shall provide it to Horizon Power prior to the submission for DCR. Survey diagrams are not essential at this stage.
Number and Type of Lots	Split into residential, commercial and industrial lots respectively.
Proposed Design Loading ADMD's	This will assist the network planning study. Horizon Power will specify the preferred design ADMD in the DIP if it considers that the proposed design ADMD is not suitable.
Letter of Authorisation	Letter from the developer appointing the designer and/or designer organisation and the engineer of the subdivision/s and authorising such to deal directly with Horizon Power as their representative.
Payment guarantee for DIP & DCR fees	This is the Letter of Acceptance of responsibility for payment for DIP and DCR fees if the project does not proceed.
Number of stages	For large subdivision development with more than one stage, usually in green field development.
Time frame of development	Especially for subdivisions with a large number of stages. This will assist the network planning study.

TITLE	DESCRIPTION
Concept plan (electronic format)	For green field subdivisions with a large number of stages a comprehensive concept plan is to be provided when the DIP for the first stage is requested, For any subsequent stage, the designer is required to send a DIP request with an updated subdivision plan, which also shows the design of the previous stages. Horizon Power will provide a project number for each stage

8.3.2 DIP Content

Horizon Power will provide designer organisations with a DIP in electronic format.

This will contain information unique to a scheme or stage of development. The designer will use this within the framework of this manual, to complete the scheme design.

The DIP, along with the design information within the UDS or other relevant manuals, is to be used as the basis of the design.

The DIP is valid for six months from date of issue. If the scheme does not proceed within this validity period, the designer shall re-apply for a DIP. The DIP will consist of the information given in Table 8:

Table 8: Design Information Package

TITLE	DESCRIPTION
DIP Letter	Detailing conditions and design requirements that apply. It also includes a reference number for future correspondence and drawing numbering.
DIP Drawing (.dgn, .pdf)	Provides the following: Details of existing HV system, e.g. cable size and type, entry and exit points at boundary of development. Details of existing transformer sizes and switchgear types, locations, cable route, etc. Details of existing LV cables, including sizes and types and interconnection points. Three phase fault level. Any undergrounding or relocation of overhead systems required within the development and/or on surrounding boundary roads, if required. Any other works Horizon Power requires to be done as part of the project.
Electric Office map LV (.pdf)	Electric Office map showing surrounding LV network and Horizon Power interconnection points

TITLE	DESCRIPTION
Electric Office map HV (.pdf)	Electric Office map showing surrounding HV network and Horizon Power interconnection points
LV Design files (.lvd)	LV Design files of existing network if required
Surrounding subdivision Design Drawings (.dgn, .pdf)	Design drawings of previous subdivision stages surrounding the development, if available and required
WAPC.pdf	Subdivision approval letter with conditions from WAPC
General	Any other relevant information, e.g. cyclonic ratings.

For any changes to the information contained in the DIP, written approval from Horizon Power shall be obtained before they can be included in the design.

8.4 Design Conformance Review (DCR)

When submitting a design drawing (including a revised drawing) for DCR the designer is to provide the entire document in electronic form in the appropriate format, as shown in Table 9:

Table 9: Submission Requirements of Design for DCR

Document Name	Format Required & Detail
Cover Letter	PDF format.
UDS Design Drawing	Microstation DGN and PDF
LV Volt Drop Assessment Report	LV Design File or other format approved by Horizon Power.
Voltage Flicker Assessment Report	Motor Data in format approved by Horizon Power.
Bill of Materials Option B (see Note 1 below)	TXT file based on the Distribution Design Catalogue manual created from Micro station
Designer Organisation's authorisation	A statement (in PDF format) authorising Horizon Power and any of its contractors or other parties to use the UDS design drawings as it sees fit, and to provide the UDS design drawings to the developer.
NPER Engineer Certification/Check Sheet (see Appendix D)	PDF format
NPER Engineer's certificate of \$10M Professional Indemnity (PI) Insurance	PDF format (Note: The certificate of PI insurance may be submitted on annual basis.)

Document Name	Format Required & Detail
Letters of approval including environmental approval from local government, Indigenous and other service providers as required.	PDF format
Other certificates as required, e.g. substation retaining wall certificate.	PDF format
Cadastre Survey Data file to expedite the incorporation of information into Horizon Power Distributed Facilities Information System (DFS). (see Note 2 below)	Cadastre Survey Data file based on latitude/longitude coordinate system (preferred system); however, MGA (Map Grid of Australia) will also be accepted.

Note 1:

The Bill of Materials shall cover the materials to be used in the subdivision. It is to be based on compatible units contained in Horizon Power's *Distribution Design Catalogue* [4] to conform.

Note 2:

- The Cadastre Survey Data (CSD) file should only include the pre-calculated cadastral plan of the current subdivision stage where Horizon Power asset are to be installed.
- If the CSD file is not provided with the submission for DCR, it is to be provided to Horizon Power through the electronic mail box to the Horizon Power District contact at least five working days prior to operational readiness review for Option B subdivisions. The CSD file is required to be input into Horizon Power's GIS data base (Electric Office) so that the necessary switching and commissioning program can be produced for the energisation of the subdivision.

8.4.1 Submissions with Approved Non Standard Equipment

Horizon Power requires developers to use only standard equipment approved by Horizon Power. Non-standard equipment may be used only with approval by Horizon Power.

8.4.2 Environmental and Aboriginal Considerations

The Developer shall investigate and manage environmental impacts and Aboriginal issues associated with a subdivision.

If Horizon Power is to undertake work within or for the subdivision, the developer is to provide copies of its environmental approvals where those approvals may cover Horizon Power work.

Horizon Power's Environmental Policy [13] shall be adhered to.

8.5 Load Calculation

8.5.1 Design Load

Design load shall be calculated using the after diversity maximum demand (ADMD).

For guidelines regarding the ADMD values for each district and diversity factors, refer to *Information – Electrical Design for Distribution Networks: After Diversity Maximum Demand HPC-3DC-07-0001-2012* [11].

For rural subdivisions Horizon Power may specify an ADMD in the DIP.

8.5.2 Non-Residential, Three Phase, Diversified Loads

For these loads, the developer shall use average load kVA/hectare values e.g. commercial and light industrial estates, unless otherwise known.

The current minimum design requirement for these loads is 200 kVA/hectare.

The above value is based on a horizontal development, e.g. single storey building. If the development is likely to be a multi-level development, the minimum design value will also depend on the total usable floor space and the type of usage. Please consult the local Asset Manager to obtain the design ADMD value to be used.

(To obtain the load kVA, multiply the kVA/hectare figure with the area of the lot, in hectares.)

8.5.3 Single Phase, Non-Diversified, Discrete Loads

For loads such as street lights and pumps, the developer shall use maximum load kVA values, e.g. from the name-plate rating, equipment specifications or by measurement.

To obtain the maximum kVA value for a single phase load, using the kW rating and the power factor, use the following formula:

$$\text{Single Phase kVA} = \frac{kW}{\text{powerfactor}}$$

8.5.4 Three Phase, Non-Diversified, Discrete Loads

For these loads, the Developer shall only use maximum load kVA values calculated in accordance with the guidance given in AS/NZS 3000 e.g.:

- **High schools:** as specified by designer or electrical consultant or a minimum of 600 kVA.
- **Primary schools:** as specified by designer or electrical consultant or a minimum of 250 kVA.
- **Neighbourhood shopping centres:** obtain the load kVA based on a minimum load density of 200 kVA/hectare, or as specified by designer or electrical consultant.
- **Large shops/business centres:** as specified by designer or electrical consultant.
- **Pumps and other large 3-phase fixed equipment:** obtain from equipment name-plate or specifications.

8.5.5 Motor/Pump Starting

Dependent upon the size and location of the electrical motor, starting restrictions may apply and is different for each district. The developer shall contact Horizon Power to seek confirmation regarding the largest size of motor that can be installed in each district.

Designers shall assess the voltage flicker for motor starting as described in section 8.6.2.

The developer's designer/consultant shall ensure the proposed motor starting requirements are acceptable, prior to the connection of the motor.

Where the subdivision affects the existing and/or proposed pumps of Water Corporation, the designer shall obtain actual pump starting and full load operating details from Water Corporation. The designer is to provide this data to Horizon Power for verification.

Designers shall calculate the voltage fluctuations of the network in the subdivision and shall include the result in the submission for DCR.

8.6 Power Quality

The developer shall ensure that the design scheme provides connected customers with a quality of electricity supply within the limits below.

8.6.1 Voltage Level

Under no-load and full-load conditions, the voltage level shall be within:

- For low voltage (i.e. 240 V single phase or 415 V three phase) – plus or minus 6% of the nominal voltage at the point of supply
- For high voltage customers (i.e. 6.6 kV, 11 kV, 22 kV and 33 kV three phase) – plus or minus 10% of the nominal voltage at the point of supply

8.6.2 Voltage Fluctuations (Flicker)

Designers shall assess the voltage fluctuation (flicker) for motor starting in accordance with AS/NZS 61000 (parts 3.3, 3.5, 3.7 and 11), HB 264 and the Horizon Power *Distribution Design Manual Volume 1 – Quality of Electricity Supply* [5]. The latter document specifies the following flicker planning limits:

Table 10: Planning Flicker Limits

Parameter	LV (415 V)	HV (≤ 35 kV)	HV (>35 kV)
Pst	1	0.9	0.8
Plt	0.8	0.7	0.6

Horizon Power reserves the right to impose customer specific flicker emission limits, these will be provided as part of the DIP.

8.6.3 Voltage Distortion (Harmonics)

Designers shall assess the voltage distortion (harmonics) in accordance with AS/NZS 61000 (parts 3.2, 3.4, 3.6 and 3.12) and the Horizon Power *Distribution Design Manual Volume 1 – Quality of Electricity Supply* [5]. The latter document specifies the following harmonic planning limits:

Table 11: Planning Harmonic Limits

Harmonic Order (h)	Harmonic Voltage Limit (%)	Harmonic Order (h)	Harmonic Voltage Limit (%)	Harmonic Order (h)	Harmonic Voltage Limit (%)
5	5	3	4	2	1.6
7	4	9	1.2	4	1
11	3	15	0.3	6	0.5
13	2.5	21	0.2	8	0.4
17	1.6	>21	0.2	10	0.4
19	1.2			12	0.2
23	1.2			>12	0.2
25	1.2				
>25	$0.2 + [0.5 \times (25/h)]$				
Limit of total harmonic distortion: 6.5%					

Horizon Power reserves the right to impose customer specific harmonic emission limits, these will be provided as part of the DIP. The designer may choose to use methods or software to carry out the evaluation and assessment, as long as they are approved by Horizon Power.

8.6.4 Voltage Imbalance

Single-phase loads should be balanced across the three phases, to minimise voltage imbalance.

8.6.5 Network Reliability

The developer shall ensure the subdivision electricity infrastructure is designed to provide Horizon Power's network customers with a reliable supply of electricity by:

- a) Where overhead reticulation is used within the subdivision, and the subdivision is in a cyclonic area, and the number of customers is equal to or greater than 50:
 - i) Redundant HV connection (points of supply to the subdivision) are required, and
 - ii) Either a HV intertie between connection points, or a HV ringmains network between the two connection points.
- b) Where either underground or overhead reticulation is used within the subdivision, and the number of customers is equal to or greater than 500 customers or load total ADMD is greater than 2 MVA:

- i) Redundant HV connection (points of supply to the subdivision) are required, and
- ii) Either a HV intertie between connection points, or a HV ringmains network between the two connection points.

Horizon Power shall advise whether or not the subdivision lies in a cyclonic area in the DIP, using the Horizon Power Environmental Conditions [12].

8.7 Head Works

Network capacity at each lot of a subdivision may be limited by the existing capacity of the network. The developer may be required to reinforce the network to achieve the design capacity of its proposed electricity infrastructure in the subdivision.

With the exception of transmission infrastructure, all head works required to provide electricity to a subdivision will be underground where possible. However Horizon Power may consider the extension of the overhead distribution network on a short term basis across vacant land to the subdivision, provided that the developer gives an assurance that the vacant land will be developed into a subdivision within 10 years.

8.7.1 Technical Studies

The developer shall consult Horizon Power at the subdivision development planning stage to ensure that Transmission and Distribution infrastructure reinforcement is considered. As Horizon Power localities are supplied from isolated power stations there may also be a requirement for the developer to contribute towards technical studies (e.g. generation capacity study, fault level studies, protection grading studies etc.).

8.7.2 Zone Substations

Major subdivisions, e.g. multiple stage large residential subdivisions and large industrial subdivisions for resources processing plants, may have substantial power requirements of over 4 MVA. These subdivisions would require new transmission and distribution infrastructure, including a new zone substation and new transmission lines to provide the network capacity needed to supply the subdivision. The developer shall ensure the site for the zone substation is provided at no cost to Horizon Power. Additionally, major upgrades to the existing HV network (e.g. construction of a new feeder) may be required to service these subdivisions. The developer shall meet the cost for all network augmentation.

It should be noted that the need for a new zone substation will vary with different subdivisions and their locations.

8.7.3 Future Transmission Power Infrastructure

Currently, the installation of underground electricity infrastructure is limited to the distribution system. While the technology exists for underground transmission power lines, i.e. power lines operated at 66 kV and above, it is generally cost prohibitive.

An area built with the distribution network underground may need to route an overhead transmission line through, or install a new zone substation in the area.

Horizon Power will normally advise the developer of the potential line corridor and zone substation at the time of subdividing. The developer shall inform prospective land purchasers of Horizon Power's future development. Where Horizon Power has advised of future transmission equipment the developer shall ensure this is shown on all marketing documents and other materials for prospective land purchasers.

8.7.4 Generation Capacity

In stand-alone Towns and Communities the power is either produced from a Horizon Power owned and operated power station or one owned and operated by an IPP (Independent Power Producer). New subdivisions of considerable size may trigger the requirement to expand the capacity of the local power station. If it is found there will be insufficient generation capacity the developer should account for the generation capacity upgrade in their project schedule.

It is the responsibility of the developer to account for associated delays in the project schedule.

8.7.5 Availability of Three-Phase Power

Head works may include extension of the three-phase network to the subdivision site. Where the nearest electricity infrastructure is single-phase:

- a) If three phase power is available within 500 m of a subdivision, the developer shall extend that HV three phase power to the subdivision to enable the reticulation of LV three phase power to each lot within the subdivision. Refer to the *Western Australian Distribution Connections Manual* [37].
- b) If HV three phase power is no more than one kilometre away from the subdivision, Horizon Power may elect to extend its HV three phase system to within 500 m of a subdivision. The developer will then be required to extend the last 500 m to the subdivision. Refer to the *Western Australian Distribution Connections Manual* [37].
- c) If HV three phase power is more than one kilometre away from the subdivision, the developer shall extend the single-phase system (SPUD or SPURS).

8.7.6 Existing Aerial Transformers

Horizon Power will not increase the capacity of existing aerial transformers to meet the needs of large subdivisions in urban areas. Where existing aerial transformers are of insufficient capacity, underground cables, ground mounted switchgear and transformers will be installed to supply the subdivision.

8.8 High Voltage Reticulation

8.8.1 Extension of High Voltage Feeders

HV feeder cables shall be extended to meet the requirements of the subdivision and Horizon Power load growth plans. The Developer shall ensure that the following high voltage cables are used for all UDS works. In particular circumstances Horizon Power may require the use of feeder cables larger than those listed here; these will be specified in the DIP.

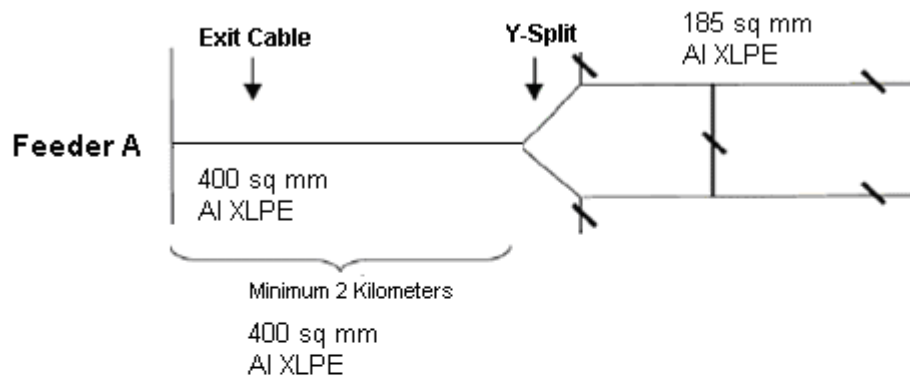
The use of cables of a different size than those below shall not be used unless explicit prior written consent has been obtained from Horizon Power's nominated engineer.

