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1. SCOPE

This Work Category Specification (WCS) documents the *Service* requirements for underground civil work.

1.1 GENERAL

- (a) As part of and in conjunction with this WCS, read WCS133 for the general standards and conditions that are relevant to, and are incorporated into this category of work.
- (b) For the avoidance of doubt, a breach of a general standard or condition contained in WCS133 is a breach of WCS61.

1.2 APPLICATION

- (a) The application of *Services* includes, but is not limited to, the following functions:
 - (i) Civil works associated with initial or argumentation to the underground electricity network in urban and rural locations.
 - (ii) Cutting and removal of surfaces, for example concrete, asphalt and bitumen.
 - (iii) Excavation, backfilling and surface reinstatement of excavations and trenches.
 - (iv) Installation of *Conduits* and *Pipe*.
 - (v) Excavation for joint bays, earth and concrete *Pits*.
 - (vi) Installation of cable, direct lay, in *Pipes* and *Conduits*.
 - (vii) Installation of performed *Pits*.
 - (viii) Foundations for padmount transformers and ground mounted electrical apparatus (plant).
 - (ix) Retaining walls associated with ground mounted electrical apparatus.
 - (x) Precast / insitu concrete foundations for public lighting columns.
 - (xi) Vacuum excavations.
- (b) The *Service Provider* may be required to supply specialised *Services* of vacuum excavations, trenchless technology and construction of reinforced concrete *Pits*. The following documents detail the requirements for trenchless technology and reinforced concrete *Pit* construction *Services*:
 - (i) WCS61.1 – Underground Trenchless Technology.
 - (ii) WCS61.2 – Underground Reinforced Concrete Pits.

2. AMENDMENT RECORD

Version	Change
13	<ul style="list-style-type: none"> ▪ Removal of general standard and conditions clauses now published in WCS133. ▪ Removal of Appendix A – Work Process Assessment ▪ Removal of Appendix B – Sampling Plan ▪ Removal of Appendix C - Final Product Assessment. ▪ Reference to WCS133 added.

3. AIMS / OBJECTIVES

The aim of this WCS is to ensure:

- (a) The overall aims and objectives detailed in WCS133, Section 3 - Aims and Objectives, are met by the application of procedures herein.
- (b) The additional category of work specific aims and objectives below are met:
 - (i) Underground network civil infrastructure and Energex electrical assets are installed consistent with *Construction Standards*.
 - (ii) Delivery of civil construction for uninterrupted construction and maintenance of Energex electrical distribution and transmission network infrastructure.

4. COMPETENCIES, TRAINING AND QUALIFICATIONS

- (a) *Service Providers / Operators / subcontractors* performing *Services* are suitable licensed and trained in accordance with WCS133, Section 4 - Competencies, Training and Qualifications.
- (b) For competencies, training and qualification requirements specific to this category of work refer to the below included references and clauses.

4.1 ENERGEX COMPETENCIES

[Table 1](#) specifies the Energex Competencies / *Authorisations* (or combination thereof) that are Energex requirements to be held by *Operators*.

Table 1 – Operator Competencies

CAMS Code	Competency Description	Operator Requirements
<i>Operators hold the following competencies.</i>		
A OILS	Oil Spill Management (Note 1)	MO
A SOIL	Sediment Control Awareness (Note 1)	MO
A VIRO	Gen. Environment Awareness (Note 1)	R
A WEED	Declared Plants Management Awareness (Note 1)	MO
U EO	Electricity Officer	R
U GCI	Generic Contractor Induction	R
U OHAW	Overhead Safety Awareness	R
U UGAW	Underground Awareness	R
	Authorised Person (as defined in Electricity Safety Regulation 2013)	R
<i>Operators hold the following competencies when the relevant work activity is being undertaken.</i>		
A IWG	Individual Work Group	R
A RR	Restricted Recipient	MO
U SSAW	Substation Safety Awareness	R
	Excavation Plant (Note 2).	AR

Legend:

- R Required.
- AR As required.
- MO A minimum of one person on *Worksite* holds this competency.

Note 1: *Service Providers* with their own environmental training system equivalent as a minimum to the Energex environmental training system; may train and assess their own *Operators* as competent.

Note 2: *Operators* are to be trained and assessed as competent by a Registered Training Organisation (RTO) with appropriate scope for the plant being operated, and hold a current ‘Statement of Attainment’ or ‘Nationally Recognised Qualification’. Provide *Energex Officer* with a copy of current ‘Statement of Attainment’ or ‘Nationally Recognised Qualification’ for all *Operators* of excavation plant.

5. VEHICLES AND PLANT

For vehicles and plant requirements, refer to WCS133, Section 5 – Vehicles and Plant.

6. MATERIALS, TOOLS AND EQUIPMENT

- (a) For materials, tools, equipment requirements, refer to WCS133, Section 6 – Materials Tools and Equipment.
- (b) For materials, tools, equipment requirements specific to this category of work refer to the below included references and clauses.

6.1 NOMINATED TOOLS AND EQUIPMENT

[Table 2](#) specifies the nominated materials, tools and equipment required when providing *Services* for this category of work.

Table 2 – Materials, Tools and Equipment

Description	Supplier
Cable / Pipe locator	<i>Service Provider</i>
Sound barriers / fence	<i>Service Provider</i>
Road / surface cutting and rock breaking equipment	<i>Service Provider</i>
Sediment barriers / fence	<i>Service Provider</i>
<i>Shoring</i> systems	<i>Service Provider</i>
Backfill compaction equipment	<i>Service Provider</i>
Cable hauling system	<i>Service Provider</i>
<i>Conduit</i> sealing equipment	<i>Service Provider</i>
Concreting tools and equipment	<i>Service Provider</i>
Cable cutting crimping and sealing systems	<i>Service Provider</i>
<i>Pit</i> access cover lifting devices	<i>Service Provider</i>

7. SAFETY

- (a) For safety requirements, refer to WCS133, Section 7 – Safety.
- (b) For safety requirements specific to this category of work refer to the below included references and clauses.
- (c) Implement control measures to eliminate and / or reduce the following (but not limited to) risk exposures:
 - (i) Surfaces near edges of excavations with insufficient compaction of backfilling could be unsuitable for operation of heavy plant (e.g. backhoes).

