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Construction of Cable Route and Associated Civil Works

ETS-13-02

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1.0	21 Apr 26		Updated to align with current Australian Standards and to maintain consistency with, and potential conflicts against, relevant legislation in all Australian states. Transferred from signalling to track & civil renumbered accordingly.

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1 General

1.1 Scope

This document describes the requirements for the following works:

- Construction of cable routes.
- Construction of ULX and URX crossings.
- Construction of cable pits, jointing pits and cable turning chambers.
- Installation of all main and local signalling, communications and power cables.
- Cable routes interfacing with railway access road
- Removal of redundant material, equipment and surplus spoil.

This Standard shall be read in conjunction with all other relevant Signalling Standards referenced within this document.

Where an ARTC Standard prescribes compliance that exceeds the requirements of AS 3000 or AS 7703, the ARTC standard shall be adhered to. In the event of a contradiction between these standards, clarification can be sought from Engineering Services.

For installation of any services other than signalling, please refer to ETG-17-01 and AS 4799.

This document is multidisciplinary in nature and includes requirements applicable to both civil and signalling disciplines.

1.2 Document Owner

The Manager Engineering Services is the Document Owner. For any query, initial contact to be made at standards@artc.com.au.

1.3 Responsibilities

The Project Manager, business units and contractors to ensure the implementation of this standard during the construction works on ARTC network.

The Principal Track and Civil, and the Principal Signalling Engineers have shared responsibility for changes to this document and approving waivers.

1.4 Drawings

The documentation and drawings to be used in the execution of the works shall be the relevant approved drawings.

1.5 Definitions

The following definitions apply in this Standard. The terminology may not necessarily have the same meaning in other Standards or in referenced documents. In this document, the following definitions of terms shall apply:

Term or acronym	Description
ARTC	Australian Rail Track Corporation
ARTC's Representative	A person, company or authority nominated by ARTC to make engineering determinations on ARTC's behalf.
Contractor	A person, company or authority nominated by ARTC or ARTC's primary contractor to manage a specific contract.
CSR	Combined Services Route (CSR relates to the shared route of telecommunication cables, signalling cables and power cables. CSR does not refer to other services to be included in the shared route, such as water and gas)
External cable route	External cable route is any cable route not in a building
GLT	Ground Level Troughing
GST	Galvanised Steel Troughing
HDPE	High-Density Polyethylene
Internal cable route	Internal cable route means any cable route inside a building.
Location case (also called location cupboards or locations)	Location cases are signalling equipment cupboards or housings that are not buildings.
Local cable route (also called local route)	Local cable route is any cable route that does not fall into the category of main or internal cable route.
Local cables	Local cables are all cables not being main cables.
Main cable route (also called main route)	Main cable route means any external cable route that contains or is intended to contain at least one main cable.
Main cables	Main cables are any cables that are run from a cable termination point in one building, equipment room or location case to a cable termination point in another building, equipment room or location case. Note that joints in cables including those for loading and balancing purposes do not constitute a termination of the cable for the purposes of defining main cables.
NND	Non-destructive digging
OHWS	Overhead Wiring Structure
Project Manager	Is the person who is responsible for planning and monitoring, administration and control of project works
Signal Maintainer/Electrician	A person described as per ESP2001F-27
Site Supervisor	A person, company or authority nominated by ARTC or ARTC's primary contractor to manage the site
Stabilised sand	Stabilised sand is a mixture of sand and Portland cement in the ratio 10:1.
ULX	Underline Crossing
URX	Under-road Crossing

1.6 Referenced Documents

The following documents are referenced in this Standard:

1.6.1 Australian Standards

The following documents and drawings are referenced in this Standard:

AS/CA S009 Installation requirements for customer cabling (Wiring Rules)

AS 1074 Steel Tubes and Tubulars for Ordinary Service

AS 1289 Methods of Testing Soils for Engineering Purposes

AS 1379 Specification and supply concrete

AS 4792 Hot-Dip Galvanized (ZINC) coatings on ferrous hollow sections, applied by a continuous or specialized process

AS 2758.1 Aggregates and rock for engineering purposes concrete aggregates

AS 3000 Wiring Rules

AS 3972 General purpose and blended cements

AS 3996 Covers and Grates

AS 4799 Installation of underground utility services and pipelines within railway boundaries