All Cables and joints described within this manual shall have termite protection installed in the manufacturing process or as an additional application as approved by Horizon Power.

HV feeder cables shall also be designed either in a 'Y' or 'radial' configuration (see Figure 7) so that:

- a) Within a minimum length of exit cable from the zone substation or upstream of the Y split, the HV feeder cable shall be single-core 400 mm² Al/XLPE/PVC/HDPE for 22 kV networks, and single-core 185 mm² Al/XLPE/PVC/HDPE cable for 33 kV networks. The minimum length of exit cable and the location of the Y-split from the zone substation are dependent of the type of feeder, load size, distance of the load centre from the zone substation and the surrounding network configuration. However it shall not be less than 2 km in the case of both Y-split and Non Y-Split configuration.
- b) The Y-split is normally placed at an uncongested point where the feeder cable is split into two separate radial spurs via a ring main unit. HV cable of 185 mm² Al/XLPE/PVC/HDPE is used once the feeder cable has been split for the remainder of the feeder.
- c) Interconnection between the HV feeder cables is close to where the feeder splits and at the end of the feeder where appropriate.
- d) All backbone feeders through new subdivisions shall be single-core 400 mm² Al/XLPE/PVC/HDPE cable for 22 kV networks, and single-core 185 mm² Al/XLPE/PVC/HDPE cable for 33 kV networks. A backbone feeder is primarily a radial feeder emanating directly from a zone substation which supplies all the loads of the feeder, including the loads of its tee-off feeders along its length. HV feeders through a subdivision, which is of remote distance from existing zone substations and is in proximity to a proposed future zone substation, will become backbone feeders emanating from that zone substation.
- e) The above configurations are an example for large systems within Horizon Power networks. section 8.8.1 identifies cable types permitted. Horizon Power reserves the right to require larger cable sizes than those listed here due to planning requirements.

Y SPLIT FEEDER CONFIGURATION



NON Y SPLIT FEEDER CONFIGURATION

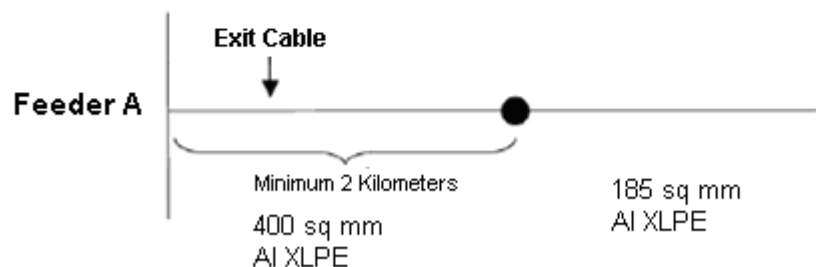


Figure 7: – Y Split and non Y Split Feeder Configurations for 11 and 22 kV Networks

8.8.2 HV Cables between RMUs and Drop-Out Fuses

The following cables shall be used:

- 11 kV and 22 kV networks: 3x1 core, 35 mm² aluminium XLPE insulated to 24 kV, PVC/HDPE sheathed cables
- 33 kV networks: 3x1 core 50 mm² aluminium XLPE insulated to 36 kV, PVC/HDPE sheathed cables

8.8.3 Ring Main Units

A high voltage Ring Main Unit (RMU) shall be used where a HV feeder splits into two or more branches to feeds transformers and/or HV customers. Horizon Power does not allow the use of HV breach joints on its networks. Standard RMUs available are of size 2+1, 2+2, 2+3, 3+0, 3+1, 3+2 and 4+0. The following examples show how this notation is used:

- 2+1 Ring Main Unit – Three-Way Switchgear Unit; two automatable switch disconnectors plus one fuse switch
- 2+2 Ring Main Unit – Four-Way Switchgear Unit; two automatable switch disconnectors plus two fuse switches

8.8.4 Connection to Overhead Network by Drop-Out Fuse

In existing residential areas with an overhead network where there is no potential for further network extension the transformers may be supplied via pole top drop out fuses.

The developer will need to contact the local district Network Asset Manager for approval.

The developer will need to confirm that cables connected between drop-out fuses and distribution transformers do not exceed the critical length that would cause ferroresonance. Guidance may be found in section 4 of the Distribution Substation Manual, volume 2 [7].

8.8.5 Underground Transmission Protection Pilot Fibres

Where existing transmission protection aerial pilot fibres are to be relocated underground or are required for the development of Horizon Power's network, the underground pilot fibres shall be shown on the UDS design drawing.

The underground pilot fibres shall be designed to meet the requirements in the DIP.

Underground pilot fibres shall not be installed in conjunction with high voltage cables. An alternative cable route for pilot cables shall be planned unless specified in the DIP. In situation where it is not possible to provide an alternative route, the designer shall seek the approval of Horizon Power in writing.

Where more than one underground pilot fibre is to be installed they shall be installed in separate routes. Shared trench arrangements for multiple underground pilot fibres shall not be used unless prior approval is obtained in writing from Horizon Power.

8.9 Substations

8.9.1 Substation Sites

When the installation of a substation (including package substations, transformers and switchgear) is required, the relevant clauses contained in the Horizon Power documents *Western Australian Distribution Connections Manual* [37], *Substation Installation Technical Requirements* [20] shall apply.

The developer is responsible for advising potential land purchasers of all substation sites and their proposed use. As a minimum, substation sites shall be shown on the developer's sales brochures.

Substation sites are to be located on public owned land (e.g. road reserve extension or public open space). Where available, parks are preferred over road reserve. The developer is responsible for providing land for all substation sites. Substation sites shall also be located in the 'kink' of road reserve and as close as possible to the road boundary line extension along normal gazetted public road reserve. Where the developer chooses to locate substation sites on POS, it shall take the following into consideration:

- Suitable location of sites within POS.
- Size, shape, contour and dimensions of POS.
- Community standards of health, safety and amenity.

Substation sites:

- a) Cannot be lower than the finished level of both the subdivision lots and the adjacent road carriageway, so that water cannot drain towards the substation. Note that in rural areas, the finished level of road carriageway is usually higher than that of the surrounding areas to allow natural draining of water from the carriageway.
- b) If the site is higher than the finished level of the subdivision, retaining walls with access steps or suitable batters shall be provided by the developer at no cost to Horizon Power. The batters shall have an incline of no less than ratio 1:6, and shall meet both the appropriate Australian Standard and the requirements of the LGA. Where retaining walls or batters are required, the land requirement of the site shall be increased to include retaining walls or batters.
- c) Where civil site level and retaining walls are required, details shall be shown by the designer on the UDS design drawing for DCR. A signed certificate of verification by a professional civil engineer registered on the NPER verifying that the substation retaining walls are structurally sound for their purposes is required.
- d) Require an area no less than one metre in front of and below the level of doors within the substation to enable the doors to be opened without obstruction.
- e) Shall not be located in the vicinity of a water course or open drains.
- f) Shall not be located on a transmission easement or distribution cable easement.

The substation site civil and land requirements are shown on drawings in the *Distribution Substation Manual* [7]. For rural subdivisions where 63 kVA substations are used, the foundations shall be a standard concrete pipe culvert as per the DSM.

Horizon Power may specify the location of substation sites of a subdivision based on strategic operational requirements in the DIP.

8.9.2 Substation Transformers and Sizes

Transformer types and sizes, to be installed in different types of subdivisions shall meet the design criteria specified in the *Maximum Transformer Sizes for Non Interconnected Systems* [14].

Depending on the size and subdivision layout, in rural subdivisions it is often more cost effective to install multiple small (63 kVA) transformers rather than larger 160 kVA transformers. The same site size and layout as the 160 kVA non MPS will apply (Horizon Power drawing DSM 3-26 Sheet 1 of 3 [7]), so that the transformer can be upgraded easily in the future.

To minimise voltage drop on the low voltage network, the transformer shall be close to the centre of the load.

8.9.3 Substation LV Connections

The transformer low voltage side is fitted with 3-phase 100 A fuses and distribution bar. A maximum of two LV feeder cables can be connected back-to-back to the distribution bar and a maximum of 4 x 25 mm² service cable can also be connected to the distribution bar.

Horizon Power prefers the connection of one 240 mm² LV feeder cable from the distribution bar to a nearby uni pillar and then splitting into 2 x 185 mm² LV feeder cables for reticulation where LV feeder length is not exceeding 500 m (see section 8.11.1). The cabling cost can be greatly reduced by using 120 mm² cables.

The developer will not be permitted to connect consumer's main cables directly to the distribution bar. They shall always be connected via service pillars at the property boundaries or point of supply.

8.10 High Voltage Earth Systems

8.10.1 HV Earths near Telecommunications Equipment

No HV earths (e.g., substation and HV cable pole terminations) or HV cable joints shall be located within 15 m of any telecommunications equipment or pits. Earths are to be installed in accordance with AS/NZS 3835 *Earth Potential Rise—Protection of Telecommunications network users, personnel and plant*.

Where this is not possible, the telecommunication utility's written approval to allow HV earths to be installed within 15 m of their equipment pits shall be obtained by the developer and shall be provided to Horizon Power. An earthing design shall be carried out by a qualified electrical engineer to the requirements of AS/CA S009 section 6.1.3. If the telecommunication utility requires the relocation of their equipment as an alternative, all costs to do so will be the responsibility of the developer.

8.10.2 HV Cables and Earths in Proximity of Metallic Pipes

Earth Potential Rise (EPR) between the HV earth and metallic Pipes can occur during an earth fault. Alternating current on a HV power line or cable can induce a low frequency voltage on a parallel metallic pipe and is called Low Frequency Induction (LFI).

Where HV power lines, cables and earths are to be installed in proximity of a metallic Pipeline, the Designer shall assess EPR and LFI on the Structure in accordance with Horizon Power's *Standard – Distribution Power Lines in the Vicinity of Conductive Installations* [18] and obtain approval from the Structure owner (e.g. Including but not limited to Alinta and WaterCorp) of the locations of HV cables and earths.

The Designer shall provide the assessment report and the pipeline owner's approval to Horizon Power.

Potential electrical hazards are to be assessed in accordance with the Australian Standard AS/NZS 4853. Pipelines assessed in the EPR and LFI study are classified as Category B pipelines in accordance with the Standard. These pipelines are located completely underground with facilities that are only accessible to authorised personnel.

8.10.3 HV Earths near Traction Railway

Traction rail power in Western Australia is (at the time of writing) one of two types:

- 25 kV single-phase system, with 1:1 booster transformers; and
- 50 kV 180° two-phase system, with negative feeders and 1:1 autotransformers.

There is (at the time of writing) no direct current traction rail present in Western Australia, and so stray direct currents need not be considered.

The earth system associated with a railway (consisting of the rails, and earth electrodes at substations and transformer sites) is part of a separate electrical system (traction power) than the mains supply. The potential of the system may rise in response to electrical faults with traction power. Because of this, HV cable joints, substations and the associated earth electrodes and grading rings shall not be placed within 15 m of railway corridors.

8.11 Low Voltage Reticulation

8.11.1 LV Feeder Design Criteria

The developer shall ensure its designer uses the following design parameters to design each LV feeder in a UDS design:

- a) Voltage variations at the customer's point of attachment (i.e. service pillar) shall be within the quality limits in section 8.6.1.
- b) Conductor current carrying capacity shall be greater than the design ADMD of the feeder
- c) The summed currents of all outgoing feeders of a transformer does not exceed the name plate continuous rated current of the transformer
- d) LV feeders shall be protected by LV fuses installed immediately after the transformer, e.g. transformer fuse board or contiguous panel with the transformer. The fuse rating for residential street circuits cannot exceed 315 Amps at any substation. Downstream fusing shall not be used to extend the length of a feeder backbone.
- e) LV fuse selection shall be as per section 7.3 of the *Distribution Design Manual Volume 4* [5], for satisfactory protection, the prospective phase-to-neutral current at the end of the LV feeder should be at least three (3) times the LV fuse current rating. This is the methodology is used in the *LV Design* software where the 'fault level view' functionality is used.
- f) Interconnection of LV feeders shall be done when feeders are separated by not more than two lots. These lots are outside the subdivision but will be developed in the future. They shall be interconnected by underground cables running in Horizon Power allocated cable alignment along the road boundary of the undeveloped lots via suitable open points.(i.e. Uni-pillar).
- g) In order to provide operational flexibility, uni-pillars shall be installed for every 16 lots along the complete length of every LV feeder. These should be wired to allow use as open points, to improve supply reliability.
- h) Where the LV feeder terminates, unless terminated in fixed equipment, the cable shall be terminated within a uni-pillar.

Designers shall use the *LV Design* software package to ensure the voltage drop, line currents and fuse protection are adequate for each circuit and shall include the zip file of the software design results in the submission for DCR.

Where load types are known in industrial or commercial subdivision the designer shall also provide a voltage flicker assessment of any known equipment which may be classified as unstable loads within the lots in the DCR submission.

Designers may choose to use other methods or software to carry out the evaluation and assessment, provided they are approved by Horizon Power.

8.11.2 LV Feeders Terminating in Cul-de-sacs

A second LV feeder shall be made available at the entrance of the cul-de-sac. This second feeder shall be a feeder with either

- a) No load connected, or
- b) Spare capacity which can pick up not less than 25% of the design load of the cul-de-sac feeder.

Mini pillars shall be used for service connections as per normal LV feeders, however uni pillars are still required:

- c) If the number of lots in the cul-de-sac does not exceed 16, a uni pillar shall be installed at the entrance
- d) If the number of lots is more than 16, multiple uni pillars shall be installed, one for every 16 lots of the cul-de-sac

8.11.3 LV Cables

The Developer shall ensure that the following low voltage cables are used for all UDS works, unless otherwise specified by Horizon Power in writing.

All cables and joints described within this manual shall have termite protection installed in the manufacturing process or as an additional application as approved by Horizon Power.

The copper screen neutral shall have equivalent current-carrying capacity to the active conductors.

8.11.3.1 Mains Cables

The following cables shall be used for mains cables:

- 240 mm², 3-core, solid aluminium conductor, copper screen neutral (wave wound), 0.6/1 kV, XLPE insulated, PVC sheathed cables.
- 185 mm², 3-core, solid aluminium conductor, copper screen neutral (wave wound), 0.6/1 kV, XLPE insulated, PVC sheathed cables.

8.11.3.2 Mini Pillar Connection Cables

25 mm², 3-core, stranded copper conductor, helical wound stranded copper neutral screen, 0.6/1 kV, X-90 XLPE insulated 5V-90 PVC sheath cables (as per AS/NZS 4026) shall be used.

8.11.3.3 Street Lighting Cables

16 mm² stranded copper, XLPE insulated, helical copper wire neutral screen, PVC sheathed cables shall be used.

8.12 Underground Reticulation

The lot size determines the requirement for electricity, and also whether or not it must be underground. This is shown in Table 12 below.

Table 12: Reticulation Requirements

Lot Size	Reticulation of Electricity Required	Underground Reticulation Required	Comment
Up to and including 10 ha	Yes	Yes	
Between 10 and 50 ha	Yes	Overhead allowed with Horizon Power's approval.	Horizon Power shall be consulted. Service connection for each lot shall be a pillar.
Larger than 50 ha	No	Overhead allowed with Horizon Power's approval.	Horizon Power shall be consulted. Service connection for each lot shall be a pillar.

All proposed locations of underground works (pits, cables, footings, earthing electrodes and rings, etc.) should be researched using the *Dial Before You Dig* facility [35], regardless of the area in question is developed or undeveloped, road reserve or public open space. This information service may or may not have information on buried services in public space, and is unlikely to have information on buried services on private land.

8.12.1 Cable Easements

If both Horizon Power and the local government authority approve the installation of cables in private properties, POS or PAW, they shall be protected by an easement. The developer shall create the easement required in favour of Horizon Power at no cost to Horizon Power, and shall be responsible for advising all potential land purchasers of the easement locations and its use and restrictions. Horizon Power requires these cable easement routes to be registered on the Deposited Plan of the land parcel that the cable crosses.

The minimum width of an easement for the installation of underground electrical cables shall be 1.0 m or as defined by Horizon Power. All cables installed in easements on private property shall be installed in ducts.

'Easement in Gross' is an easement that is used for service authorities to protect their interests over Crown and freehold land. An easement in gross is an easement without a dominant tenement.

Horizon Power usually requires one of the following types of easement in gross.