8. ENVIRONMENT

- (a) For environmental requirements, refer to WCS133, Section 8 - Environment.
- (b) For environmental requirements specific to this category of work refer to the below included references and clauses.

8.1 ENVIRONMENTAL PRECAUTIONS

Take all precautions necessary to minimise or eliminate the effects of noise, exhaust gases, hydraulic fluids, lubricants, fuel, dust and other environmental pollutants emitted by plant and equipment during civil construction operations.

9. EXTENT OF WORK

9.1 GENERAL

- (a) For the general extent of work requirements, refer to WCS133, Section 9 – Extent of Work.
- (b) For extent of work requirements specific to this category of work refer to the below included references and clauses.
- (c) Provide *Services* in accordance with (but not limited to):
 - (i) Work Category Specification WCS61 – Underground Civil Construction.
 - (ii) Work Category Specification WCS61.1 – Underground Trenchless Technology.
 - (iii) Work Category Specification WCS61.2 – Underground Reinforced Concrete Pits.
 - (iv) Work Category Specification WCS133 – General Standards and Conditions.
 - (v) Energex Manual 00293 – Commercial and Industrial Substation Manual.
 - (vi) Energex Manual 00305 – Underground Distribution Construction Manual.
 - (vii) Energex Manual 00796 – JW Public Lighting Construction Manual.
 - (viii) Energex Form 1485 – Conduit Verification and Certification Sheet.
 - (ix) Energex Form 2121 – Safedig for Improved Power Supply We Upgrade Underground Installations (or *Service Provider* equivalent).
 - (x) Energex Form 2225 – Advice of Call.
 - (xi) Australian Standard AS 1289.0:2014 - Methods of testing soils for engineering purposes - Definitions and general requirements.
 - (xii) Australian Standard AS/NZS 2053.1:2001 - Conduits and fittings for electrical installations - General requirements.
 - (xiii) Australian Standard AS 3600-2009 - Concrete structures.
 - (xiv) Australian Standard AS 3610-1995 - Formwork for concrete.
 - (xv) Australian Standard AS 4373-2007 - Pruning of amenity trees.
 - (xvi) Australian Standard AS/NZS 4671:2001 - Steel reinforcing materials.
 - (xvii) Energex approved *Work Plan*, construction drawings and associated drawings and instructions. (*Worksite* specific and current amendment may be provided as part of the *Work Order*).
 - (xviii) Current plans detailing existing underground essential services infrastructure in the immediate area and surrounding the *Worksite*.
 - (xix) *Service Provider's* safe system of work.

9.2 DETAILS OF WORK

- (a) The extent of the construction work is incorporated in the *Work Plans*. The *Work Plans* are to indicate the full scope of the required construction work. *Work Plans* are issued to the *Service Provider* with amendments from time to time.
- (b) A *Works Order* supplied by Energex will include, but not limited to:
 - (i) Plans and drawings.
 - (ii) *Site* related information (e.g. existing underground installations).
 - (iii) Materials lists.
 - (iv) Any other instruction required to ensure the works are completed safely and effectively, with associated *Work Plans*, drawings and other information necessary to outline the *Services* required to be provided.

9.3 PREPARATION FOR CIVIL WORKS

9.3.1 Public Notification

- (a) Consult Energex Corporate Communications Group over *Services* being provided:
 - (i) To determine the most appropriate strategy for communicating with impacted community.
 - (ii) Advising distribution date of notification to local residents of impending works.
 - (iii) Ensuring affected local residents concerns are addressed.
- (b) Inform local residents of proposed *Services* being provided in their neighbourhood at least *7 Business Days* before scheduled work commences and not more than *28 Business Days* before work commences, using Form 2121, via letter drop method and assist Energex as required to advise the wider community by notification in the local press.
- (c) While providing *Services*, if the work requires access to private property, contact the owner / occupier to discuss proposed *Services* being provided and obtain written agreement of approval to enter property to carry out work. Resolve all objections received prior to work proceeding.
- (d) Where work requires the removal and reinstatement of a section of driveway to a property; contact the owner to discuss proposed works and obtain a written agreement of approval to remove a section of driveway and reinstate it after construction if agreement not initially provided prior to commencement of work. Resolve all objections received prior to *Services* being provided proceeding.
- (e) *Operators* are to briefly explain the nature of work being undertaken when approached by members of public while providing *Services* at *Site*.

9.3.2 Locating Existing Underground Services

- (a) Prior to commencement of any excavation works, for example ground penetration and / or mechanical excavation, the *Service Provider* is to ensure all underground services have been located and positively identified at the *Worksite*. Dial Before You Dig (DBYD) can be utilised for obtaining below ground essential service locations.
- (b) In Bulk, Zone and Commercial and Industrial (C & I) substation, there will normally be a higher concentration of underground electrical cables and other electrical infrastructure for example, earth grids in a confined area.

9.3.3 Photograph of Work Site

The use of photographic records of *Site* conditions prior to excavation is recommended. In this way the *Work Group* may defend themselves against unfounded accusations of causing damage.

9.3.4 Undisturbed Survey Marks

Exercise care so that no survey pegs or Permanent Survey Marks (PSMs) are disrupted during the course of providing *Services*. Should survey pegs or PSMs be disrupted, the *Service Provider* is responsible for reinstatement. The reinstatement of survey pegs or PSMs is only to be performed by a Registered Surveyor.