AS 7664:2020 Railway signalling cable routes, cable pits, and foundations

1.6.2 ARTC Standards

ESA-11-01 Cables for Railway Signalling Applications – General Requirements

ESA-11-04 Pits and Turning Chamber requirements for Signalling Applications

ESC-03-01 Level Crossing Equipment

ESC-07-03 Small Buildings, Location Cases, Terminal Cases and General Purpose Cases

ESC-07-04 Install of Equipment Racks and Termination of Cables and Wiring

ESC-09-02 Lightning and Surge Protection Requirements

ESS-07-03 Installation of Trackside Equipment

ETC-08-04 Earthworks Construction Specification

ETG-17-01 Installation of Utility Services and Pipelines within Railway Boundaries

ETS-13-01 Installation of Underground Services Crossing ARTC Railway Tracks

WHS-PR-019 Excavation and Trenching

1.6.3 Drawings

Refer to Appendix C.

1.7 Environmental Considerations

All personnel are not exempt from statutory obligations and shall conform to all of the appropriate Local Government, Environmental Protection Acts and subordinate regulations applicable within the construction site jurisdiction.

All cable route/s shall be designed to be as unobtrusive as possible, both to reduce its visual impact on its surroundings and to avoid drawing attention to the presence of copper cable.

The route shall not be attached to or alter the appearance of any building or structure which is on a heritage list or is subject to a preservation order without specific approval from the relevant heritage authorities.

Vegetation (including trees or shrubs) shall only be removed or lopped to the least extent necessary to safely construct, operate and maintain the cable route and associated rail infrastructure, and to maintain required clearances. Care shall be taken not to damage the root systems of mature or substantial trees. All vegetation works shall be authorised by the ARTC Environment Representative and undertaken in accordance with the project environmental and heritage assessment and requirements, and only where lawful under the applicable State or Territory rail, transport and native vegetation provisions (including any relevant exemptions or approval pathways).

During the construction of trenching for buried cable route or ground level ducting, care shall be taken to prevent silt runoff into any waterway and to prevent blockage of any natural or track drainage.

1.8 Site Surveys

Site surveys shall be carried out to determine locations for external work including equipment, structures, buildings, equipment housings, track circuit limits, foundations, cable routes, under-track crossings and all like work.

Site survey drawings, installation drawings and notes etc. shall be prepared and submitted to ARTC's representative for acceptance at least 14 days prior to work commencing.

Site works shall be executed in accordance with the accepted site survey drawings, installation drawings and notes etc.

These site survey drawings shall show the information requirements in respect to cables routes as detailed in Section 16.

The final As-Built Site Survey Drawings shall reflect the requirements of Section 16 and include the installed cable route arrangements.

1.9 Cable Route Generic Installation Drawings

This Standard includes, or references, a number of standard installation drawings illustrating guidelines for the construction of cable route.

Where standard installation drawings are not supplied or where particular problems are encountered on site that require special arrangements or equipment to complete the work, the necessary construction/installation drawings shall be prepared and submitted to the ARTC representative for a determination to be made.

1.10 Existing Equipment

Where existing signalling or communications equipment, that is ultimately to be removed or recovered, inhibits the installation of new signalling or communications equipment, ARTC's Representative will determine the action to be taken. There may be a requirement to:

- Carry out temporary work through staged designs or by other means accepted by ARTC Project Manager.
- Re-position the new equipment.

1.11 Location of Existing Services/Cabling

The construction area is likely to contain numerous existing buried utility services e.g. water, gas, electricity, communications etc, not all of which are fully documented.

In the case of existing ARTC cabling, the Cable Search form (ETS1302F-01) contained in **Appendix A** shall be used. Cable search is required to identify the location of ARTC cables before commencing any excavation, boring or grading work.

Where utility services are involved, the search requirements relevant to each of the utility service providers shall be used.

2 Excavation, Boring, Backfilling and Compaction

ETC-08-04 and WHS-PR-019 should be referred for any excavation, boring, backfilling and compaction works and will take precedence in case of any contradiction with this standard.

2.1 Excavation

2.1.1 Location of Existing Services

Before excavation or boring operations commence, the location of all existing signalling and communications cables, railway drains and all other underground services in the area to be excavated including water, stormwater, sewerage, gas, power and telephone cables shall be located and marked.