8.12.1.1 Section 167 Easements

This is an easement created automatically on new subdivision plans under section 167 of the *Planning and Development Act* [43].

It is created when new titles of lots or POS within the subdivision are created. The easement shall be shown on the deposited plans submitted to the Land gate for the issuing of land titles.

8.12.1.2 Crown Easement

Crown easements used when it is are required to protect cables in existing POS, PAW or public road reserves. They can be granted by the Minister under the *Land Administration Act* [40]. Crown easements require the approval of the Landgate.

8.12.1.3 Easement on plans

An easement created on both existing Crown and freehold titles (survey plans) under section 136C of the *Transfer of Land Act* [47]. It can be created by the registration of a deed signed by the grantor and grantee and witnessed.

This easement is not created on newly created lots within the subdivision, but on existing titles.

8.12.2 General Locations of all above ground Assets

The Developer shall ensure that all above ground assets including service pillars, street lights and low voltage (LV) frames are located on ground level 300 mm above 100 year flood level, are not in a precarious position, and will be accessible to Horizon Power staff or designated contractors at all times. They shall be placed outside of the Clear Zone, in accordance with LGA and Main Roads requirements.

High voltage equipment and substations shall be located one metre above the 100 year flood level.

8.12.3 Cable Alignment

All cables, including street lighting cables, are to be installed on the nominal alignment of 0.0 to 0.5 m from property boundary lines along gazetted public road reserve (refer to the *Utility Providers Code of Practice for Western Australia* [50]).

Where existing cable alignment is not available, the cable alignment on the opposite side of the road is to be used.

Any variation to the cable alignment, i.e. outside the 0.0-0.5 m cable alignment to the pole alignment (2.4-3.0 m, or 2.5-3.5 m for narrow road reserves), requires the prior approval of Horizon Power. Cables proposed to be installed within this area also need the approval of other affected service utilities.

Where the cable is out of the nominal 0.0 to 0.5 m alignment, ducts are not required, however mechanical protection shall be as per the 'Category B wiring system mechanical protection' under the *Wiring Rules* (AS/NZS 3000 section 3.11.4.3) and section 12.11 of the *Underground Cable Installation Manual* [25]:

- Polymeric cable cover strips (complying with AS 4702)
- Precast concrete slabs

- Fibrous cement slabs
- Bricks manufactured specifically for protection of cables
- Continuous concrete pour

The detailed requirements of each of these methods may be found under section 12.11 of the *Underground Cable Installation Manual* [25].

Where Horizon Power permits street lighting cables to be installed on the pole alignment (2.4-3.0 m, or 2.5-3.5 m for narrow road reserves), the cables shall be installed in heavy duty ducts in accordance with the *Underground Cable Installation Manual* [25].

8.12.4 Number of Cables Permitted within Nominal Cable Alignment in Green Field Areas

The designer is to determine the number of cables that can be installed in the nominal cable alignment, in accordance with the requirements of Appendix I and example drawings R55 – R59 of the *Distribution Construction Standards Manual* [3]. The minimum depth of cover of cables is 850 mm, however, the depth of cover of cables in nominal cable alignment shall be increased as required so that cables joints will have the necessary depth of cover.

When HV or LV cables are installed in ducts, a minimum clearance of 100 mm between ducts and the property boundary shall be maintained. Minimum separation between different ducts shall be as per the tables in Appendix K and example drawings in the *Distribution Construction Standards* [3].

Where the cable alignment on one side of the road is unable to accommodate the number of cables required, excess cables are to be installed on the cable alignment on the opposite side of the road.

8.12.5 Cables and Electrical Services in Access Lanes and Laneways

In accordance with the WAPC Planning Bulletin No. 33 *Right of Way or Laneways in established areas guidelines* [56], 'Laneways' refers to a public road in an established area, designed to provide access to the side or rear of lots, principally for vehicle parking.

WAPC development control policy No. 2.6 *Residential road planning* [55] defines access lanes and rear laneways as public roads for the purpose of allowing vehicular access to properties in new areas. The policy [55] requires a minimum of six metres and a maximum of 13.5 m for the width of reserve for laneway.

Horizon Power always requires cables and electrical services including pillars and street lighting to be installed in gazetted road reserves not laneways. Where exceptions are granted, the following conditions apply:

- a) A written submission explaining why this is necessary is submitted (prior to submission for DCR) and meets with Horizon Power's satisfaction
- b) There is no alternative route for the installation of cables
- c) Access to electrical services from normal gazetted public road reserves is unsafe or not available
- d) Other WAPC conditions in the subdivision approval do not permit the installation of electrical services along normal gazetted public road reserves

If Horizon Power approves the installation of cables in a laneway, the cable shall be installed in the 0.0-0.5 m alignment from property boundary in cable ducts, with a minimum of one spare duct.

8.12.6 Ducts

The Developer shall ensure all cable ducts are non-metallic and comply with Australian Standard AS/NZS 2053.1. Steel ducts are allowable for water crossing only as described in section 8.12.8, and rail crossing as per the *Underground Cable Installation Manual* section 6 [25]. The size of ducts required for different type of cables is shown in Table 13:

Table 13: Cable Duct Sizes

Description	Nominal duct size
All HV Feeder Cables	150 mm
HV Transformer Cables with phase conductor CSA > 35 mm ²	150 mm
HV Transformer Cable with phase conductor CSA ≤ 35 mm ²	100 mm
All LV Main Cables	100 mm
Mini Pillar Connection cables	50 mm
All Street Light Cables	50 mm

All cable ducts, including spare cable ducts required, shall be shown on the UDS design drawing. For cable duct specifications refer to Appendix F.

8.12.7 Cable near Retaining Walls

Cables near to retaining walls shall be installed in ducts, with a minimum of one spare duct.

The location of all retaining walls and their civil design details shall be shown on the UDS design drawing submitted for DCR.

8.12.8 Water Courses and Drains

The developer shall ensure all water courses or open drains shall be shown on the UDS design drawing.

The design drawing shall show the design for the installation of cables that cross a water course or open drain. Cables shall be installed in concrete-encased heavy duty ducts with a minimum cover of 850 mm below the bottom of the water course or open drain. The concrete encasement shall have a minimum thickness of either:

- 75 mm, or
- 75% of the nominal diameter of the largest conduit (whichever is larger).

The concrete encasement shall have a maximum thickness of either:

- 150 mm, or
- 200% of the nominal diameter of the largest conduit (whichever is smaller).

Where the water course is non-navigable and is deeper than two metres or the open drain is deeper than two metres, cables can be installed in heavy duty ducts with an extra steel conduit for additional support and cross the creek or drain in open air. The steel conduit and heavy duty duct shall be extended at least two metres into soil from either side of the creek or open drain to provide support so that the cable does not suffer damage by its own weight. The developer will confirm in writing that the design of the span is within engineered standards.

Cables are increasingly being installed by directional drilling. Cables installed across water courses using directional drilling will be done so in accordance with section 8.12.9 and after consultation and agreement with Horizon Power. Markers approved by Horizon Power will be placed on both sides of the water course or drain above the high water level.

8.12.9 Directional Drilling

The requirements for the drilling are as a minimum:

- a) Cables will be installed in heavy duty drillers duct at a depth greater than 900 mm but no greater than 1500 mm, and extending a minimum of 1500 mm either side of the water course
- b) Drillers log of the depth and location of the cable (as described in section 10 of the *Underground Cable Installation Manual* [25]) will be kept and provided to Horizon Power as part of as-constructed documentation
- c) Markers approved by Horizon Power will be installed on both sides of the section where directional drilling is used
- d) The requirements listed in section 10 of the *Underground Cable Installation Manual* [25]

8.13 Points of Supply

The point of supply for an underground customer's connection will be the customer supply terminals contained within the distribution network equipment provided (typically a pillar or wall-mounted connection box).

Where applicable, common property shall be created to allow consumer mains to be connected to the pillar. At Horizon Powers' sole discretion, a service easement may be substituted. Refer to *WA Electrical Requirements* [53] section 5.2.

Horizon Power will provide:

- One point of supply per freehold title lot . The point of supply will usually be in the form of a service pillar, a LV frame or a transformer at lot boundary
- One point of supply to service all the survey-strata lots that may include 'common property lot' shown on a strata plan.

For residential lots, one mini pillar will be installed to serve every two lots. If developers intend to install one service pillar per lot due to special circumstances, such as parapet walls built to property boundary or retaining walls higher than 300 mm, they shall provide justifications to Horizon Power and obtain the approval of Horizon Power.

A mini pillar is supplied via a 25 mm² cable (rated in conduit at approximately 100 Amps) and can service a total combined load of up to 100 Amps per phase.

A uni pillar should be provided as the point of supply for any group housing lot (building strata or survey strata) with more than four dwelling units, or where combined loads exceed 100 Amps per phase.

For Option A installations, the site shall be made ready and pegged by the developer for immediate installation of the pillar.

Each industrial or commercial lot shall be protected with a fused supply, either from a direct transformer connection, fuse unit or a universal pillar.

8.13.1 Service Pillar Location

When lots face gazetted public road, service pillars shall be located within the lot boundaries at the corner, adjacent to common boundaries where possible, as shown on the drawing in the Appendix C of the *Underground Cable Installation Manual* [25]

Where retaining or boundary walls exist along the boundary, the service pillar shall be installed as per the following:

- a) If a side retaining or boundary wall exists and this stops short of the front boundary, the pillar may be located in front of the wall. A minimum distance of 250 mm shall be maintained between the pillar and both the retaining wall and any boundary fence. Please note, this may affect the installation of a boundary fence.
- b) If front and side retaining walls exist, then the pillar is to be located 500 mm from the inside of each wall and ducts shall be provided under each wall for both the Horizon Power supply cable and the neighbour's consumer's main cable.

8.13.2 Service Pillar Exclusion Zone

It is preferred that no other utility services shall pass through or be located within the service pillar exclusion zone.

For both mini and uni pillars, the service exclusion zone shall be the minimum separation required between the pillar low voltage earth electrode, this being at the centre of the pillar, and other services as defined in AS/NZS 3000:2007 Table 3.7. This requires 500 mm separation from water services, sanitary drainage and gas, and 600 mm for stormwater drainage. In practical terms, this is an exclusion zone of radius 500 mm around the centre of the pillar (the exclusion zone is extended to 600 mm for stormwater drainage).

8.13.3 Removal of Existing Overhead Mains

Where existing aerial mains are to be removed as part of the subdivision work, the developer is responsible for the reconnection of existing Horizon Power aerial-connected customers to the underground system all at their cost. Changes may be required within customers dwelling for safety purposes. Developers will ensure customer installations comply with relevant regulations and standards prior to energisation.

The reconnection services to existing customers can be one of the following methods:

- a) Where there is sufficient space at the front boundary of the affected lot for a normal pillar to be installed, as shown in drawing U35 in the Distribution Construction Standards [3], and the existing overhead services will be replaced with underground services (i.e. consumer mains). Horizon Power will provide a pillar at the developer's cost. The developer is responsible for installing the underground service from the pillar to the existing customer (i.e. consumer mains).
- b) In the case where there is insufficient space for a normal pillar to be installed, a wall mounted pillar will be required. The proposed wall-mounted pillar, cable arrangement (including earth cable) shall be included in the DCR, and have written approval by the customer. Changes may be required within customers dwelling for safety purposes.

The designer is to include the appropriate design on the UDS design drawing to be submitted for DCR.

In all of the above options, the developer is to inform existing customers affected that all wiring downstream of the Horizon Power pillar is their responsibility. That is, if the wiring is damaged (e.g. by storms) they will be responsible for repairs.

8.14 Street Lighting

The developer shall ensure its designer liaises with the LGA or Main Roads as appropriate to establish the street lighting requirements, and designs an appropriate lighting scheme. For areas where Main Roads have declared Control of Access, street lighting shall be designed to comply with the requirements of Main Roads WA. For all other areas, street lighting shall be designed to comply with the requirements of the LGA.

All new street lights within new subdivisions are to be dusk to dawn. Where the lighting is installed, each street light shall be supplied from the nearest mini/universal pillar with a fuse at the mini/universal pillar and an isolation link at the street light pole.

A MEN loop is compulsory between neutral and earth terminals on the supply side of the cut-outs. A 6 mm² copper earth conductor shall bond the steel standard to the earth terminal.

8.14.1 Street Lights near to Existing Overhead Power Lines

The Developer shall ensure its UDS design meets all safe clearances in accordance with the latest *AS/NZS 7000 Overhead Line Design—Detailed Procedures* are maintained between existing power lines and street lights in the subdivision. The designer shall show the clearances of street lights to any existing overhead power lines on the UDS design drawing to be submitted for DCR.

Street light poles shall not be installed on the same side of a road where existing overhead transmission and/or distribution (HV and LV) mains will remain.

8.14.2 Street Light Locations

All street lights are to be installed along the common property boundary line on the 2.7 m alignment unless prior written approval is obtained from Horizon Power.

Where the road reserve is narrow (nominally 14 to 16 m), the location of street lights shall be as per Figure B3 of the *Utility Providers Code of Practice* [50] street lights shall be located 2.3 m back from the face of the kerb, if the footpath is located behind the kerb.

Where the road reserve has a verge wider than 3700 mm, street lights may be installed at a minimum set back from the kerb line in accordance with the conditions below, however, the developer is required to obtain the approval of the LGA or Mains Roads (as appropriate) and other utility providers.

- a) The designer shall show the setback on the UDS design drawing for DCR where it is not on the 2.7 m alignment.
- b) Where a road terminates at a tee junction at end of a terminating road, street lights shall be installed close to the centre of the road or along a property boundary extension.
- c) Street lights shall be provided and installed at the end of all cul-de-sacs.
- d) Street lights shall not be installed in water course or drains.

8.14.3 Horizon Power's Standard Street Lights

Horizon Power has two types of standard street light poles as follows:

- Horizon Power non-decorative street light poles
- Horizon Power Cyclone Rated street light poles for Cyclonic areas, complying with *Distribution Design Catalogue HPC-1DC-07-0012-2014* drawing SL18 [4].

These are non-decorative galvanised steel poles fitted with standard luminaries.

8.14.4 Approval of Decorative Street Lights in Subdivision

If decorative poles and luminaries are required by the developer, it will be the responsibility of the developer to liaise with the LGA to have the lights installed. These lights will be installed as unmetered or metered supplies.

Horizon Power will only operate Horizon Power approved decorative street lights. Installation of non-approved decorative street lights will require agreement from the LGA to undertake maintenance or operation.

Powder coated street light poles may be installed within the new subdivision with standard luminaries, however Horizon Power will replace them with standard poles when they fail or reach end-of-life. The additional cost for like-for-like replacement shall be the responsibility of the LGA.

Energy consumption on Horizon Power's standard street lights will be charged to LGAs as per gazetted street lighting tariffs.

8.14.5 Public Lighting Owned and Maintained by Customer

The developer is responsible for all work associated with the installation of a special non-Horizon Power public lighting system (e.g. pedestrian lighting). The LGA is responsible for the ongoing operation and maintenance of the system and payment of the applicable tariff charges after handover.

The LGA may choose an un-metered (UMS) or metered supply. Where an un-metered supply is used, the installation shall comply with Horizon Power's *Unmetered Supply Policy* [26].

The following conditions apply to Public Lighting:

- a) A letter shall be provided from the LGA stating:
 - i) The LGA shall own, operate and maintain the street light system,
 - ii) The LGA shall pay the applicable tariff charge, and
 - iii) In addition to advice provided by an electrical contractor's statutory forms, the LGA will advise Horizon Power of any increase or reduction in the connected load.
- b) The installation shall not be connected to Horizon Power's street lighting system and cabling shall not be run in Horizon Power's cable alignment. The developer is responsible for all installation work, including cabling, which shall be run in the 2.7 m alignment.
- c) Compliance with AS/NZS 3000 Wiring Rules including earthing and protection
- d) Provision of either:
 - i) A main switchboard and main control in accordance with Wiring Rules Rule 2. 3.3.1 (main switches for each point of supply). The main switch shall be a miniature circuit breaker, sized to match the load current. Where a switchboard is required, a weatherproof durable label will be installed by the developer adjacent to the main switch, reading 'Main Switch – Unmetered Supply - Installation Maintained by City/Shire of <Insert City/Shire Name> - Isolate supply at all times before commencing work'.
 - ii) Alternatively, in the case of un-metered supplies, a single light standard can be supplied through a fuse from the nearest pillar with appropriate labelling, without the need for a switchboard.
- e) Each light standard shall be equipped with a means of isolation located in the base.
- f) Each light standard shall be identified as belonging to the City/Shire of <Insert City/Shire Name>, and include instructions for maintenance and repairs to be referred to the City and not Horizon Power.