9.3.5 Setting Out of Work

- (a) Accurately set out:
 - (i) Works for exposing / locating existing underground infrastructure from available data.
 - (ii) For infrastructure to be constructed (the *Services* being provided).

Note: As detailed on construction drawings (*Works Plan*) and / or scope of works in conjunction with *Construction Standards*.

- (b) By agreement, Energex may assist with setting out of work.

9.3.6 Route Proving

- (a) Excavate trial holes along proposed route at critical locations to identify obstructions / confirm practicality of construction at various Locations of Interest and report to *Energex Officer* any required changes to facilitate uninterrupted infrastructure installation.
- (b) Excavate trial holes by hand only, assisted by mechanical plant and have typical dimensions of 500 mm x 500 mm x 300 mm -1000 mm deep.
- (c) Provide a record of existing essential services to assist with determination of the practicality of proposed construction, including consideration for relocation of existing essential services.
- (d) Final alignment is to be agreed with the *Worksite Supervisor* and the cable route marked on surface prior to start of excavations.

9.3.7 Breaking of Surface

- (a) Break bitumen, asphalt, concrete, paved or tiled surfaces (cut cleanly / neatly so edges not jagged) of footpaths and roadways in accordance with *Authorities* requirements.
- (b) During the removal of surface finishes (e.g. concrete, asphalt or bitumen); segregate, collect, treat (if necessary) and removed from *Worksite* in an approved manner the slurry formed by saw cutting operations.
- (c) *Worksite Supervisor* determines the most suitable method of installation under decorative driveways for example stencilled, stamped, pavers and exposed aggregate, which are in good or near new conditions for example, utilising directional bore for *Conduit / Pipe* installation.

9.3.8 Site Conditions

- (a) Unless otherwise indicated on an issued permit; make safe all roads and footpaths at the end of each day to allow normal pedestrian and vehicle use. Temporary reinstatement should be appropriate for the *Site* conditions and maintained until final restoration is completed.
- (b) During non-daylight hours utilising flood lighting; prevent excessive glare from flood lighting impacting on nearby vehicular and marine vessel traffic and or nearby residents and *Premises*.
- (c) Remove excess dirt, mud and sand from plant and vehicles before leave the *Site* and entering onto public sealed roads. No significant deposits of dirt, mud and sand left are to be left on sealed roadways.

9.4 EXCAVATION

Undertake all excavation for the provision of *Services* in accordance with requirements set out below:

- (a) All trenching and open cut excavation activities, are controlled as part of the Construction Safety Plan and complies with the *Laws*.
- (b) Take into account; proposed changes to existing finished surface levels when deciding depth of excavations to ensure correct depth of cover on underground component of infrastructure is maintained after completion of surface reinstatement.
- (c) Excavated spoil; not to be placed on the carriageway or in gutters.
- (d) Dispose of surplus spoil on the same day as excavation occurs. Where disposal of spoil is required; the *Service Provider* complies with the directions from *Authorities* on the location and manner of transport to an approved disposal *Site*.
- (e) Only dispose of spoil removed from *Site* at an approved facility or *Site* accepting the class of material being removed.
- (f) Vegetation obstructing access to *Site* is to be pruned (not broken by machinery) in accordance with AS4373, and trees (including palms) that are removed from *Site* during excavation are to have their stumps removed from *Site* also.
- (g) Keep disturbance of existing Energex cables and joints to a minimum.
- (h) Place suitable mechanical protection around Energex cables to prevent damage during excavation.
- (i) In some instances careful excavation of trial holes are necessary to determine in advance the alignment and depth of existing essential services and infrastructure to facilitate the installation of protective materials prior to excavating with machinery.
- (j) Limit the use of excavation by mechanical plant for example, backhoe in trenches when there is evidence of debris and rubble in the ground near existing underground electricity cables and essential services.
- (k) Typically over excavate for precast concrete component / module installation (e.g. precast street light column foundation) to allow 200 mm clearance around the precast concrete component / module when placed in excavation.

9.4.1 Trenches, Joint Bays and Pits

- (a) Excavate trenches, joint bays and openings for *Pits* in accordance with the construction drawings (*Work Plans*), scope of works and the Energex *Construction Standards*.
- (b) Confirmation by *Energex Officer* of any alternate alignments and depths of cover to overcome *Site* difficulties before proceeding with installation if nominated depth of cover and vertical or horizontal separation from other services or obstructions is likely to be reduced.
- (c) The *Energex Officer* will instruct the *Service Provider* on the type of mechanical protection to be installed, where the depth of cover or separation from existing essential services or other services to the electricity cables is less than those nominated by owner or controlling *Authority*.
- (d) The *Energex Officer* will instruct the *Service Provider* on the type of mechanical protection to be installed, where the depth to the electricity cables (excluding direct layed cables) is less than:
 - (i) 600 mm for cables / *Conduits* / *Pipes* installed in locations other than under roadways;
 - (ii) 750 mm for cables / *Conduits* / *Pipes* installed under Local *Authority* minor roadways; and
 - (iii) 1200 mm or as directed for cables / *Conduits* / *Pipes* installed under Department of Transport and Main Roads arterial roadways.

9.4.2 Excavation in Rock

- (a) Excavations in rock are works that require material to be first broken up by pneumatic tools or explosives, before it can be removed.

- (b) It is not considered excavation in rock when material can be reasonably removed by:
 - (i) A 7 tonne, 55 kW (74 HP) for distribution works / a 12 tonne, 60 kW (90 HP) for transmission works, mechanical excavator (in good working condition).
 - (ii) Moderate use of a jackhammer.
- (c) Notify the *Energex Officer* by submitting initial details of pending variation claim for excavation in rock before proceeding with further excavation.