The following steps are to be followed:

1. Mechanical excavation shall not be undertaken within the site until the locations of existing signalling equipment and systems both buried and above ground in the vicinity of the proposed mechanical excavation have been validated by a suitably qualified signal maintainer/electrician that is acceptable to the ARTC Project Manager unless approved otherwise.
2. Where the nearest edge of excavation work is proposed less than 2m from signalling cables and conduits, the location of existing services shall be identified. The means of identification and control shall be determined based on assessed risk and should include the use of NDD techniques or other means as accepted by ARTC. Distances outside of this should use ground penetrating radar to locate and mark the location of signalling cables and conduits.
3. Excavation, boring or grading works within the following distances of existing signalling service cables/conduits shall not be undertaken unless the location of these cables/conduits have been accurately located. If the cable/conduits cannot be located, electrical supply shall be isolated from:
    a. Cables carrying 120V (nominal) or below – 0.5m measured horizontally.
    b. Cables carrying above 120V– 2.0m measured horizontally.

    Works within these distances shall be performed during pre-agreed track possessions, unless when using hand digging or NDD techniques. All works should be carried out under the supervision of the Signal Maintainer/Electrician until all underground ARTC electrical cables in the area are exposed and/or are relocated clear of the worksite.

    When using NDD techniques that involve hydro-excavation to locate existing direct buried cables, the pressure should be set appropriately for the age, state and location of the existing direct buried cables.

4. Detailed plans identifying the excavation areas and all signalling equipment and systems locations should include the horizontal distances between the excavation and identified signalling equipment and systems. Where applicable, spatial data should be compiled in addition to the detailed plan. The detailed plans, in conjunction with any GIS spatial data, shall be submitted to the ARTC Project Manager for review and comment prior to commencing any mechanical excavation. Any incorrect signalling cables and conduits records shall be updated.

2.1.2 Preparation of Cable Route

The selected cable route shall be cleared and levelled only to the extent necessary to permit trenching and access for plant/vehicles. Any debris, excess soil and/or rock shall be disposed to a rubbish tip or other suitable location (including in corridor). Any railway materials (e.g. sleepers) in the cable route path shall be relocated to a suitably agreed location.

Care shall be taken to ensure that this work does not block natural drains or create un-drained areas.

Excavations shall be to the minimum width and depth necessary to best carry out the work in accordance with this Standard. The bottom of trenches shall be level and even, free from stones, sharp objects etc.

2.1.3 Stability of Excavation

Excavations in or near tracks, platforms or access roads shall be securely shored to prevent the sides of the excavation from collapsing. All trenches shall be shored to comply with the requirements of WHS (Work Health and Safety) obligations.

Excavation work shall not commence in or near tracks, platforms or access roads until sufficient shoring material is available on site to shore up the excavations as the work progresses.

2.1.4 Placement of Spoil

Spoil shall not be placed on top of pits, ballast, foul of track gauge or accessways. If spoil is to be temporarily placed on the track, tarpaulins, plywood or other suitable material shall be used to provide a barrier between the ballast and the spoil.

Spoil placed between the rails or within 1m from any rail shall not extend above the top of rail level.

Spoil shall not be placed in a position where it could obstruct track drainage or be washed into track drains or onto the ballast during periods of heavy rain.

Spoil shall not be placed in a position where it may damage or affect the operation of existing equipment (e.g. Mechanical signalling control rodding or wires, cable routes, power operated points etc.). redundant

2.1.5 Programming of work

At all times, the protection of existing infrastructure, the stability of adjacent terrain and the prevention of inadvertent entry to open excavations shall be managed to ensure safety of the works. Particular consideration should be made for times when the work site is unattended or kept open overnight.

2.1.6 Public Safety

To ensure the safety of all personnel including the general public, suitable barricades shall be erected around excavations or covers provided across excavations where continuous access is required across them, when work is not actually taking place. Barricades shall comply with the Work Health and Safety Act.

Excavation on platforms shall cause the minimum interference and risk to the public and train operators. Temporary covers shall be provided for trenches to allow access to trains, platform amenities and booking offices. At no time while train services are running shall access to or from the platform to any part of a train be blocked.

Excavated material shall not be stockpiled on platforms unless agreement is reached with the asset manager.

2.1.7 Proximity to Existing Services

When trenching alongside or across gas, water mains, or service utility lines, any restrictions applying to the easement shall be complied with, and liaison shall occur with the easement owners and service owners to establish mutually agreed methods of protection and support for the services.