A Preliminary Notice and Notice of Completion shall be submitted to Horizon Power to initiate the issue of a service ruling and final inspection of the installation as appropriate. If it is an un-metered supply, the developer's electrical contractor shall endorse the Preliminary Notice and the Notice of Completion in the following terms: 'Un-metered Supply' 'Total Load kW'.

8.14.6 Street Lighting Outside Gazetted Public Road Reserve

Horizon Power standard street lights may only be installed in a gazetted public road reserve.

If the LGA or other authorities require lights in POS, PAW and Crown Reserves, private street lighting shall be installed.

8.14.7 Street Lighting Within Gazetted Public Road Reserve

Main Roads WA defines its requirements for the placement of poles in the *Utility Services in Road Reserves* [52], section 8.3.1, as follows:

- a) Services should be placed on the alignment given in Appendix B of the *Utility Providers Code of Practice* [50]
- b) Above-ground services should be placed outside the Clear Zone.

Developers shall ensure the installation of street light poles conform to the *Utility Providers Code of Practice* [50] and Main Roads requirements.

8.14.8 Banners and Decorative Fixtures on Street Lights

The attachment of banners and artwork to street lights causes greater stress on the poles during windy weather. Attachment of such artwork to Horizon Power street lights may be done with Horizon Power approval (by the Customer and Community Relations Manager for the district in which the street light lies). The attached artwork must comply with the technical requirements stated in *Decorative Fixtures, Signs, Banners and Artwork on Horizon Power Assets* [1].

8.15 Existing Assets within or adjacent to a Subdivision

The treatment of existing Horizon Power overhead power lines that traverse or are adjacent to such development proposals shall be as below.

8.15.1 Transmission Power Lines

Transmission power lines operate with a line-to-line voltage of 66 kV and above.

For an overhead transmission power line that traverses or is adjacent to the development, generally the power line can remain in situ. However, an Easement in Gross is to be provided for the power line at the proponent's cost. The power line is to be considered adjacent to the development if the development is within the prescribed safety clearance zone (the easement) applicable to the particular transmission line. This is determined in accordance with AS/NZS 7000 *Overhead Line Design—Detailed Procedures*.

There may be circumstances where it is impractical for the overhead transmission power line to remain in situ. Each case will be dealt with on its merits.

8.15.2 Distribution Power Lines Located in Small Lots

For an overhead distribution power line that traverses lots of 10 hectares or less within the development, the following options are available:

8.15.2.1 Rebuild Underground through the Development in Road Reserves

The overhead distribution power line may be rebuilt underground through the development, provided:

- a) It is installed gazetted road reserves
- b) The LGA has restricted the construction of buildings on the lot to a building envelope (nominated by that LGA)
- c) The new underground easement is at least two metres from the building envelope
- d) The cable is installed in ducts to Horizon Power's requirements
- e) Spare ducts are installed to Horizon Power's requirements
- f) Permanent above ground markers are installed along the cable route to Horizon Power's requirements
- g) Cable pulling pits are to be installed at 100 metre intervals along the spare duct route or to Horizon Power's requirements

8.15.2.2 Relocate off the Development

If no gazetted road reserves are created in the development or, at Horizon Power's discretion, the gazetted road reserves that are created are deemed not suitable for the rebuilt line, then the overhead distribution power line may be relocated entirely off the development. If any of the following conditions are true, the relocated line shall be installed underground:

- a) Surrounding electricity infrastructure is underground
- b) The local government authority has a requirement for underground electricity in the area
- c) There is an underground scheme proposed or in place for the area
- d) Clearing required for overhead construction would cause unacceptable environmental impact or excessive maintenance costs to Horizon Power
- e) An objection has been made by an affected member of the community and has not been resolved

Where none of the above conditions are true, the relocated line may be rebuilt as overhead.

When a power line is to be relocated off the development, it is the responsibility of the proponent to perform all negotiations with all affected parties, including members of the community, relevant departments and bodies, and Indigenous groups.

Horizon Power will not be an active participant in these negotiations. In all cases an easement (as per section 167 of the *Planning and Development Act* [43]) shall be provided at the proponent's cost. The section/s of the power line installed underground through the development off gazetted road reserves shall be kept to a minimum.

To minimise the impact of undergrounding the overhead line on adjacent landowners, the line to cable transition pole and its stay may be located within the development. The transition pole will also be located within the subdivision to minimise the impact on future landowners, i.e. not block driveways, PAWs, etc. In general, the transition pole shall be located within 0.5 m of the lot boundary.

8.15.2.3 Rebuild Overhead through the Development outside of Road Reserves

In circumstances where in Horizon Power's opinion it is impractical to achieve one of the previous two options, the overhead distribution power line may be rebuilt in overhead construction through the development outside of gazetted road reserves provided none of the following circumstances exists:

- a) Where any appropriate authority has a requirement for new electricity lines in the property to be underground;
- b) Where clearing required for overhead construction would cause an unacceptable environmental impact;
- c) Where an objection has been made by an affected member of the community and has not been resolved; and

All of the following conditions are met:

- d) The lot size is four hectares or larger;
- e) The edge of any existing or proposed building or building envelope for the lot is at least 20 m from the centre line of the overhead line;
- f) Ongoing ready access will be provided to the line for construction, operation and maintenance; and
- g) Vegetation will be cleared and kept clear at least 20 m from the line in accordance with Horizon Power Network's requirements
- h) Native Title, Heritage Environmental issues are resolved, and written evidence of their resolution is available.
- i) Local government requirements are met requiring the installation of fire breaks etc.

Note that whenever a power line is to be relocated within a property, it is the responsibility of the proponent to perform all negotiations with, and obtain the approval of, all affected members of the community and relevant departments and bodies. Horizon Power will not be an active participant in these negotiations.

8.15.2.4 Leave In-situ

In circumstances where, in Horizon Power's opinion, it is impractical to achieve one of the options 8.15.2.1, 8.15.2.2 or 8.15.2.3, then the existing overhead distribution power line can remain in-situ provided it meets the conditions stated in section 8.15.2.3.

An Easement in Gross shall be provided at the Developers cost, as described in section 8.15.1.

8.15.3 Distribution Power Lines Located in Large Lots

For an overhead distribution power line that traverses lots of greater than 10 hectares within the development, generally the power line can remain in situ provided that no building envelope or structure is proposed or any vegetation that may interfere with the lines is within 20 metres of the line. An Easement in Gross shall be provided at the Developers cost, as described in section 8.15.1. There may be circumstances where it is impractical for the overhead distribution power line to remain in situ. Each case will be dealt with on its merits.

8.16 Design Documents

8.16.1 Subdivision Design Drawing Requirements

The developer/designer shall ensure that the design drawings submitted for DCR complies with the *Subdivision Design Drawing Minimum Requirements* in Appendix E.

Failure to meet the above minimum requirements will result in non-conformance.

8.16.2 Variations to Horizon Power Designs or Standards

Horizon Power will consider requests for variations in design or standard practice. These shall be made by the developer or his representative in writing. The request shall include a marked up plan showing proposed changes and the developer shall include sufficient documentation to justify the changes.

9 CONSTRUCTION ADMINISTRATION

This section describes roles and responsibilities of key project personnel, and requirements for construction phase activities.

9.1 Key Project Personnel

All persons who undertake work associated with a UDS in subdivisions shall be approved by Horizon Power and hold all necessary licences and authorisations for that work.

The developer shall ensure that all work associated with a UDS is carried out by qualified persons as required by the applicable written laws.

9.1.1 Site Superintendent/Project Engineer

Horizon Power requires the developer to appoint a site superintendent/project engineer as the site representative for the installation of electrical services. In addition to the functions given by the developer, the site superintendent is the developer's representative for the following purposes in connection with a UDS namely:

- a) Liaising and cooperating with the CPM to ensure site safety
- b) Arranging site meetings
- c) Communications regarding the works programme and advising resource and material availability
- d) Ensuring Horizon Power receives the signed-off electrical cable test schedules
- e) Ensuring Horizon Power receives the signed-off Material & Equipment Schedule for Option B subdivisions
- f) Ensuring Horizon Power receives the signed-off 'As Constructed' drawings
- g) Preparation of Operational Readiness Dossier
- h) Participation in Operational Readiness Review
- i) Coordination of Operational Handover and Asset Handover
- j) Accepting warranty commitments on behalf of the developer

None of the developer's personnel or contractors who undertake UDS works are eligible to be the site superintendent.

9.1.2 Construction Project Manager (CPM)

The CPM is appointed by Horizon Power as its site representative to whom all technical and contract issues shall be directed.

The developer should refer all these matters directly to the CPM.

9.1.3 Quality Assurance Officer

The Quality Assurance (QA) officer is appointed by Horizon Power as its inspector to monitor electrical equipment installation standards on subdivision developments.

The QA officer will conduct periodic inspections during the progress of the installation construction work. At the Operational Readiness Review, the QA officer conducts a final check to ensure all requirements have been met and advises the CPM that Operational Handover can proceed.

The QA officer can also be the CPM, or can be a person or organisation independent of the construction contractors and/or Horizon Power.

9.1.4 Cable Laying Contractor

The cable laying contractor shall employ authorised cable laying supervisors and/or authorised cable layers in the installation of underground cables and street light columns.

9.1.5 Cable Laying Supervisor

A person supervising the installation of underground cables and street light columns, including the pulling-in of cables into enclosure housing electrical apparatus that is completely disconnected from source of electricity supply, shall be authorised under Horizon Power's authorisation process.

Nationally accredited Australian Qualifications Framework (AQF) standard training is required for any person who lays underground electrical supply cables.

To supervise works on UDS schemes within the NWIS and NIS, the supervisor shall apply to become authorised and registered with Horizon Power.

9.1.6 Cable Layer

A person installing underground cables and street light columns, including the pulling in of cables into enclosure housing electrical apparatus that is completely disconnected from source of electricity supply shall have successfully completed the nationally accredited course 'Lay Underground Electrical Supply Cables'. A person who has successfully completed this course will be issued a certificate and can apply to Horizon Power to become an authorised cable layer within Horizon Power.

9.1.7 Cable Jointer

A person who performs cable jointing work shall have completed nationally accredited training in Cable Jointing and shall apply to become authorised by Horizon Power.

Persons who hold the following authorisations under Horizon Power's authorisation process can install underground cables.

- a) HV Cable Jointer up to 33 kV (XLPE). This authorisation applies to all jointing and termination work on *low and high* voltage cables in underground where cables are completely disconnected from the source of electricity supply.
- b) LV Cable jointer up to 600 Volts (XLPE). This authorisation applies to all jointing and termination work carried out on *low* voltage cables underground where cables are completely disconnected from the source of electricity supply.

Authorised cable jointers may perform cable insulation testing, continuity and core-to-core testing of underground cables, provided they have appropriate training and Horizon Power approval to do such testing.

9.1.8 Electrical Worker

The following work shall be carried out by electrical workers licensed under the *Electricity (Licensing) Regulations* [38]:

- a) The final connection of all underground cables and circuits, including switchgear, transformers, earthing and street lights.
- b) The wiring of circuits, including street light circuits.
- c) The testing of cables and circuits, except where the testing of cables is permitted under section 9.1.7 Cable Jointer.
- d) The installation of substation equipment, including transformers and switchgear excluding the unloading and positioning of substation equipment onto their supporting bases.

Where the final connection of cables requires cable termination by HP-approved cable jointers, the Electrical Worker shall have equivalent qualifications in cable jointing (at the voltage level applicable), and be certified by HP for jointing cable. This is to prevent the voiding of warranties of certain types of cable termination, and also to comply with the *Electricity (Licensing) Regulations* [38], which require the final connection to be made by a licensed Electrical Worker.

9.1.9 UDS Subdivision Installer Qualification Matrix

Table 14 summarises the UDS installer qualification requirements.

Table 14: UDS Installer Qualification Requirement

Qualification	Lay Cable	Joint Cables (Up To 33 kV)	Joint Cables (Up To 600 V)	Test excluding Earth and VLF Tests	Earth & VLF Tests	Cable Termination	Cable & Circuit Connection (Note 1)	Service Connection
Cable Layer (Completed AQF training Pts 1 & 2 of Lay Underground Electrical Supply Cables)	P	N	N	N	N	N	N	N
Person completed only Pt 1 of Lay Underground Electrical Supply Cables	P (Note 2)	N	N	N	N	N	N	N
Cable Laying Supervisor	P	N	N	N	N	N	N	N
AQF Cert III – Cable Jointing	N	P	P	N	N	P	P (Note 6)	P
HV Cable Jointer	N	P	P	P (Note 3)	P (Note 8)	P (up to 33 kV Cable)	P (Note 6)	N
LV Cable Jointer	N	N	P	P (Note 3)	P (Note 8)	P (up to 600 V Cable)	P (Note 6)	N
Electrical Worker (licensed under the <i>Electricity (Licensing) Regulations</i> [38])	N	N	N	P (Note 4)	P (Note 4)	N	P (Notes 4, 7)	P (Note 5)

P = Permitted

N = Not permitted

Notes:

- (1) Cable & circuit connection includes the connection of cables and circuit on switchgear, transformers, earthing and street lights.
- (2) Permitted only for a maximum period of 12 months and shall be supervised by either an accredited cable layer or a Category A accredited cable laying supervisor.
- (3) Accredited cable jointers may perform cable insulation testing, continuity and core-to core testing of underground cables, provided they have completed the necessary training.
- (4) As defined in the existing Electricity (Licensing) Regulations [38]. However this may change from time to time and the developer shall ensure that the requirements in the Regulation are complied with.
- (5) Must have completed the URD Service Connections Training Course or have the Service/Contractor Connect Authorisation.
- (6) Permitted only if the Jointer also holds an Electrical Worker licence.
- (7) Where the final connection is by a cable termination, the Electrical Worker shall be HP-certified and qualified as a cable jointer as appropriate for those terminations.
- (8) Where jointers carry out tests, they shall have appropriate HP-approved training for those tests.

9.1.10 Enquires on Accreditation and Training

The Developer can find out whether a contractor is a Horizon Power preferred contractor (vendor), or whether a person is accredited or authorised to carry out work in subdivisions, by contacting Horizon Power [29].

9.2 Materials and Equipment

In a UDS the developer may only use materials and equipment approved by Horizon Power. All the materials and equipment listed in the *Distribution Design Catalogue* [4] with a corresponding Horizon Power stock number are Horizon Power standard materials and equipment and may be used without further approval from Horizon Power.

Non-standard equipment shall first be approved by Horizon Power for use. The process to seek approval to use non-standard equipment is shown in section 8.16.2.

Materials and equipment in the *Distribution Design Catalogue* may be revised from time-to-time.

9.2.1 Direct Purchase from Western Power Logistics

For Installation Option B schemes, Developers may purchase material directly from Western Power provided equipment meets Horizon Power specifications, with particular regard to equipment for cyclonic regions. Western Power holds stock in Jandakot stores, this may be ordered by using Western Power's standard procedure for ordering.

Developers are responsible for checking the quantity and quality of materials from Western Power.

9.2.2 Ownership and Responsibilities for Equipment

When the developer supplies and installs electricity infrastructure associated with the UDS, the developer owns all equipment and is responsible for its security up until the asset handover, at which time ownership passes to Horizon Power.

When Horizon Power supplies equipment to the developer or the developer's subcontractor to install, the equipment remains the property of Horizon Power but its control and security is the responsibility of the developer until it is installed and formally handed over to Horizon Power. Any loss due to damage or theft is the responsibility of the developer until asset handover.

When Horizon Power supplies and installs equipment, ownership of all materials remains the property of Horizon Power, both during and at the completion of the project.

9.3 Site Safety

The developer is responsible to ensure that the site is safe in accordance to the *Occupational Safety and Health Act* [41] and the *Occupational Safety and Health Regulations* [42].

At the time of writing this document, the *Work Health and Safety Bill* [48] is draft legislation. Should this bill be enacted, the developer shall ensure the site is safe in accordance with that bill and its associated regulations.

The developer is responsible for the workplace created by all work undertaken on or in connection with a development and the UDS for that development.

Before any works are undertaken on the development site in connection with a UDS, the developer shall:

- a) Prepare and approve a Site Safety Management Plan for its development. This Plan shall incorporate Horizon Power's *Electrical Safety Standards* [8]; and
- b) Give the CPM a copy of its Site Safety Management Plan prior to or at the initial prestart meeting.