9.4.3 Shoring, Trench Lining, Battering or Benching Excavations

- (a) *Shoring*, trench lining, battering or benching is to be established to prevent the collapse of excavation walls while providing *Services*. The construction of this infrastructure complies with *Laws* including all Australian Standards and State and Commonwealth Legislation.
- (b) *Shoring* and trench lining systems and equipment supplied and utilised are to be designed and certified by a competent person (e.g. structural engineer and or geotechnical engineer).
- (c) Construction and removal of certified *Shoring*, trench lining, battering or benching of excavations is to be undertaken by a minimum of two competent *Operators* who are qualified and trained to carry out this work.
- (d) While any work is progressing at the *Site* with open excavations, a minimum of one competent *Operator* who is qualified and trained to construct and remove *Shoring*, trench lining, battering or benching is on *Site* to:
 - (i) Examine the excavation including batter or bench and installed *Shoring* or trench lining each day, before *Operators* commence work.
 - (ii) Where deficiencies are detected in the excavation, *Shoring*, trench lining, bench or batter, work in the excavation ceases immediately and *Operators* do not enter the excavation until rectification has been carried out.
 - (iii) Regular surveillance of the *Shoring*, trench lining, batter, bench, sides and surrounding surfaces of an excavation is to occur while work is progressing to determine if any change in conditions has occurred. If any changed conditions are detected, the existing control measures to prevent the collapse should be assessed for their adequacy.

9.5 VACUUM EXCAVATION

9.5.1 Overview

- (a) Vacuum excavation *Services* are to comply with all the general requirements for excavation outlined in the clause 9.4 - Excavation.
- (b) Applications for vacuum excavation systems are summarised below, but not limited to:
 - (i) Pothole to verify location of existing underground infrastructure.
 - (ii) Obtain soil samples at varying depths.
 - (iii) Excavate ground openings in the vicinity of a high density of existing underground cables and essential.
- (c) Vacuum excavation systems use a wand (water or air pressure) to effectively expose existing underground services with minimal risk of damage. The wand nozzle has an oscillating configuration to disperse jet stream to prevent concentration in one spot.
- (d) Limit the water or air temperature to 38° C or pressure to 20.68 MPa (3000 psi).
- (e) When working near direct laid cable or joints, limit water or air pressure to 10.34 MPa (1500 psi) as vacuum excavation systems have the potential to cause damage to these assets.

- (f) Monitor water or air temperature and pressure data so that nominated limits outlined above are not exceeded during operation.
- (g) Fit a neoprene rubber or equivalent surround to the return tube inlet to prevent mechanical damage to direct laid electrical cables and joints where contact is possible.
- (h) Wand air and water is to be recycled (filtered) where practical.
- (i) Concentrated jet stream of water or air are not to be used to remove natural soil surrounding:
 - (i) In-situ fibre cement *Conduits / Pipes* or ducts.
 - (ii) *Conduits / Pipes* or ducts suspected to be Asbestos Containing Material (ACM).
 - (iii) Direct laid cables or joints.
- (j) Shield the *Worksite* to prevent over spray (water and soil or air and soil mixture) defacing surrounding street furniture and nearby buildings or vehicles. The shield is to remain in place until the excavation reaches sufficient depth to prevent the escape of over spray from excavation to the surrounding area.
- (k) Stop vacuum excavation if damaged electrical cable or joints are sighted and notify the *Energex Officer* and *Operators* are not to enter the excavation until instructed by the *Energex Officer*.
- (l) Exposed electrical cables or joints may require supporting and / or have electrical insulation barriers placed over them before vacuum excavation can continue.

9.5.2 Water or Air Pressure / Vacuum Excavation Plant

- (a) When excavating in the vicinity of energised electrical cables, ensure:
 - (i) Earth protection systems (fitted to plant / vehicles) are operational in accordance with manufactures guidelines.
 - (ii) Plant / vehicle is barricaded with separation distance to prevent physical contact by *Operators* outside the barricade.
- (b) *Operators* can in an emergency, shut down the excavation plant remotely (typically from outside the barricaded area surrounding the plant); when plant / vehicle has appropriate controls fitted.

9.6 INSTALLATION OF CONDUITS AND PIPES

9.6.1 Initial Installation

- (a) Install *Conduits / Pipes* and associated fittings and bends in accordance with AS/NZS 2053.1, and the construction drawings (*Work Plans*).
- (b) The rating for underground cables to be installed in *Conduits / Pipes* is heavily dependent on:
 - (i) The geometry of the *Conduit / Pipe* bank.
 - (ii) Spacing between *Conduits / Pipes*.
 - (iii) Depth these *Conduits / Pipes* are buried below surface level.
 - (iv) The thermal properties of the backfill around the *Conduits / Pipes*.Therefore the *Service Provider* is to ensure due consideration is given to the following during installation:
 - (v) Spacing between *Conduits / Pipes* in a bank and between *Conduit* banks maintained in accordance with the construction drawings.
 - (vi) Depth of *Conduits / Pipes* below surface level maintained in accordance with *Construction Standards*.
- (c) Confirmation by the *Energex Officer* of any changes to the *Conduits / Pipes*:
 - (i) Class.
 - (ii) Alignment.
 - (iii) Configuration (e.g. trefoiled or flat lay).

- (iv) Vary the length to overcome *Site* difficulties.
- (v) Require adjacent collars to be staggered.
- (vi) Spacers fitted to maintain the design layout.
- (d) *Conduit / Pipe* installed with depth of cover and clearances to sides of the trench in accordance with *Construction Standards*.
- (e) The *Service Provider* ensures that during the laying:
 - (i) The *Conduit / Pipe* is grit free at the time of laying.
 - (ii) Measures are taken to prevent later contamination by sealing the ends by an approved method.
- (f) After installation, including trench backfill and compaction, clean and test each *Conduit / Pipe* section with a mandrel (100 mm length and eye spigot each end) sized 6 mm less than the *Conduit / Pipe* bore.
- (g) The *Service Provider* is to replace or repair any defective *Conduit / Pipe* installations.
- (h) The *Service Provider* is to certify the *Conduits* they have installed have been tested and are suitable for cable installation. Use Form 1485 for this certification.
- (i) Install an Energex approved draw rope in each electrical *Conduit / Pipe* and reseal the ends (except *Conduit / Pipe* entering *Pit* chamber of the *Pit* and duct system).
- (j) For critical / high risk *Conduit / Pipe* installations (e.g. installations under *Authority* infrastructure such as road and rail corridors) there may be an added requirement to confirm *Conduits / Pipes* suitable for cable installation by CCTV system inspection of internal bore that:
 - (i) Has a self-levelling colour camera that clearly identifies any surface deformation of the internal bore of electrical *Conduit / Pipe* installations (e.g. minimum aperture / FOV of F2.0 / 75°, with light sensitivity of 0.5 Lux and image resolution of ≥ 540 TVL).
 - (ii) Records video (e.g. AVI Video).
 - (iii) Captures still images (for example JPEG image).
 - (iv) Has zoom capability (to move in on areas of interest for closer inspection and image capture).
 - (v) Has a distance counter and imposed digital representation of distance appearing on all still images and recorded video.
 - (vi) Has a inbuilt sonde for positively locating the camera head.
 - (vii) Profiles the internal bore of *Conduit / Pipe* installations either by mechanical skids (typically 6 mm less in diameter than the internal bore of *Conduit / Pipe* installation) or wave frequency equipment (or equivalent).
- (k) The *Energex Officer* is to approve all non-standard *Conduit / Pipe* installations.

9.6.2 Roadway Installations

Construct *Conduit / Pipe* installations across and along roadways; to prevent the crushing of installed *Conduits / Pipes* during the reinstatement and compaction of the roadway sub-grade and base course material by ensuring:

- (a) *Conduit / Pipe* of sufficient class that will resist the compressive forces of material compaction (e.g. using 125 mm HD *Conduit* instead of 100 mm LD *Conduit*).
- (b) Bedding material around *Conduits / Pipes* compacted to the same field dry density as the sub-grade material above.
- (c) Use of cable protection cover over *Conduit / Pipe* bank that will distribute the loads applied from above sub-grade material installation and compaction.

9.6.3 Apertures

- (a) Safely access all types of in-situ *Conduit / Pipe* in the existing Energex underground network by establishing an inspection window to determine content of the internal bore of in-situ *Conduit / Pipe* in first instance before any additional construction work, for example but not limited to, the removal of a section of the in-situ *Conduit / Pipe*.
- (b) Do not use reciprocating and cut off saws under any circumstance to cut into in-situ *Conduit / Pipe* on the existing Energex underground network.
- (c) When cutting apertures in PVC or polyethylene *Conduit / Pipe*:
 - (i) Only cut aperture (window) edges to sufficient depth to allow final removal of aperture (window) by lightly tapping out.
 - (ii) Fit all cutting devices used to cut an aperture in the wall of *Conduit / Pipe* (inspection window) with a depth control device to regulate the depth of any cut or penetration. The cutting tool or blade is not to penetrate through the internal surface of the *Conduit* wall.
 - (iii) Prior to using any cutting device to form an aperture in the *Conduit / Pipe* (inspection window), *Operators* are to fully expose the *Conduit / Pipe* to determine the location of cable/s in relation to proposed aperture. (Note that cables may have a set in them and may not be laying in bottom of the *Conduit / Pipe* bore).

9.7 CABLES

9.7.1 Protection

- (a) The *Service Provider* ensures cable protection (e.g. polymeric cover strip) is installed at the correct height above and centrally over *Conduits, Pipes* and cables in accordance with construction requirements after the installation of the granular or fluidised thermal backfill bedding material.
- (b) For some projects, cable protection will be positioned at the sides after the installation of *Conduits, Pipes*, cables but before installation of the granular or fluidised thermal backfill bedding material.
- (c) Where steel protection has been installed between cables and other existing underground essential services, or where cables have been laid at a depth less than those outlined in Statutory Regulations, the *Service Provider* is to record the position of the protection on the 'As Constructed' drawings.

9.7.2 Installation

- (a) The *Service Provider* is required to prepare for the installation of cables (unless directed otherwise) by:
 - (i) The placement of granular or fluidised thermal backfill bedding material (compact base layer) in the trench.
 - (ii) The setting up of cable installation plant and equipment.
- (b) The *Service Provider*:
 - (i) Plans the cable installation, and provides the *Energex Officer* with the cable tension pulling calculations for the proposed cable installation between each nominated entry and exit point.
 - (ii) Liaises with *Energex Officer* to ensure supplied cable lengths delivered on cable drums match the section length between joint locations for installation.
 - (iii) Liaises with *Energex Officer* to determine a suitable delivery time for cable drums.
 - (iv) Ensures cables to be installed are lubricated with an approved lubricant, and applied to the cable reducing frictional forces between cable and skid plate or *Conduit / Pipe* bore surface.
 - (v) Ensures that cables are installed at the correct depth, alignment and separation from other existing underground essential services (unless approved otherwise by the *Energex Officer*).