Horizon Power's CPM will liaise with the developer's site superintendent to ensure all Horizon Power's personnel who will come onto the developer's site are inducted according to the developer's Site Safety Management Plan.

The CPM will ensure that Horizon Power's personnel and contractors follow the developer's Site Safety Plan and all lawful directions given by the site superintendent in connection with site safety.

To the extent that Horizon Power's own work safety practices and procedures are:

- More specific to the UDS works to be undertaken; or
- More exhaustive than those of the developer's Site Safety Management Plan,

The CPM will ensure Horizon Power's personnel and contractors follow those practices and procedures.

9.3.1 Safety for Horizon Power Works

The developer shall ensure that Horizon Power's personnel have uninterrupted access to that part of the development site reasonably required for the UDS works to be undertaken by Horizon Power.

The developer's Site Superintendent and the CPM will liaise and cooperate to:

- a) Identify the extent of Horizon Power's site for UDS works;
- b) Fix the date and times the subdivision site will be ready for Horizon Power to carry out required works;
- c) Ensure that as far as reasonably practicable, Horizon Power will have continuous, uninterrupted and exclusive access to that site at all times while it completes the UDS works.

9.4 Pre-Start Meeting

Upon receipt of the quote acceptance and payment of the quoted price and GST, the installation phase will commence. Horizon Power will send a receipt to the developer acknowledging payment, appoint a CPM, and advise the name of the CPM.

The developer shall contact the CPM within ten working days of the date on the letter to arrange a date and time for a pre-start meeting. Those who are to attend the prestart meeting with the CPM are:

- The developer or the developer's representative (if available)
- Site civil superintendent/project engineer
- Civil engineer
- Cable laying contractor

The pre-start meeting shall be held no later than one week before cable laying is proposed. The meeting should be held as early as possible to raise any materials or resource issues that may impact the proposed programme.

The developer shall provide the following information to the CPM at least two working days prior to the pre-start meeting:

- a) Confirmation of the site superintendent/project engineer
- b) Confirmation of the civil engineer
- c) Confirmation of the cable laying supervisor
- d) Confirmation of the cable joining supervisor
- e) Names of other electrical contractors/workers who will carry out installation
- f) Confirmation of qualifications of cable layers and cable joiners, noting down accreditation numbers
- g) Confirmation of the latest design revision, to ensure all are working from the correct design
- h) Environmental, Heritage and Native Title issues
- i) Requirements for where the subdivision will connect to the existing network, including isolations and permits required
- j) Civil issues that may impact on the electrical installation, such as drains, footpaths, retaining walls, batters and flood levels
- k) Commencement date of the construction works

- l) An up-to-date construction project programme and schedule of site meetings/QA visits

All notes taken down shall be entered on the Subdivision Site Inspection Pre-Start Meeting Form and are to be signed off by both the Horizon Power representative and the site superintendent/project engineer. The site superintendent/project engineer shall be given a copy of this information.

At the pre-start meeting the following matters will be addressed:

- i. Site access and security arrangements
- ii. Site safety risk assessment
- iii. Materials availability and timing of materials release
- iv. Project construction timetable and schedule of site visits
- v. QA requirements for the civil works, cable laying and electrical works

9.5 Project Programme

The developer shall submit the project programme to the CPM at least seven working days prior to the pre-start meeting to enable the CPM to confirm availability of Horizon Power resources and materials at that meeting.

9.6 Existing Customers and Affected Parties

The developer is responsible for notifying all concerned parties, including other Horizon Power customers affected by the work associated with a UDS.

9.7 Inspection

A QA officer will conduct periodic inspections during the progress of the electricity infrastructure installation. The developer shall give the QA officer site and equipment access to conduct all inspections required.

The QA officer will accordingly inform the site superintendent/project engineer of any non-conformance.

With at least five working days' notice of the following key milestones, the developer shall provide the QA officer and the CPM notice of:

- The commencement of any cable pull to enable inspection of equipment and methodology.
- Intended trench construction (both excavation and backfilling), to allow the QA officer to schedule inspection of duct/cable alignment and separation, and check the suitability of backfill.
- Testing of high voltage cables, switchgear, transformers and substation earthing.

The site superintendent/project engineer shall minimise the duration of open trenches, with the aim of backfilling within the same day as excavation. Those trenches left open overnight shall be fenced off with star pickets and reflective tape. Where the QA officer is unable to carry out inspection, the developer is responsible for providing inspection pot holes, and associated costs, as required by the QA officer for inspection.

9.8 Design Changes during Construction

During the construction of the subdivision there may be changes to the requirements of the subdivision which will require changes in the electrical design.

9.8.1 Major Changes in Design

If major changes are made to a design after design conformance and payment has been received from the developer, the designer shall submit the revised design drawing to Horizon Power for a DCR of revision while under construction. The developer will be responsible for all costs incurred by Horizon Power including all administration costs as a result of a design change.

The following changes are considered major and a DCR of revision while under construction is required.

- a) Encroachment on any easements
- b) Relocation of uni pillars
- c) Relocation of open points from one universal pillar to another
- d) Addition or deletion of pillars
- e) Re alignment of cables (HV or LV cables) to the 2.7 m pole alignment
- f) Change/deviation of cable route over five metres
- g) Change of status of switching points
- h) Relocation of switchgear or transformer substation
- i) Addition or deletion of lots in the subdivision
- j) Addition or deletion of street lights
- k) Relocation of street lights of a distance greater than five meters if other services impact
- l) Relocation of street lights away from boundaries
- m) Elimination of conduits or any other infrastructure

9.8.2 Minor changes in Design

If the changes are minor and not significant enough to warrant a review of the design, they can be approved by the CPM. However, the changes shall be shown on the 'As Constructed' drawing.

The following changes are considered minor changes and can be approved by CPM on site.

- a) Minor deviation of cable route under five metres
- b) Minor relocation of street lights of not more than 20 m within the street lighting alignment (outside transmission line easement) and the design continues to comply with relevant standards and requirements
- c) Relocation of pillar for reticulation pump along the same LV feeder towards the district substation
- d) Relocation of mini pillars (including uni pillars) across side lot boundary from the corner of a lot to the corner of the adjacent lot
- e) Relocation of street lights less than five meters if other services impact (only for those on truncated boundaries or with a measurement from a boundary)

9.9 Testing

For installation Option B UDS subdivisions, the developer shall carry out all tests specified below to prove the integrity of the electricity infrastructure installed and to ensure all technical requirements are met. The developer shall submit a test schedule to the CPM five working days prior to the commencement of tests.

Testing is to be carried out using the Horizon Power *Distribution Commissioning Test Sheets* [5]. These test sheets are intended for commissioning, subsequently some sections are not appropriate for pre-commissioning purposes and should not be completed at this stage. Those sections of the test sheets will be completed at the Commissioning stage.

All electrical testing of electricity infrastructure shall be carried out by an electrical worker licensed under the *Electricity (Licensing) Regulations* [38] and/or an authorised cable jointer as permitted under section 9.1.7.

The electrical worker or the accredited cable jointer who carries out the tests is to complete and sign off the testing sheets (listed below), up to the commissioning stage. They shall then be forwarded to the QA Officer to be received at least five working days prior to the Operational Readiness Review.

Horizon Power reserves the right to:

- Witness any test
- Require tests to be repeated
- Have equipment to be opened up
- Pot-hole trenches for inspection

The tests include as appropriate:

- a) Low voltage cables with/without pillars (HPC-4DL-07-0016-2014 sections 1 to 8)
- b) High voltage XLPE cables (HPC-4DL-07-0005-2014 sections 1 to 10)
- c) High voltage mixed cables (HPC-4DL-07-0008-2014 sections 1 to 5 for phasing and insulation tests, sections 6 to 9 for VLF and post-VLF insulation tests)
- d) Earth system resistance testing (all equipment) (HPC-4DL-07-0004-2014 sections 1 to 3)
- e) Low voltage kiosk (HPC-4DL-07-0018-2014 sections 1 to 3)
- f) Distribution substation (non-fire rated) (HPC-4DL-07-0003-2014 sections 1 to 4)
- g) High voltage ring main switchgear (HPC-4DL-07-0012-2014 sections 1 to 8)
- h) Non-MPS distribution transformer (HPC-4DL-07-0021-2014 sections 1 to 3)
- i) MPS distribution transformer (HPC-4DL-07-0019-2014 sections 1 to 3)
- j) Steel standard street lights (HPC-4DL-07-0031-2014 sections 1 to 4)
- k) Other tests if appropriate for CT-measured customers, private parallel generators, high voltage overhead, or overhead hardware, using the appropriate *Distribution Commissioning Test Sheets*.

The developer is responsible to repair or correct any equipment or workmanship issues which are found by test to be unsatisfactory.

9.10 Construction Documents

9.10.1 As Constructed Drawings

Upon completion of all work of the UDS for a subdivision, the developer shall provide Horizon Power with an 'As Constructed' drawing of the UDS.

The developer shall ensure that the 'As Constructed' drawing:

- a) Is certified 'As constructed', signed and dated by a surveyor who is eligible for membership of the Surveying and Spatial Sciences Institute (SSSI). A certificate from the surveyor is acceptable. The surveyor will certify that all asset including cables, transformers, switchgear, pillars, street lights and etc., are physically installed as shown on the 'As constructed' drawing.
- b) Is in DGN format.
- c) Includes revision number, revision date and 'As Constructed' details, including any changes in design or Horizon Power standard requirements.
- d) Includes locations of all underground in-line joints and all off-alignment cables are detailed using standard symbols.
- e) Is submitted electronically to Horizon Power with the certificates of the site superintendent and the surveyor to the CPM, at least five working days prior to the scheduled date of the Operational Readiness Review.

The CPM will not accept any 'As Constructed' drawing on site from the construction contractor.

9.10.2 As Constructed Records

Upon completion of all the UDS work of a subdivision, the developer shall provide Horizon Power with the following 'As Constructed' records:

- a) Cable installation records of alignment and depth, location of cable joints and road crossings. Where directional drilling has been used, drilling logs shall be included. The cable installation records shall be signed off by a surveyor who is eligible for membership of SSSI.
- b) Test sheets as listed in section 9.9, signed off by the licensed electrical worker who has carried out the tests or by an authorised cable jointer if tests have been carried out by such person. They shall also be signed off by the relevant commissioning staff.
- c) A HV cable joint schedule signed off by an authorised cable jointer who has carried out the work.
- d) A material and equipment schedule shall be completed and signed off by the authorised cable laying contractor.

The developer shall ensure that the 'As constructed' records are provided to the CPM at least five working days prior to the scheduled date of the Operational Readiness Review.

9.11 Operational Readiness Review for Installation Option B

The Operational Readiness Review is a key milestone for Installation Option B subdivisions [9]. It occurs to permit commissioning and connection of the UDS. This may be done in stages. The review allows:

- a) Clearance of Horizon Power conditions for WAPC approval
- b) The transfer of operational control of the equipment to the Operating Authority, to enable connection to its network and live commissioning checks to be conducted
- c) Verification of the Operational Readiness Dossier, a collection of documents necessary for safe operation of the electrical infrastructure

A pre-requisite of the Operational Readiness Review is the Operational Readiness Dossier. During the inspection, this dossier shall be checked for accuracy completeness by the CPM.

During the Operational Readiness Review, the CPM will indicate to the site superintendent/project engineer any defects or outstanding items to be rectified. The site superintendent/project engineer is responsible for recording any defects or outstanding items.

There may be incomplete works that are deemed insignificant with respect to operation. An example of such further works would be the repair of paint damage on pad-mounted equipment or the replacing of a temporary label with a permanent one.

The CPM will certify completion of the review, allowing commissioning and operational handover to proceed.

9.11.1 Operational Readiness Dossier

The Dossier shall as a minimum include the following:

- a) 'As constructed' drawings, as described in section 9.10.1
- b) 'As constructed' records, as described in section 9.10.2
- c) Distribution Test Commissioning Sheets and other relevant test documentation, which shall be:
 - i) At the Operational Readiness Review stage, complete with the exception of Commissioning
 - ii) Following commissioning, fully complete
- d) Documentation of the inspection conducted at the Operational Readiness Review (including photographs)
- e) Documentation of the LGA approval or WAPC approval with conditions
- f) Operational Handover Certificate (added at completion of the Operational Handover)

The following shall be included as appropriate:

- g) Evidence that the equipment register and computerised management systems (e.g. Poweron Fusion) have been accurately populated
- h) Stakeholder approvals (e.g. other affected customers)

- i) Compliance certificates, including as applicable: electrical contractor completion notices, gas installers notices of completion, certificate of compliance for Type B gas appliances, Worksafe registrations, environmental site licence (completion of environmental works approval and confirmation of compliance with site licence conditions)
- j) Operations and Maintenance Manuals
- k) Environmental, Heritage and Aboriginal land use approvals
- l) Local government and Main Roads approvals
- m) Site safety procedures, site risk register
- n) Site security procedures
- o) Emergency response procedures
- p) Fire system detection/protection procedures
- q) Permit, isolation and switching procedures

9.12 Commissioning

Commissioning involves the energisation of equipment and can commence only after the Operational Readiness Review is complete and all electrical permits are relinquished.

Horizon Power or its nominated representative carries out all commissioning of installed equipment. Test sheets stated in section 9.9 shall be handed over to the commissioning party to complete. These shall then be added to the Operational Readiness Dossier, for reference by the Operating Authority.

9.13 Operational Handover

The operational handover of an Option B UDS subdivision occurs when all works associated with the UDS subdivision or staged electrical works have been completed and are being handed over to Horizon Power for operation as part of Horizon Power's network.

The Operational Readiness Dossier required for the operational handover is described in section 9.11.1.

9.13.1 Operational Handover Certificate

The Operational Handover Certificate shall include at a minimum:

- a) Signed and dated acknowledgement from the Developer and all contracted parties that the assets are now under the control of HP Commissioning and Operations
- b) A statement from the developer and all contracted parties that all personnel have been notified and acknowledge the assets are live from the date on the handover certificate

An template Operational Handover Certificate has been included in Appendix J.

9.14 Asset Handover

The asset handover acknowledges that ownership of the electricity infrastructure associated with the UDS has passed from the Developer to Horizon Power.

9.14.1 Asset Handover Certificate

The *Asset Handover Certificate* is the official acknowledgement by the developer that ownership has passed to Horizon Power and the UDS has been constructed in accordance with this manual.

Samples for small residential subdivisions (Option A) and large subdivisions (Option B) are available [\[23_24\]](#).

9.15 Warranty

The developer shall in writing, warrant the design, installation and workmanship for a period of twelve months from the date of the asset handover certificate.

Any defects or omissions associated with the electricity infrastructure which occur during the warranty period will be repaired or corrected by Horizon Power who will then recover the associated costs from the developer.

9.16 Access to Electrical Equipment

The developer shall ensure that all contractors and personnel working on or near Horizon Power's network comply with Horizon Power's *Electrical Safety Standards* [\[8\]](#). Access to electrical equipment shall be prohibited by means of lockable gates/doors, where appropriate, with three point locking devices.

If the contractor requires access to any equipment that has been commissioned and handed over to Horizon Power or equipment bearing an operational label (see drawing R50 in the Distribution Construction Standards [\[3\]](#)), then the contractor shall first obtain the appropriate electrical permit from Horizon Power.

10 CONSTRUCTION REQUIREMENTS

The Developer shall ensure all Electricity Infrastructure, including substation, earthing and street lights, is installed in accordance with drawings and diagrams shown in the following:

- Distribution Construction Standards Manual [3]
- *Distribution Design Catalogue* [4]
- *Distribution Substation Manual (DSM)* [7]

10.1 Excavation

10.1.1 Excavation near to existing assets

The developer shall ensure that when excavation work is to be carried out near Horizon Power underground and overhead electrical networks, the contractor complies with the following:

- *Guidelines for Excavation Work near Horizon Powers Underground and Overhead Electrical Network* [10]
- *WorkSafe Code of practice – Excavation* [57]
- *Substation Installation Technical Requirements* [20]

10.1.2 Survey Pegs

The developer shall ensure:

- a) All subdivision and lot boundaries are accurately pegged. Any additional costs incurred by Horizon Power as a result of boundaries being pegged incorrectly will be charged to the developer.
- b) Prior to the commencement of trenching and cable laying work, all final survey pegs are in place and maintained in-situ throughout trenching and cable laying until the CPM has completed inspections.
- c) Any moved or missing pegs are replaced.
- d) Where there are large curves or long lot frontages, sufficient peg positions are in place to enable accurate placement of cables in the allocated alignment.