- (vi) Utilises a controlled tensioning device during the hauling of cables to prevent damage to cable being installed by limiting actual hauling tension to the maximum allowable for the cable or a lesser tension so that the maximum allowable side-wall pressure (according to the manufacturers recommendations) is not exceeded. The controlled tensioning device is to record the actual hauling tension on the cable for the installation. (Provide the recorded data in a format that can be read by Energex, e.g. a graphical representation plotting time elapsed against hauling tension and cable length installed.)
- (vii) Ensures *Operators* inspect cable as it comes off drum for signs of factory imperfections or damage and during the cable hauling for possible damage. Stop cable installation when damage is found, for *Energex Officer's* inspection.
- (c) *Operators* monitor cable for signs of cable damage during the cable hauling through contact with displaced cable rollers, snatch blocks, misaligned *Conduits / Pipes* and grit in trenches or *Conduits / Pipes*. Stop cable installation when damage is found, for *Worksite Supervisor's* inspection and where necessary for repairs to be made or identified for later action.
- (d) When cables are installed, position the ends in an elevated position.
- (e) Seal the cable ends with Energex approved seals, and inspect prior to and after installation of cables to confirm positive seal against contamination entry and where necessary reseal suspect ends of cables.
- (f) Direct lay cable installation is a specialised class of work consisting of excavating and *Shoring* of trenches (when required), hauling of cables into the open trench, backfilling around the cables with special Fluidised Thermal Backfill (FTB) [when required] followed by removal of *Shoring* and general backfilling of trenches. This is followed by *Reinstatement* of the road surface to allow access to the area.
- (g) *Operators*, do not install cables into previously installed *Conduits / Pipe* (by others) until they have confirmed the *Conduits / Pipes* are on the correct alignment at the correct depth below final finished surface level and clear of any obstructions.

9.7.3 Cable Drums

- (a) Handle cable drums so that:
 - (i) The drum axle is horizontal.
 - (ii) Stored in a manner to prevent damage.
 - (iii) Not dropped while being handled.
 - (iv) Lifted by means of lifting equipment, for example a crane or cable jinker, using a suitable drum spindle and conforming slings or chains (SWL of slings and chains not exceeded). For all lifting equipment used, test certificates are available, tagged with a current test label and maintained in good order.
- (b) Return cable drums to an Energex nominated location specified by the *Energex Officer*.

9.7.4 Scrap Cable (Conductor)

All scrap cable (conductor) and surplus cable (conductor) remains the property of Energex and taken into account when reconciling cable (conductor). The *Service Provider* returns all of the scrap or surplus cable (conductor) to the relevant Energex store.

9.7.5 Abandoned Cables

Completely remove in-situ underground cables to be abandoned. Where complete removal is not practical, then correctly terminate and label the abandoned cable. Fully detail the abandoned cable on the 'As Constructed' drawings, and the reference is to remain on all network data records until the abandoned cable is removed completely.

9.8 CONCRETE CONSTRUCTION

9.8.1 Foundation

- (a) The floor of the excavation to be a graded surface and reasonably smooth across the width of the excavation, and where practicable, also along its length.
- (b) After excavation, check the subgrade which will support the infrastructure foundation to be constructed, and if the subgrade is suspected as being inadequate (unstable) refer the matter to the Civil Construction Engineer for direction.
- (c) As a guide foundation subgrade details are as follows:
 - (i) Unstable soils are soft clay to sandy gravel with soil strength 50 – 150 kPa. These soil types may REQUIRE a foundation base (slab) of additional area to decrease the bearing pressure on the soil under the infrastructure. (Refer to Civil Construction Engineer before proceeding with construction while providing *Services* under this WCS).
 - (ii) Stable soils are very stiff clay to shale / rock with a soil strength of 150 kPa or higher. These soil types generally DO NOT REQUIRE a foundation base (slab) of additional area to decrease the bearing pressure on the soil under the infrastructure.

9.8.2 Formwork

- (a) Construct formwork in accordance with AS 3610, including current amendments.
- (b) All formwork to be rigidly constructed and true to the shape and dimensions shown on the construction drawings. Joints to be sufficiently tight to prevent the leakage of concrete. Formwork to be rigidly braced and strutted to prevent deformation under the weight and pressure of wet concrete, constructional loads, earth pressure and surcharge.
- (c) All concrete forms to be thoroughly wetted or oiled to facilitate stripping.
- (d) Remove formwork as soon as concrete has hardened sufficiently to resist damage from removal operations but in no case less than 24 hours after pouring.
- (e) In the case of early stripping of walls, re-strut the walls.
- (f) Do not strip soffits or roof slabs, less than 7 days after pouring.
- (g) Do not load any walls or roof slabs, before 21 days unless approved otherwise by the Civil Construction Engineer in charge of the infrastructure being constructed.

9.8.3 Reinforcing Steel

- (a) Reinforcement to be plain round bar or tempcore grade y-bar, or hard drawn steel wire fabric complying with AS/NZS 4671.
- (b) Reinforcing material used to be free of loose rust scale, grease, paint or any other contamination that may reduce the strength of the steel-concrete bond.
- (c) Reinforcing to be placed, tied and supported to ensure that it is fully covered by the concrete to the required distance. Place all reinforcement on bar chair supports when in horizontal plane; and against nylon bar chairs when in the vertical plane to ensure correct cover of concrete.
- (d) Cover the reinforcement to be 50 mm minimum, externally, and 30 mm minimum, internally unless specified otherwise.
- (e) Embedded items to be positioned carefully to ensure that they are correctly located and fixed to reinforcing steel.

9.8.4 Concrete

- (a) All concrete work to be in accordance with AS 3600.
- (b) Concrete is nominal Grade 32 (for non-aggressive soil and aggressive soil in dry conditions) with maximum aggregate of 20 mm and slump of 75 mm unless specified otherwise on construction drawings (*Work Plans*).
- (c) For grade of concrete in aggressive soil in extremely wet soil conditions please consult Civil Construction Engineer.
- (d) Use ready-mixed concrete:
 - (i) The location of the mixing plant is such that the concrete is poured within 1.5 hours from the time of batching.
 - (ii) Use no admixture in the concrete that adversely affect its strength, cause corrosion of the reinforcing or adversely affect the strength of the steel-concrete bond.
- (e) Placing of concrete is to proceed in a continuous operation until completion of the part of the work between construction joints:
 - (i) If stopping of concrete placement elsewhere is unavoidable, then make a construction joint where the concrete pour stopped.
 - (ii) Use a minimum of joints in the construction.
- (f) Thoroughly compact the concrete during the placing operation, so that no voids remain within the concrete:
 - (i) Using a mechanical immersion vibrator wherever possible.
 - (ii) Elsewhere by rodding or tamping.
- (g) The concrete is to have a smooth, hard surface finish, free of burrs or irregularities with straight edges (within tolerance).

9.8.5 Concrete Finish

- (a) Floors and top of roof to have wood-float finish.
- (b) Walls to have smooth off form finish.
- (c) All external angle corners to be radiused smooth.
- (d) Remove any projections and dags evident after formwork is stripped.
- (e) Make good any honeycombing by grouting solid with a structural non-shrink grout.
- (f) Should reinforcement steel be visible after stripping formwork, carry out no corrective work without approval from the Civil Construction Engineer.

9.8.6 Grouting

- (a) Grout to be nominal 1:3 cement / sand grout mix (unless specified otherwise on construction drawings / *Work Plans*) and used for grouting under base plates (e.g. base plate of steel public lighting columns).
- (b) Apply the grout in a 'fairly dry' mix that is pushed through from one side until it comes out the other side thus ensuring that the space is filled before trowelling off in a bevelled edge.

9.8.7 Drilling Concrete Components

Do not use explosive powdered tools, for example Ramset or HILTI guns, to penetrate reinforced concrete or precast concrete components.

9.9 PRECAST COMPONENTS

9.9.1 Identification

- (a) Clearly stencil precast concrete; components, modules or assembled combinations thereof delivered to *Site* with the following information:
- (i) Individual precast components net weight (Tonnes to three significant figures).
 - (ii) Assembled precast concrete compounds gross weight (Tonnes to three significant figures).
 - (iii) Method for lifting all precast components and assemblies.
 - (iv) Identification of lifting anchor points.
 - (v) Component type and date of manufacture (internal face only).

Note All alpha and numeric characters stencilled on precast components are to be a minimum of 30 mm high, paint of high visibility colour and placed on components at two locations typically top and side face of components.

9.9.2 Lifting / Handling

- (a) The lifting, handling and installation of precast concrete components / modules on a construction *Site* is in strict accordance with the *Laws* and the requirements of the relevant Australian Standards and Work, Health and Safety Regulations.
- (b) Should '*Reid Swiftlift*' or equivalent concrete lifting system be fitted for lifting precast concrete components / modules. *Operators* use only nominated lifting system components to lift precast component / modules by lifting from system anchors cast in concrete.
- (c) Lifting components / modules from all anchors provided. The load will always be shared between two diagonal points and enclosed ANGLE OF SLING / CHAINS IS NOT TO EXCEED 60°.

9.10 BACKFILL

9.10.1 Materials

- (a) Stabilised sand to be nominally 1:18 cement / clean sharp *Pit* sand (unless specified otherwise on construction drawings / *Work Plans*), and be thoroughly mechanically mixed; and placed without excessive water, using emersion vibrators.
- (b) The rating for the underground cables to be installed is heavily dependent on the backfill around the *Conduits / Pipes*, and cables. Therefore the *Service Provider* ensures due consideration is given to the following during installation of backfill materials:
- (i) Selection of bedding material to also take into account thermal resistivity of the bedding material. At maximum dry density thermal resistivity of the bedding material around the *Conduits / Pipes* or cables is no greater than 1.2 K m / W.
 - (ii) *Energex Officer* may request a sample of the bedding material to be used for thermal resistivity testing prior to installation.
 - (iii) Selection of the bedding material; also ensures that bedding material is maintained around the *Conduits / Pipes* and cables both during installation and at maximum dry density and type of bedding material utilised does not dry-out and shrink away from and form voids around the *Conduits / Pipes* and cables.
- (c) Acceptance of the tested and / or stabilised bedding / backfill materials by the *Energex Officer* when nominated for use to backfill around cables, *Conduits* and *Pipes* and reinstate excavations. The Project Manager will advise the *Work Group* when required of an approved source of suitable bedding loam, and any stabilisation of product the *Work Group* will have to undertake prior to installation of bedding loam.

- (d) The rock component of any backfill to be < 20% of the volume and no rock particle is to be > 75 mm across any face.
- (e) The lean mix, road base and the asphalt mixtures comply with the relevant *Authority* / Instrumentalities or road owner requirements.
- (f) The determination of a source of fluidised thermal backfill (which is used for heat dissipation for underground cables called Energex cable mix) requires the *Energex Officer* / *Service Provider* to provide the supplier with a mix design and confirm that a sample batch provides a satisfactory thermal resistivity.
- (g) Where required by the relevant *Authority* or owner, the *Service Provider* undertakes compaction tests in accordance with their requirement.
- (h) Where backfill composition requirements of the relevant *Authority* or road owner differ from this instruction; obtain approval from the *Energex Officer* prior to agreeing to these requirements.
- (i) Backfilled excavations nominated for soil testing to achieve insitu dry density not less than 95% of maximum dry density as determined by the modified AS 1289, compaction test unless specified otherwise. The testing is to be carried out by a NATA registered Laboratory.
- (j) For both granular and fluidised thermal backfill bedding material installations around cables, install and compact a base layer in the trench before installation of the cables. Allow sufficient time for the base layer to firm before installation of cable utilising flat and corner rollers to avoid scuffing.