An offset peg at an agreed distance from the property boundary prior to trench excavation is acceptable. However, final boundary pegs shall be installed by the developer upon completion of ground work and prior to the installation of pillars. Offset pegs shall be agreed with the CPM at the pre-start meeting.

10.1.3 Trenching

The developer shall ensure that excavation of trenches is carried out as shown on the conformed scheme design drawing, and complies with both the *Underground Cable Installation Manual* [25] and Drawings No. R55-R59 in the Distribution Construction Standards [3]. Particular care shall be taken to ensure that there is sufficient cover over the cables.

Where the presence of structures, existing services or plant in the road reserve will not allow the installation of cables with these minimum specified covers, the developer shall bring the matter to the CPM's attention and seek direction prior to proceeding further. Horizon Power will advise in writing, the acceptable installation requirements.

For machine excavation the minimum safe approach distances above and beside identified underground cables are as shown in Table 15:

Table 15: Minimum Safe Approach Distances to Underground Cables

Nominal Voltage	Minimum Approach Distance (mm)	
	Powered Tool or Plant	Hand Tools (Un-powered)
Low voltage, up to and including 1000 V (1 kV)	300	Closer than 300 mm (0.3 metres): Hand dig (maintain physical clearance - no contact) Horizon Power representative not required
Greater than 1000 V, up to and including 33 kV	500	Closer than 500 mm (0.5 metres): Hand dig - Horizon Power representative to supervise the works
Greater than 33 kV, up to and including 132 kV	3000 (see note)	Closer than 3000 mm (3.0 metres) Horizon Power representative to supervise the works (see note)

Notes:

Powered tools may be used up to 1.0 metre from underground cables between 33 kV and 132 kV ONLY WHEN:

- The Horizon Power representative is supervising the works and
- Pot-holing has identified the relevant cable/s.

Un-powered hand tools can then be used from 1.0 metre to the relevant cable/s

Where there are existing cables in the cable alignment, hand digging shall be used to excavate for the installation of new cables.

The developer shall coordinate joint trenching requirements and shall make all necessary arrangement with other utilities to achieve this.

Cable ploughing may only be carried out in accordance with the *Underground Cable Installation Manual* [25].

10.1.4 Cable Ducts

The developer shall ensure that all ducts are installed in accordance with the conformed design drawings and as indicated in Appendix F.

10.1.5 Road, Railway and Vehicle Crossing

Where the road reserves have not been constructed or formed, the site superintendent/project engineer will ascertain and agree with the CPM the required depth of cover of cables before excavation upon such road reserves.

The developer shall ensure that all cables crossing roads and vehicle crossing are installed to meet the requirements of Horizon Power's *Underground Cable Installation Manual* section 6 [25]. When crossing a road or railway reserve, the trenching shall be such that a minimum of 850 mm of cover or as otherwise agreed by Horizon Power is maintained over the duct at all points, with a maximum depth, if required, of 1100 mm at the crown of the road. The trenching shall be such that the final contour of the road reserve is followed.

Backfill material, method and testing shall comply with section 10.3 of this document and section 16 of the *Underground Cable Installation Manual* [25].

Where thrust boring or directional drilling is performed, works shall comply with the relevant requirements stated in section 8.12.9 and section 10 of the *Underground Cable Installation Manual* [25].

10.2 Cable Installation

10.2.1 Cable and Duct Placement at Road Truncations

The developer shall ensure:

- a) All cables and ducts crossing roads at truncations are to be installed in accordance with drawings R51 and R52 in the Distribution Construction Standards [3].
- b) The ducts are installed from edge to edge of the cable alignment.

10.2.2 Cable Laying

The developer shall ensure that all cable laying works comply with Horizon Power's *Underground Cable Installation Manual* [25].

Cables shall be installed in Horizon Power's standard alignment and in accordance with the *Utility Providers Code of Practice for Western Australia* [50] and drawings R55-R59 in the Distribution Construction Standards [3]. Other services are not permitted in the power cable alignment without written permission from Horizon Power.

During the installation, underground straight joints in HV or LV cables shall be kept to a minimum. The number of HV or LV cable joints permitted is to be calculated by the following formula:

$$\begin{aligned}
 N &< 1 + L1/L2 & \text{where} & & L1 > 150 \text{ m} \\
 N &= 1 & \text{where} & & 60 < L1 \leq 150 \text{ m} \\
 N &= 0 & \text{where} & & L1 \leq 60 \text{ m}
 \end{aligned}$$

Where,

- N = Number of joints permitted
- L1 = Total Cable route length between terminals (metres)
- L2 = 250 m (Standard cable drum length)

Joints at existing working end locations are additional to these requirements.

All cables shall be marked or tagged as they are laid, to individually identify them, prior to jointing.

The ends of cut cable shall be capped with mastic lined, heat shrink caps immediately after cutting to prevent water ingress.

The preferred method of installing cable is to mount the cable drum on jacks, cable trailer or cable stand and unroll the cable from the top of the drum into the trench. If it is necessary to pull in the cable, then cables shall be fully supported by suitable proprietary cable rollers during cable laying. Where mechanical means are used to pull cable, the mechanism shall have a tension-limiting mechanism, to limit the tensile stress placed on the cable. At no stage may the cable be permitted to drag on the ground or be subjected to treatment which may damage the outer sheath.

Any damage to the cable will lead to Horizon Power rejecting the affected part of the installation and new cable will need to be laid.

10.2.3 Cable Installed near to Retaining Walls

Where cable is to be installed near to retaining walls, the developer shall ensure that the cable is installed in and protected by cable ducts. Cable ducts shall be installed prior to the construction of retaining walls.

Retaining walls and footings shall not encroach on the nominal cable alignment of 0.0-0.5 m.

10.2.4 Cable Installed in Laneways

In accordance with section 8.12.5 the developer shall obtain Horizon Power's prior approval for the installation of underground cables in a laneway.

10.2.5 Cable Installed in Easements

Where cable is to be installed in an easement, the developer shall supply and install the cable ducts as per the design drawing with the cross-section details of cable encasement as shown in drawing R53 in the Distribution Construction Standards [3].

Marker tape shall be installed as per the *Wiring Rules* (AS/NZS 3000 section 3.11.4.5). Where thrust boring or directional drilling is used, it shall be done as per the requirements of section 8.12.9, and marker tape is not required.

10.2.6 Cable Installed off Nominal Alignment

Mechanical protection of cables installed off the alignment shall be as per section 8.12.3.

Marker tape shall be installed as per the *Wiring Rules* (AS/NZS 3000 section 3.11.4.5). Where thrust boring or directional drilling is used, it shall be done as per the requirements of section 8.12.9, and marker tape is not required.

10.2.7 LV Cable Joints, Terminations and Working-End Pillars

When terminating low voltage three-phase cables, the core numbers and colours shall always match each other and cores one, two and three shall be terminated red, white, blue respectively. All LV cables that do not form part of future extensions of the network, and are not terminated within fixed equipment, shall be terminated within a uni pillar.

LV cables may be extended to the subdivision scheme boundary for future extension into the next stage. The Developer shall ensure these cables are terminated into working-end pillars. Working-end pillars shall not be installed inside any lot boundaries (including POS lots) and shall be painted white and labelled 'Working end only – not for connection'.

10.2.8 HV Cable Joints and Terminations

Particular care should be taken to ensure correct phase connection occurs. Sufficient slack through extra depth or looping should be left to enable re-termination if required.

The cable jointer shall complete and label the installer identification tag and fit the tag to each joint or termination in accordance to drawing R39 in the Distribution Construction Standards [3].

The cable jointer shall also complete the 'HV Cable Joint Schedule' as shown in Appendix G and add the schedule to the Operational Readiness Dossier.

10.3 Backfilling

Cables shall be bedded with a thickness of sand prior to backfilling using fill.

Cables shall be firmly and uniformly bedded on sand bed of thickness 150 mm, above by a bed of thickness 300 mm, and on either side by a bed of thickness 100 mm. Sand shall be placed in the trench carefully so as to avoid disturbance of the cable separation.

The developer shall ensure:

- a) Backfilling does not commence until approved by the CPM
- b) Bedding and backfilling meets the requirements of Horizon Power's *Underground Cable Installation Manual* [25]
- c) Backfilling, materials and methods used complies within the guidelines of section 10.3.1
- d) Where cable joints or terminations are performed by Horizon Power, the appropriate portions of the trench are not backfilled until the Horizon Power work is completed. Additional charges will be incurred for any extra works required by Horizon Power. Those trenches left open overnight shall be fenced off with star pickets and reflective tape. Horizon power shall be provided five working days' notice of the relevant trench activity, with the aim to minimise the time the trench is open.
- e) All backfill and reinstatement is completed so that water run-off, or collection, will not cause soil erosion.

10.3.1 Backfill Selection Criteria

Sand used for bedding shall be clean sand free of rocks, clay lumps, tree roots, building rubble, metal, glass, sharp objects, harmful hydrocarbons, organic solvents or other harmful material that is likely to damage cables. It shall comply with the particle size distribution requirements shown in Table 16 when tested in accordance with AS 1289.3.6.1.

Table 16: Particle Size Distribution Requirements for Bedding & Backfill

Sieve Size (mm)	Percentage Passing by Mass
4.75	100
2.36	95 to 100
0.075	0 to 5

Some hydrocarbons in soil have the potential to damage cables. They may be of natural origin (for example decayed organic matter in topsoil) or manufactured (for example petrol). Not all hydrocarbons are detrimental.

Where sand has been extracted from a virgin site or licensed quarry that has not previously been used for industrial or similar purposes, then the possibility of having harmful hydrocarbons present is low and laboratory testing is not required unless there is evidence of unusual colour, texture or odour. Sand from existing or former industrial sites may only be used for cable bedding if a suitably experienced scientist or engineer confirms that the hydrocarbons and other chemicals present will not damage the cable or be injurious to the health of persons laying the cable or likely to excavate the cable in the future. In those cases the contractor/developer is required to provide a certification from the scientist or engineer confirming that the sand is approved. Samples may require agreed hydrocarbon site tests prior to use.

10.3.2 Backfill between HV and LV Cables

In a two layer situation, HV should be below LV, with 200 mm of bedding sand between the two cable groups.

10.3.3 General backfill for cable trenches

After completion of the bedding and backfill with 'sand' detailed above, the balance of the trench shall be backfilled with the material excavated from the trench, provided it is free of organic matter and rocks of 75 mm diameter or larger, so as not to cause subsidence or prevent ready excavation with hand shovels. If necessary, the contractor shall import suitable approved material.

10.3.4 Procedures for backfilling

Non-Trafficable Areas

The trenches in non-trafficable areas, the backfill material shall be placed, compacted and neatly trimmed off to the final verge level. Backfill shall be placed and compacted in layers not exceeding 150 mm loose thickness for clay/cohesive materials or 300 mm loose thickness for sand/gravel/cohesion less material.

It shall be compacted to not less than 95% of the maximum dry density when tested by the methods of section 5 of AS 1289 for excavations in road verges, public open spaces. For all areas in private properties (except paved areas) the compaction shall achieve the density of the surrounding ground (with a minimum of 95% dry density ratio in accordance with section 5 of AS 1289).

For cohesive materials 'standard compaction' shall be used as a reference density. For sands and gravels 'modified' compaction shall be used as the reference density.

Trafficable Areas

The backfill shall be evenly placed and compacted in lifts not exceeding 300 mm unless otherwise specified. The contractor shall strictly monitor the moisture content of the fill and generally ensure that it remains in the range of 85% to 115% of the optimum moisture content as determined in accordance with the latest edition of AS 1289.5.2.1 *Methods of Testing Soil for Engineering Purposes – Soil Compaction and Density Tests*. The contractor shall be responsible to ensure that all backfill is placed with a moisture content most suited to the specific site and soil conditions. Where sand is not available, then the backfill shall be cement stabilised. The pavement above the backfill shall be reinstated to the same thickness and composition as the adjacent pavement.

10.3.5 Reinstatement

The developer shall ensure:

- a) Reinstatement is based on minimum green field requirements.
- b) The reinstatement meets the LGA's requirements.

10.3.6 Finished Ground Level

The Developer shall ensure:

- a) Prior to the commencement of any electrical work, including cable laying, the finished ground levels are established by the site superintendent/project engineer.
- b) Pillars and pad-mount transformers and switchgear are not to be installed unless the sites are completed with finished ground level.

10.4 Horizon Power Street Lights

After installation of the column and prior to installation of the concrete bell, the hole is to be back-filled and well tamped to provide a secure foundation.

10.5 Wall-Mounted Pillars

Horizon Power's CPM will supply the wall mounted pillar to the developer, who is responsible for having it installed on the façade of the affected building. A minimum of four weeks' notice is required to enable Horizon Power to order the pillar.

Horizon Power will supply and install the underground service cable up to the façade of the building, allowing sufficient length to reach the wall mounted pillar itself. The developer shall have the cable fixed to the façade of the building, up to the wall mounted pillar. Horizon Power will undertake the final connection of the underground service to the wall mounted pillar, in conjunction with the developer's electrician.

Changes may be required within customers dwelling for safety purposes. Developers will ensure customer installations comply with relevant regulations and standards prior to energisation.

10.6 Working in the Vicinity of overhead power lines

The developer shall ensure that when work is to be carried out in the vicinity of Horizon Power's overhead power network, the contractor complies with the requirement of:

- The *Occupational Safety and Health Regulations* [42]
- WorkSafe Western Australia, *Guidelines for Work in the Vicinity of Overhead Power Lines* [58]

When planning above ground work near a power line, the contractor shall lodge a *Request to Work Near Overhead and Underground Electrical Networks Application Form* [17] [to Horizon Power](#).

10.7 Substations

The developer shall ensure that each substation site is prepared and constructed in accordance with:

- a) The requirements shown on the confirmed design drawing.
- b) *Substation Installation Technical Requirements* [20] of Horizon Power.

The developer shall ensure that all substation equipment, including transformer and switchgear, is installed by a licensed electrical contractor or a licensed electrical worker, in accordance with the following:

- c) The manufacturer's information
- d) Horizon Power's requirements as illustrated in drawings of the *Distribution Substation Manual* [7] and the *Distribution Design Catalogue* [4]

10.7.1 Substation Earthing

The developer shall install all substation earthing in accordance with substation earthing arrangements shown in drawings DSM-6-11 and DSM-6-12, section 6 of the *Distribution Substation Manual* [7].

The substation earthing grid shall be buried 500 mm below finished ground level of the substation.

The substation earthing shall also be constructed to comply with the requirement of 'Earthing Connections Concept Diagram' of AS 2067 Appendix B.

All earthing cables shall be tagged and labelled at the earth bar end to clearly indicate where they are connected.

10.7.2 Substation Screening

Where a MPS or non-MPS arrangement is to be installed, Horizon Power does not require screening around the substation site. If screening is required, the developer is responsible for installation. All screening shall meet the requirements of Horizon Power's *Substation Installation Technical Requirements* [20] and *Distribution Substation Manual* [7].

The use of metallic screen fencing is not recommended and is to be avoided in subdivision development. When a customer requires a conductive fence to be installed in close proximity to a substation, a two metre separation from the substation earth grid and the conductive fence is required, as per DSM-6-13 (sheet 2) of the *Distribution Substation Manual* (section 6) [7]. In this case the conductive fence is *not* bonded to the HV or LV earth system.

Where a conductive fence is to be installed *within* the two metres of the earth grading ring, the fence shall be bonded as per section 9 of the *Substation Installation Technical Requirements* [20] and drawing DSM-6-13 (sheet 3) of the *Distribution Substation Manual* (section 6) [7]. This fence shall be isolated and not continuous or adjacent to conductive fence leading to other areas.

The requirements of AS 2067 and AS/NZS 3000 shall apply and approval of the proposed earthing arrangement shall be obtained from the CPM prior to installation.

Appendix A Revision Information

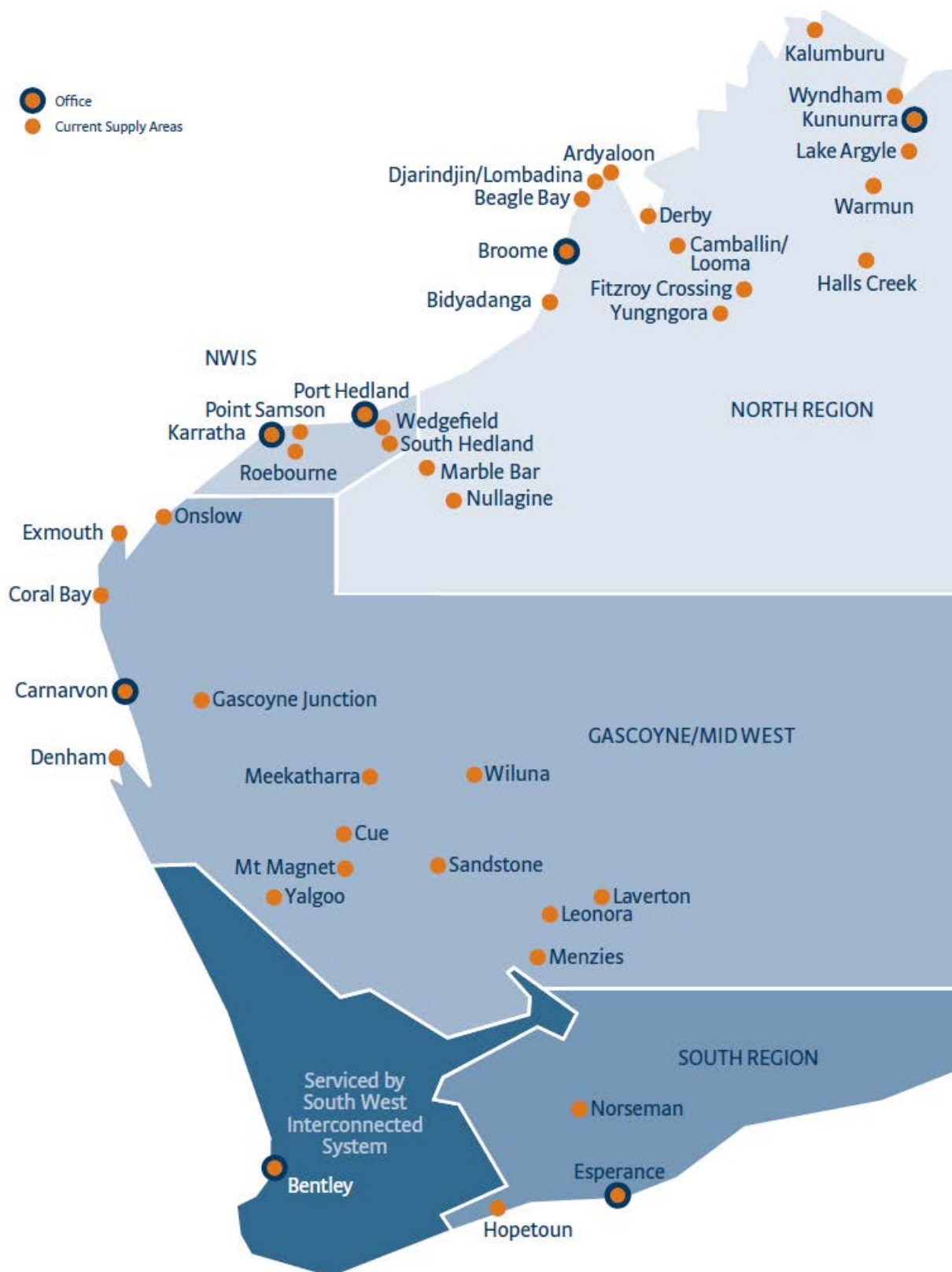
(Informative) Horizon Power has endeavoured to provide standards of the highest quality and would appreciate notification if any errors are found or even queries raised.

Each Standard makes use of its own comment sheet which is maintained throughout the life of the standard, which lists all comments made by stakeholders regarding the standard.

A comment sheet **HPC-5DA-07-0012-COM** found in **CS10# 3017641**, can be used to record any errors or queries found in or pertaining to this standard, which can then be addressed whenever the standard gets reviewed.

Date	Rev No.	Notes
13/01/2012	1	First Issue
21/10/2013	2	Second Issue
20/08/2015	3	Third Issue

Appendix B The Areas We Serve



Appendix C Design Information Package Checklist

Before a Design Information Package should be issued, check the following information has been submitted to Horizon Power.

Submitted Information				
Item	Description	Yes	No	N/A
1.1	Subdivision title and stage number.			
1.2	Number of lots identified within the stage.			
1.3	WAPC number is supplied and is relevant to this development.			
1.4	Subdivision layout and cadastral information.			
1.5	Letter of Authorisation signed by the developer to accept costs. This must include the designer, customer and developers information.			
1.6	Subdivision concept plan for multiple stage developments.			

The following detailed information must be issued using the *Design Information Package Standard Template Form* [\[2\]](#).

Issued Information				
Item	Description	Yes	No	N/A
2.1	Subdivision title and stage number.			
2.2	Town name where the development will occur.			
2.3	The high voltage value that will feed the subdivision.			
2.4	Cable sizes for the high voltage.			
2.5	Cable sizes for the low voltage.			
2.6	Cable sizes for the street lighting.			
2.7	Maximum transformer size allowed for this development			
2.8	After Diversity Maximum Demand value (ADMD)			
2.9	High Voltage detail and connection points to the existing system.			

Item	Description	Yes	No	N/A
2.10	Low voltage detail and connection points to the existing system.			
2.11	Street light detail and connection points.			
2.12	Other relevant information applicable to this subdivision that may affect the design.			

The following information should accompany the detail within the Design Information Package:

Accompanying Information				
Item	Description	Yes	No	N/A
3.1	Drawings that complement the design information package information.			
3.2	CWM covering letter.			
3.3	LV design of existing transformers outside the subdivision being used to supply capacity within the subdivision.			

Detail within the Design Information Package:

Detail				
Item	Description	Yes	No	N/A
4.1	Has the latest System Study been reviewed or have Technical Services undertaken a HV feeder planning study where new install transformer capacity will exceed the System Study recommendations?			
4.2	Have current HV feeder loads been reviewed to ensure that the new subdivision can be installed regardless of installed transformer capacity?			
4.3	Check that specified HV entry and exit points will allow for future development and optimisation of the existing system.			
4.4	Check pole and RMU switch numbers are clearly identified and shown for HV entry and exit points off/to the existing system.			
4.5	Check all specified cable and joints are termite proof or protected.			

Item	Description	Yes	No	N/A
4.6	Check new HV feeder cables are specified as 400 mm Al for feeders within 2 km of a substation or where system studies indicate voltage drop on the feeder.			
4.7	Check the specified transformer sizes meet criteria for Horizon Power's policy on <i>Maximum Transformer Sizes for Non Interconnected Systems</i> [14]			
4.8	Check the specified ADMD value meets criteria for Horizon Power's policy on minimum ADMD for designs within towns [11].			
4.9	Check if the existing overhead aerials outside the subdivision are required to be put underground as per Horizon Power's <i>Distribution Subdivision Policy</i> [16]			
4.10	Check if easements are required over land for existing overhead networks that will remain as per Horizon Power's <i>Distribution Subdivision Policy</i> [16]			
4.11	Check if transmission networks will be affected by the subdivision and require easements or relocation.			

Have you completed the following before submitting to the designer?

Final Checks				
Item	Description	Yes	No	N/A
5.1	Reviewed all of the above to ensure that it meets the requirements of conditions stipulated by Horizon Power to the WAPC for this development.			
5.2	All the documentation to be sent to the designer has been put into a zip file.			
5.3	All the documentation to be sent to the designer has been saved into CS10 under the correct file number.			
5.4	Updated CWM/Ellipse with the correct events			
5.5	Updated the subdivision tracking spreadsheet [19]			

Completed by: _____

Date: _____

Appendix D Subdivision Design Submission NPER Engineer Certification

Subdivision Design Submission NPER Engineer Certification
(Must form part of conformance review submission)

Horizon Power ref: ES/GS/MS/RS/PS/BS/KS_____

Designer/Consultant ref_____

Designer's Drawing No._____ Rev _____ Date:_____

Designer's Drawing No._____ Rev _____ Date:_____

Designer's Drawing No._____ Rev _____ Date:_____

The submitted drawings meet Horizon Power's requirements. This includes the following:

HV Network

ITEM	Description	Yes	No	N/A
1.1	HV entry and exit points are as per the Design Information Package or as agreed with the Horizon Power representative.			
1.2	Correct size HV feeder cable has been used as per the Design Information Package or as agreed with the Horizon Power representative.			
1.3	HV design has switching capabilities that limit bulk load shifting on Horizon Power systems			
1.4	Correct land size has been allocated for transformers and ring main switchgear and incorporated into Public Open Space (POS) or within road reserves.			
1.5	Substation HV cable layout and connections are correct.			
1.6	Transformers sizes do not exceed specified sizes as per the Design Information Package.			
1.7	All equipment to be used within the subdivision is standard equipment authorised for use by Horizon Power.			

LV Network

Item	Description	Yes	No	N/A
2.1	A.D.M.D. values as per the Design Information Package or as agreed with the Horizon Power representative have been used in LV Design calculations.			
2.2	LV Design calculations (including cable capacity & current) are within Horizon Power's limits.			
2.3	LV Design calculations allow LV feeder protection to operate as designed.			
2.4	All motor flicker is within acceptable limits.			
2.5	LV feeders are as evenly loaded as practical.			
2.6	LV feeders are inter-connectable where practical.			
2.7	Transformer and LV feeder load details are correct and are clearly shown on the submitted drawings.			
2.8	A connection point exists for each lot within the subdivision.			
2.9	Universal pillars or distribution boards are installed for each lot of a commercial / industrial subdivision.			

Street Lighting

Item	Description	Yes	No	N/A
3.1	Provide proof that the proposed street lighting to be installed complies with local government requirements.			
3.2	Street lighting complies with Horizon Power's requirements for standard fixtures and fittings.			
3.3	Street lighting details are correct and are clearly shown on the submitted drawings.			

Other

Item	Description	Yes	No	N/A
4.1	Correct size conduits have been used for the cable specified.			
4.2	All conduit sizes are marked and clearly shown on the drawings.			
4.3	Conduits are marked where retaining walls exist.			
4.4	All cables to be installed comply with spacing's within the cable alignment and specific laying configurations are shown on the drawings.			
4.5	All safety requirements are marked on the drawings.			

Comments:

To the best of my knowledge and by virtue of my NPER registration, training, qualifications and experience I certify that the design submissions on the above drawings meet all Horizon Power's requirements in the Design Information Package, the *Underground Distribution Schemes Manual* and the published *Distribution Subdivision Policy* [16].

Signed: _____ Date: ____ / ____ / ____

Name	
Qualifications	

Authorisation of NPER Certification of Subdivision Design Revision for Minor Changes

Horizon Power ref: ES/GS/MS/RS/PS/BS/KS_____

Designer/Consultant ref_____

To Horizon Power

I hereby authorise the following person to certify design revision submissions for minor changes for the above subdivision on behalf of myself.

- 1.
- 2.
- 3.

I accept full liability and responsibility of any such certification executed under this authorisation subsequent to any minor changes required on the original design submission with my certification.

This authorisation will remain in force unless withdrawn by me in writing.

Signed:

Date:

Name

Qualifications

Minor changes are defines as follows:

- Minor adjustments of cable truncation
- Minor relocation of street lighting of not more than 20 meters within the street lighting alignment (outside transmission line easement)
- Relocation of pillar for reticulation pump along the same LV feeder towards the district substation
- Relocation of mini pillars across side lot boundary from the corner of a lot to the corner of the adjacent lot
- Installation of cables (HV or LV cables) to the 2.7 m pole alignment to avoid trees and rocks only.

(Note: Any minor change revision submission must include a copy of this authorisation)

Appendix E Subdivision Design Drawing Minimum Requirements

- a) Title Block that must include the following information:
 - i) Name of Project and Staging
 - ii) Drawing Title
 - iii) Contact Details of Developer/Project Manager (Optional)
 - iv) Electrical Consultant Contact Detail
 - v) Lot Details
 - vi) Geographic Location provided in DIP drawing
 - vii) Street Smart (Optional)
 - viii) WAPC Ref No.
 - ix) HPC Ref No.
 - x) Drawing Scale
 - xi) Electrical Consultant Drawing Number
 - xii) Sheet Number
 - xiii) Revision Number
 - xiv) Sheet Size
 - xv) North Point
 - xvi) Date Drawing Created or revision.
- b) Revision box (Must be updated every time a change is made to a drawing once a copy has been received by Horizon Power)
 - i) Revisions Number/Letter
 - ii) Checked by
 - iii) Drawn by
 - iv) Designed by
 - v) NPER Engineer
 - vi) Date of Revision
 - vii) Provide clear/unambiguous description of changes to all drawing sheets
- c) Horizon Power's legend as per the CAD Interface Package.
 - i) All drawing symbology as per HP's legend including colour and line weights.
 - ii) All cable sizes to be identified and matched with legend.
- d) Safety Issues / Warnings
 - i) 'Dial before you dig' logo.
 - ii) Working in the vicinity of overhead lines to comply with 'WORKSAFE' clearances during construction logo.
 - iii) Telecommunications cables.
 - iv) High pressure Gas.

- v) High pressure Water.
- e) Feeder Loading and Voltage Drop Table
 - i) Must be updated in every stage.
 - ii) Must be included for every transformer utilised (even if there is only one lot added or it is situated outside the subdivision boundary).
 - iii) Include any transformer whose load is altered by other subdivision.
- f) All subdivisions must show:
 - i) Transformer name, size and location
 - ii) Transformer voltages
 - iii) Fuse and Circuit No.
 - iv) Amp rating of fuses
 - v) Cable size in mm²
 - vi) Accurate Circuit Description
 - vii) Maximum volt drop on each feeder
 - viii) Maximum current on each LV feeder
 - ix) Total current on transformer
 - x) ADMD specified

NOTE: Max current is to be calculated by the LV Design package and not determined arithmetically by adding individual customer loads.

- g) Street Lighting must show:
 - i) Type of lighting
 - ii) Location and orientation.
 - iii) If Decorative Lighting is installed, indicate colour and CU unit
 - iv) Indicate if lighting is Private or Horizon Power. If a private street light is installed, a separate drawing must be submitted to Horizon Power prior to handover.
- h) Substation and Switchgear land requirements drawing
 - i) Show substation detail with dimensions of land
 - ii) Location from lot boundaries and adjacent lot numbers must be shown
 - iii) Civil requirements (1 m above the 100 year flood level, retaining walls)
 - iv) Duct requirements (if set back in POS or private property)
 - v) If non-standard equipment is to be used, all equipment shall be evaluated to the current technical requirements as determined by Asset Management. The process requires a formal submission of application for equipment approval.
 - vi) This approval from Asset Management is required prior to submitting the design for conformance review.
- i) Pole numbers and location
 - i) Pole numbers or pick ID for all poles as part of the subdivision must be shown on the design drawing.

- ii) All pole locations need to be surveyed.
- j) HV and LV open points
 - i) Uni pillar (LU11) must be shown as 'on' or 'off' with arrow point indicating cable terminated on the top bar of the uni pillar.
 - ii) LV Blades (LU9) or LV Cable termination to LV ABC switch (LU37) must be shown as 'on' or 'off'.
 - iii) Switch point status on the HV of the RMU must be shown on drawing.
- k) Stage boundary
 - i) Must cover scope of all works, including working ends.
 - ii) Must include all lots that are provided with a LV supply in this stage and exclude those lots that do not have a supply for this stage.
 - iii) Must include all cables, substations, pillars, street lights and any other assets being installed or having their ON/OFF status changed in this stage.
 - iv) Must include removal, relocation or modification to any existing Horizon Power assets. This information will be provided in the DIP.

NOTE: Boundaries can be discontinuous, i.e. there can be a boundary around the entire subdivision and then a small separate boxed boundary around a uni pillar a distance away that requires its status changed from OFF to ON.

- l) Easements
 - i) Any existing or future transmission easements and assets must be shown.
 - ii) Any existing or future distribution easements and assets must be shown.
 - iii) Any existing or future easements for other utilities must be shown.
 - iv) For underground cable easement, a cross section detail must be shown.
 - v) Type of easement must be shown (167 easement or easement in gross).
- m) Design drawing must include:
 - i) All relevant sections and dependent equipment from previous stages must be included if the same transformer is being utilised.
 - ii) Previous stages adjacent to the subdivision must be shown having the equipment and cables at a line weight of 0 and using the same styles and colours.
 - iii) HV and LV interconnection points and sources of all feeders.
 - iv) Any existing transformer which was installed in the previous stage if its capacity is being utilised for the proposed subdivision.
 - v) Location of RMU / drop-out fuses if transformer is being installed or upgraded.
 - vi) A detail of location and clearances of all equipment to be installed in the vicinity of aerial lines, easements and structures, only where applicable.
 - vii) HV and LV working end pillars.
 - viii) Retaining wall detail showing minimum distance of pillar to wall.
 - ix) All pre-negotiated and pre-approved work partially or fully funded by Horizon Power as a note, including all material that Horizon Power is subsidising.