9.10.2 Trench and Excavation Backfill

- (a) The *Service Provider* is to backfill all trenches and excavations in accordance with the *Authority* or owner specifications.
- (b) Carry out the backfilling of trenches and excavations as soon as practicable after *Conduit* , *Pipe*, cable and infrastructure installation, jointing and location recording is complete but not before installed infrastructure to be covered has been accepted by *Energex Officer*.
- (c) Screen the installed *Conduits*, cables and *Pipes* with approved bedding material, for example sand, loam or flowable fill, and protected with polymeric cable protection cover strip and / or marker tape as required prior to backfilling the remainder of the trench.
- (d) Depending on the location, backfill the remainder of the trench with excavated native soil, flowable fill or substitute material as agreed by *Authority* or owner.
- (e) Compact backfill during reinstatement to ensure ground subsidence will be negligible and the compaction complies with requirements of *Authority* / Instrumentality or owner. Consolidate each layer as it is installed.
- (f) Additionally it may be necessary to install drainage material that is plumbed into local *Authority* storm water drains.
- (g) After installation of granular or fluidised thermal backfill and cable protection the *Shoring* is to be partially or fully lifted to allow for further bedding material to fill the void between the bedding material and the native soil.
- (h) Place stabilised sandbags around existing essential services to prevent the ingress of granular or fluidised thermal backfill that would otherwise result in existing essential services being engulfed by fluidised thermal backfill.
- (i) Ensure that no damage is caused to other existing underground essential services while using mechanical rammers in locations where existing underground essential services are adjacent to or within the areas to be backfilled.

9.11 WORK COMPLETION

- (a) Leave *Worksite* in a clean and tidy condition with no potential for environmental harm to occur in accordance with the *Laws*.
- (b) The *Operator* ensures that at the completion of work; all *Worksites* are restored to a clean and safe condition, and that all waste material is removed from the *Worksite*. Return excess and scrap materials to the nominated Energex Store.
- (c) Submitted documentation includes the recorded details and signature of person authorising any constructions which differ from the approved Energex *Work Plans*. Obtain signed acceptance of alternative construction from the *Energex Officer* prior to application.

10. RECORDS

For records requirements, refer to WCS133, Section 10 - Records.

11. WORK VERIFICATION

- (a) For work verification requirements, refer to WCS133, Section 11 – Work Verification.
- (b) For additional work verification requirements specific to this category of work refer to the below included references and clauses:
- (c) Provide Energex with the option of attending *Site* to witness testing of *Conduits / Pipes* and cables installation.

12. GLOSSARY

- (a) For standard definition of words, acronyms and abbreviations used in this WCS, refer to WCS133, Section 12 - Glossary.
- (b) For addition definition of words, acronyms and abbreviations specific to this category of work, refer below.

Term	Definition
CCTV	Closed Circuit Television – a system that sends television signals to a limited number of screens.
Pit	An open hole excavation in the ground for the purpose of accessing and work on underground electrical <i>Conduits, Pits</i> , cables or cable joints.
Shoring	A system of temporary supports and sheeting material, to maintain the stability of the sides of an excavation (including trenches) to prevent collapse.

13. REFERENCES

- (a) For reference requirements, refer to WCS133, Section 13 - References.
- (b) For additional reference requirements specific to this category of work refer to Section 13 references and clauses below.

13.1 AVAILABLE DOCUMENTS

Make available (at all times) to Infield *Operators*, the relevant documents / forms listed in [Table 3](#) below for verifying *Service* requirements.

Table 3 – Available Documents

Document Reference	Detail / Description
Work Category Specification WCS61	Underground Civil Construction.
Work Category Specification WCS133	General Standards and Conditions.
Energex Manual 00293	Commercial and Industrial Substation Manual.
Energex Manual 00305	Underground Distribution Construction Manual.
Energex Manual 00796	JW Public Lighting Construction Manual.
Energex Document No. 4920-A4	Energex Overhead Construction Manual.
Energex Form 0099	Return of Energex Property – Contractor Use Only.
Energex Form 1485	Conduit Verification and Certification Sheet.
Energex Form 2121	Safedig for Improved Power Supply We Upgrade Underground Installations (or <i>Service Provider</i> equivalent).
Energex Form 2225	Advice of Call.
	<i>Work Orders</i> detailing the <i>Services</i> to be performed.
	Energex approved <i>Work Plan</i> , construction drawings and associated drawings and instructions. (<i>Worksite</i> specific and current amendment may be provided as part of the <i>Work Order</i>).
	Current plans detailing existing underground essential services infrastructure in the immediate area and surrounding the <i>Worksite</i> .
	<i>Service Provider's</i> safe system of work.

13.2 RECOMMENDED DOCUMENTS

Refer [Table 4](#) below for the recommended documents that are of relevance.

13.2.1 Energex Documents

Table 4 – Energex Document

Document Reference	Detail / Description
Work Category Specification WCS2	Underground Construction.
Work Category Specification WCS61A	Assessment – Underground Civil Construction.
Work Category Specification WCS61.1	Underground Trenchless Technology.
Work Category Specification WCS61.2	Underground Reinforced Concrete Pits.
SAHV	Queensland Electricity Entity Procedures for Safe Access to High Voltage Electrical Apparatus
Energex Manual 00301	Operating Practices Manual

13.2.2 Queensland Acts and Regulations

For Queensland Acts and Regulation requirements, refer to WCS133, Section 13.2.2 – Queensland Acts and Regulations.

13.2.3 Australian Standards and Other Documents

- Australian Standard AS 1289.0:2014 - Methods of testing soils for engineering purposes - Definitions and general requirements.
- Australian Standard AS/NZS 2053.1:2001 - Conduits and fittings for electrical installations - General requirements.
- Australian Standard AS 3600-2009 - Concrete structures.
- Australian Standard AS 3610-1995 - Formwork for concrete.
- Australian Standard AS 4373-2007 - Pruning of amenity trees.
- Australian Standard AS/NZS 4671:2001 - Steel reinforcing materials.
- Other relevant Australian Standards.

14. APPENDICES

There are no appendices included with this WCS providing additional instruction.

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