- n) Commercial, industrial and mixed use sites
 - i) Lot size in m.
 - ii) ADMD listed on each lot.
 - iii) For group housing, the number of units and total load must be shown.
- o) When submitting the drawing for conformance review (as per Electronic Submission Procedure)
 - i) All files should be placed into a zip file for every submission.
 - ii) Regardless if any of the file(s) have had their content changed or not, they should all be included into one zip file for a complete submission each time.
 - iii) Horizon Power's standard NPER certification letter and check sheet must also be included for every submission, unless a 'minor change notification' has previously been received in which case designer certification is required.

Appendix F Cable Duct Specification

INTRODUCTION

This specification applies to the supply and installation of ducts for electric cables. Unless otherwise specified, the Developer shall be responsible for the supply and installation of all cable ducts and concrete encasement (where required) as shown on the subdivision design drawings.

MATERIALS

All cable ducts must comply with AS/NZS 2053.1:2001 Conduits and Fittings for electrical installations – general requirements.

They shall be heavy duty (HD) category and either light orange in colour. In addition, all ducts must be non-metallic and comply with AS/NZS 2053.

SIZE OF DUCTS

There are numerous sizes available and they are 40 mm, 50 mm, 80 mm, 100 mm, 125 mm, 150 mm for rigid ducts. The appropriate size determined in section 8.12.6 of the UDS Manual must be selected. However, for 33 kV subdivisions, 150 mm duct must be used for the high voltage cable.

INSTALLATION OF DUCTS

All ducts shall be installed as per section 10.1.4 of the UDS.

SUPERVISION OF INSTALLATION

The Developer shall be fully responsible for the supervision of the duct installation. Any remedial works required by Horizon Power's Construction Project Manager shall be carried out promptly. Actual extra costs incurred by Horizon Power, as a result of such remedial works causing a delay to the Horizon Power contractor's work, may be charged to the Developer.

Appendix G HV Cable joint schedule

Subdivision Name: _____

Stage: _____

Subdivision No. _____

Date: _____

Location (Lot Number)	Type of Joint (Straight or Breech)	Manufacturer	Manufacturer's Cat No	Date of Installation
Cable Joiner or Cable Joiner-in-Charge:		Horizon Power Rep:		
Accreditation No:		Pay No:		

Appendix H Underground Construction Site Inspection Report

PRE-START MEETING				
Work Order #	ELLIPSE #	Date	Time On Site	Time Off Site
Subdivision Name				

Contractors

Developer:	Phone:
Consultant:	Phone:
Site Civil Supervisor:	Phone:
Electrical Installation Supervisor:	Accreditation #.
Cable Layer (1):	Accreditation #.
Cable Layer (2):	Accreditation #.
Cable Layer (3):	Accreditation #.
Cable Jointer (1):	Accreditation #.
Cable Jointer (2):	Accreditation #.
Cable Jointer (3):	Accreditation #.

Horizon Power

Construction Project Manager:	Employee #:
Construction Quality Control Officer:	Employee #:

Items to Discuss	Comments
Cable Alignment for Subdivision	
Boundary Pegs	
Final Ground Levels	
Depth of Cables	
Cables to be Capped	

Conduits	
Backfill	
Retaining Walls	
Footpaths & Street Lights	
Batters	
Drains and Water Ways	
Transformer and RMU Locations	
Materials	
As Constructed Mark Ups	
Site Inspection Frequency	
Start Date of Works	
Site Safety Requirements	
Site Environmental Requirements	
Other Notes	

Position	Name	Signature
Developer or Consultant or Site Civil Supervisor		
Electrical Installation Supervisor:		
Construction Project Manager		
Construction Quality Control Officer		

Underground Construction Site Inspection Report

TRENCHING				
Work Order #	ELLIPSE #	Date	Time On Site	Time Off Site
Subdivision Name				
Location in Subdivision				

1. Boundary Pegs in Place

	Condition	Comments
	Correct	
	No Pegs In Place	
	Some Pegs Missing	
	Finished Ground Level Defined	
	Other (See Comments)	

2. Trench Alignment

	Condition	Comments
	Correct	
	Incorrect	
	Other (See Comments)	

3. Trench Depth

	Condition	Comments
	Correct	
	Not to Start Up Agreement	
	Too Shallow	
	Too Deep	
	Other (See Comments)	

4. Bedding

	Condition	Comments
	Correct	
	Rocks In Bedding	
	Rubbish In Bedding	
	Install Suitable Bedding	
	Other (See Comments)	

5. Conduits

	Condition	Comments
	Correct	
	Wrong Alignment	
	Wrong Size	
	Wrong Class	
	Wrong Depth	
	Other (See Comments)	

Action Taken/Comments:

Position	Name	Signature
Construction Quality Control Officer		
Electrical Installation Supervisor		

Underground Construction Site Inspection Report

CABLE INSTALLATION				
Work Order #	ELLIPSE #	Date	Time On Site	Time Off Site
Subdivision Name				
Location in Subdivision				

1. Installation Method

	Condition	Comments
	Correct	
	No Rollers Installed	
	No Bells Installed On Ducts	
	No Stocking	
	No Break Load Device	
	Other (See Comments)	

2. LV Cable

	Condition	Comments
	Correct	
	Outside of Agreed Alignment	
	Incorrect Cable Size	
	Incorrect Cable Type	
	Cables Not Capped	
	Other (See Comments)	

3. HV Cable

	Condition	Comments
	Correct	
	Outside of Agreed Alignment	
	Incorrect Cable Size	

	Incorrect Cable Type	
	Cables Not Capped	
	Other (See Comments)	

4. S/Light Cable

	Condition	Comments
	Correct	
	Outside of Agreed Alignment	
	Incorrect Cable Size	
	Incorrect Cable Type	
	Cables Not Capped	
	Other (See Comments)	

5. All Cables Clear of Other Services

	Condition	Comments
	Correct	
	Incorrect	
	Protection Required	
	Other (See Comments)	

Action Taken/Comments:

Position	Name	Signature
Construction Quality Control Officer		
Electrical Installation Supervisor		

Underground Construction Site Inspection Report

JOINTING				
Work Order #	ELLIPSE #	Date	Time On Site	Time Off Site
Subdivision Name				
Location in Subdivision				

1. Installation Method

	Condition	Comments
	Correct	
	Wrong Joint Type	
	Wrong Joint Size	
	Joint Not Sealed Correctly	
	Cable Into Tee Joint Incorrect	
	Joint Incorrect Location	
	Other (See Comments)	

2. Pillars Locations

	Condition	Comments
	Correct	
	Changed From Plan Because?	
	Too High	
	Too Low	
	Other (See Comments)	

3. Pillar Terminations

	Condition	Comments
	Correct	
	Earthing Not Complete / Incorrect	
	Uni Pillar Cable Terminations Incorrect	
	Mini Pillar Cable Terminations Incorrect	
	Working End Not To Standard	
	Other (See Comments)	

4. Pole Terminations

	Condition	Comments
	Correct	
	Pole Terminations Incorrect	
	Street Lights Terminations Incorrect	
	Other (See Comments)	

Action Taken/Comments:

Position	Name	Signature
Construction Quality Control Officer		
Electrical Installation Supervisor		

Underground Construction Site Inspection Report

BACKFILL				
Work Order #	ELLIPSE #	Date	Time On Site	Time Off Site
Subdivision Name				
Location in Subdivision				

1. Backfill over Cables

	Condition	Comments
	Correct	
	Not Enough	
	Contains Rocks	
	Contains Rubbish	
	Other Contamination	
	Other (See Comments)	

2. Hard Cable Cover

	Condition	Comments
	Correct	
	Too Close to Cables	
	Not Above Cables	
	Missing	
	Other (See Comments)	

3. Danger Tape

	Condition	Comments
	Correct	
	Too Deep	
	Too Shallow	
	Missing Over Joint Area	
	Not Above Cables	
	Not Enough to Cover Multiple Cables	
	Other (See Comments)	

4. General

	Condition	Comments
	Cable Positioning Still Correct	
	Cable Positioning Incorrect	
	Other Utilities Inside Alignment	
	Other (See Comments)	

Action Taken/Comments:

Position	Name	Signature
Construction Quality Control Officer		
Electrical Installation Supervisor		

Underground Construction Site Inspection Report

INSTALLATION OF PILLARS, LV DISTRIBUTION BOARDS, TRANSFORMERS & SWITCHGEAR				
Work Order #	ELLIPSE #	Date	Time On Site	Time Off Site
Subdivision Name				
Location in Subdivision				

1. Switchgear

	Condition	Comments
	Correct	
	Incorrect Location	
	Damaged (Including Gas Level)	
	Too High	
	Too Low	
	Not Level	
	Locks Missing	
	Fuses Missing / Incorrect Size	
	Erosion Problem	
	Earthing Not Complete / Incorrect	
	Cables Not Supported	
	Other (See Comments)	

2. Pillars and LV Distribution Boards

	Condition	Comments
	Correct	
	Incorrect Location	
	Damaged	
	Changed From Plan Because?	
	Too High	
	Too Low	
	Erosion Problem	
	Earthing Not Complete / Incorrect	
	Other (See Comments)	

3. Transformers

	Condition	Comments
	Correct	
	Incorrect Location	
	Damaged (Including Oil Level)	
	Too High	
	Too Low	
	Not Level	
	Locks Missing	
	Fuses Missing / Incorrect Size	
	Erosion Problem	
	Earthing Not Complete / Incorrect	
	HV Cables Not Supported	
	Other (See Comments)	

Action Taken/Comments:

Position	Name	Signature
Construction Quality Control Officer		
Electrical Installation Supervisor		

Underground Construction Site Inspection Report

TESTING				
Work Order #	ELLIPSE #	Date	Time On Site	Time Off Site
Subdivision Name				
Location in Subdivision				

1. HV Testing

	Condition	Comments
	All Passed	
	Witnessed	
	Not Witnessed	
	Failed Sheath Test	
	Failed Megger Test	
	Failed VLF Test	
	Received Test Results	
	Not Received Test Results	
	Other (See Comments)	

2. LV Testing

	Condition	Comments
	All Passed	
	Witnessed	
	Not Witnessed	
	Failed Sheath Test	
	Failed Megger Test	
	Failed Resistor Box Test	
	Received Test Results	
	Not Received Test Results	
	Other (See Comments)	

Action Taken/Comments:

Position	Name	Signature
Construction Quality Control Officer		
Electrical Installation Supervisor		

Appendix I Equipment Drawings

This appendix contains additional drawings for key equipment used by Horizon Power in the construction of Underground Distribution Schemes (UDS).

The drawings are separated as follows:

- Low Voltage Equipment
- Substation Earthing Arrangement
- Substation Ducts Arrangement
- Street Lights
- Cable Trench Arrangement

Low Voltage Equipment Drawings

Listed below are examples of the drawings. All drawings prefixed 'U' and 'R' may be found in the *Distribution Construction Standards Manual* [3]. These drawings are not reproduced in the UDS manual.

Low Voltage Equipment Drawings Index of Drawings	
Drawing Number	Drawing Title
U8	URD Mini Pillar Installation Guide
R33	Mini Pillar XLPE Working End
U9	UDS Universal Pillar Installation Guide
U15	Cable to LV Isolators Crossarm & Cable Detail
U16/(1,2)	Cable to LV Bare Direct connected (intermediate / termination)
U17	ABC Fused Connection to Cable
U27	LV Cable to Fuse Switch
U35	Pillar Location and Exclusion Zone

Substation Earthing Arrangement Drawings

All substation earthing shall be installed in accordance with the relevant compatible unit (CU) drawings under section 10 'HU – High Voltage Underground' in the *Distribution Design Catalogue* [4]. Relevant arrangement drawings may be found in the *Distribution Substation Manual* (section 6) [7].

Listed below are examples of the drawings. These drawings are not reproduced in the UDS manual and can be accessed via the above link.

Index of Drawings	
Drawing Number	Drawing Title
HU5	Switchgear kiosk 3+0
HU6	Switchgear.kiosk 2+1
HU7	Switchgear kiosk 2+2
HU8	Switchgear kiosk 3+1
HU31	SPUD transformer 1 phase 2 bush
HU59O	Non-MPS transformer district outside installation
HU60O	Non-MPS sole use transformer
HU61	MPS district transformer
HU80	Switchgear kiosk 2 + 3
HU81	Switchgear kiosk 3+2
HU82	63 kVA 3 phase transformer
DSM-6-11	Outdoor Substation – Earthing Requirements
DSM-6-13	Outdoor Substation – Screening Arrangements

Substation Ducts Arrangement Drawings

Section 6 (Miscellaneous) of the Distribution Substation Manual [\[7\]](#)

Listed below are examples of the drawing. This drawing is not reproduced in the UDS manual and may be accessed by the document above.

Index of Drawings	
Drawing Number	Drawing Title
DSM 6-01	Substation Ducting Cross Sections – Civil Requirements

Street Lights Drawings

Distribution Construction Standards Manual [\[3\]](#)

Listed below are examples of the drawings. These drawings are not reproduced in the UDS manual and can be accessed via the above manual.

Index of Drawings	
Drawing Number	Drawing Title
R26/1	Street Light Cutout, Single Phase Supply
R26/2	Street Light Cutout, Single Phase Supply for Class II Luminaires
R26/3	Street Light Cutout Connection Arrangement for Electrical Attachment
R27	Fusing Arrangement for Street Light Columns
R32	Mini Universal Pillar Terminal Block Termination Block

All Horizon Power standard street light (non-decorative) equipment drawings are available from section 12 of the Distribution Design Catalogue [\[4\]](#).

Cable Trench Arrangements

All drawings prefixed 'R' may be found in the *Distribution Construction Standards Manual* [\[3\]](#).

Index of Drawings	
Drawing Number	Drawing Title
R55, R56, R57, R58, R59	Cable Trench Layout Examples
R52	Cable and Duct Placement on Truncations

Appendix J Operational Handover Certificate Template

Project:	
Asset(s):	

On this date: ____ / ____ / ____ and time: ____ AM / PM

Handover **from**: _____ **to** _____
 (Company) (Company)

I acknowledge that **control** of the asset(s) listed above has now passed **to** the party named above.

I acknowledge that the asset(s) listed above shall now be treated as **live**.

I confirm that those personnel who have not signed this certificate* have been **notified** of the transfer of control, and treatment of asset(s) as live.

Name	Company	Signature

**Additional personnel may sign acknowledgement of the handover using the table at the back of this certificate.*

I acknowledge that **control** of the asset(s) listed above has now passed **from** the party named above and is now under **our** control. (Sign acknowledgement below)

Name	Company	Signature

Attached Documentation – Operational Readiness Dossier*	CS10 Reference [†]

*The Operational Readiness Dossier should also include commissioning results.

[†]This reference may be a project folder on CS10, e.g. PMN/31/108/382V1

Additional Personnel – Acknowledgement of Handover

I acknowledge that **control** of the asset(s) listed above has now passed **to** the party named above.

I acknowledge that the asset(s) listed above shall now be treated as **live**.

Name	Company	Signature

Appendix K Electrical Cable Separation

Separation Requirement	Required separation between cables (mm)
Between property boundary and first cable	100
Between LV cable and LV cable	25
Between LV cable and HV transformer cable	50
Between LV cable and HV feeder cable	200
Between HV transformer cable and HV transformer cable	100
Between HV transformer cable and HV feeder cable	100
Between HV feeder cable and HV feeder cable	200
Between layers of cables	200
Note LV cables include both mains, service and street light cables.	

Appendix L Safety in Design Requirements

Demonstration of due diligence with respect to safety is required. This must cover the full life cycle of the asset that is created (or the remaining life of the modified asset) including decommissioning. The purpose of the safety in design process is to not only consider safe construction, operation, maintenance and decommissioning, but to also use these considerations in making design decisions, thus improving the safety of the installation in those lifecycle phases. The due diligence process should:

- a) Identify hazards present in the construction, operation, maintenance and decommissioning phases, and rate the severity of each hazard
- b) For each hazard, estimate the likelihood of the hazard causing physical harm
- c) Estimate the resultant risk (considering the severity of the hazard and the likelihood)
- d) Consider mitigating each risk by eliminating the risk, substitution (of material or process), isolation, administrative process, or the application of personal protective equipment
- e) Where risk mitigations are incorporated into the design, reassess the risk (which should be reduced)
- f) Document the process as a risk register, including the mitigations and resultant risk reductions