Excavation within 0.5m of existing services shall not be permitted until the service is carefully exposed and protected in a manner agreed with the service owner.

On completion of the work, a joint inspection with the service owner shall be undertaken to confirm that no damage has occurred and that the service is operating correctly.

2.2 Inspection before Backfilling

Trenches and other excavations shall not be backfilled until inspected by the ARTC representative or nominated suitable contractor with signalling construction knowledge and appropriately signed off. A record of these inspections is to be placed on the site installation documentation.

2.3 Backfilling

Whenever excavation of the track formation occurs the formation shall be restored to meet the requirements of ETC-08-04.

A minimum of 50mm of clean fill shall be provided around, and over all cables or conduits, in accordance with AS 7664:2020 Section 3.11.

Where the buried pipe or cable is located in areas other than track formation, platforms, access roads or pathways, the trench above the clean fill shall be filled with material free of broken concrete, brick, rubble, wood, glass, rubbish, steel or other metallic objects which could damage the cable or effect the operation of electronic cable locators and shall have no particles greater than 50mm.

As a minimum, the top 300mm of fill in access roads or pathways which are not sealed shall consist of material which as closely as possible matches that in the road or pathway surface in both texture and density. The fill shall be compacted as necessary to achieve matching density. Where the road or path is sealed, the trench shall be capped with the same material to the same thickness as the original seal. Any substrate or capping layer below the seal shall also be matched.

Surface drains shall be reinstated during the backfilling operations.

The backfilling of the excavations will normally take up the majority of the spoil. However, any surplus spoil or unsuitable fill shall be removed for disposal at an appropriate location (including in corridor).

If the spoil removed contains a significant amount of clay but is determined by the ARTC (typically ARTC Project Manager in consultation with Asset Manager/SME) to be suitable, it may be used but is not preferred,

Prior to the issue of the Handover Certificate, all backfilled trenches and excavations shall be examined and any depressions caused by settlement or erosion of the backfilling shall be corrected and the cause rectified.

2.4 Compaction

The first 150mm of fill over cover strips or pipes shall be carefully compacted to ensure that the cover strips / pipes are not disturbed.

Trenches and other excavations in the track formation, platforms, roads, and pathways, through shunting yards or at the base of embankments shall be:

- Compacted in layers by mechanical means to achieve 98% Standard Compaction in accordance with AS1289
- Filled and compacted in layers of 150mm maximum thickness to achieve the specified density.

Tests shall be performed using a NATA approved laboratory to establish the backfill compaction levels achieved. These tests shall be representative of the full depth of the trench.

Where backfill does not achieve the required density, it shall be re-excavated to within 200mm of the cover strips and/or pipes and re-filled and compacted correctly.

Trenches and excavations in other areas, not specified above, may be compacted by any convenient means, e.g. by using the wheels of a backhoe or bobcat. Following compaction, the trench or excavation shall be finished with a slight mound, height equal to approximately 20% of trench width, to provide for further settlement.

3 Concrete and Stabilised Sand

3.1 General

This section of the Standard details the requirements for the supply of:

- concrete for the construction of foundations, footpaths, cable pits and other concrete structures of a minor nature.
- stabilised sand.

Except when otherwise approved by ARTC's representative, ready mixed concrete shall be the preferred option used in the construction of all concrete structures.

3.2 Ready Mix Concrete and Stabilised Sand

Ready mixed concrete and stabilised sand shall be produced in accordance with the requirements of AS1379. Responsibility shall be taken to ensure that concrete and stabilised sand is ordered with the correct properties for its intended application.

Concrete strength at 28 days shall be not less than 20Mpa.

Concrete additives shall not be used without approval.

3.3 Site Mixed Concrete and Stabilised Sand

The materials for site mixed concrete and stabilised sand shall be kept free of foreign matters at all times.

Concrete mix portions by volume shall be as necessary to obtain the necessary strength for the particular application with a minimum strength of 20Mpa for any application.

Portland cement type A to AS 3972 shall be used unless otherwise specified and aggregate shall comply with AS 2758.1.

Mixing water shall be clean and free from substances deleterious to concrete or steel.

Chemical admixtures or fly ash shall not be used in the concrete mix.

3.4 Concrete Reinforcing

All concrete structures and pathways shall be appropriately reinforced with welded steel mesh to AS 1304 and/or steel bar to AS 1302 of sufficient cross-sectional area for the calculated loadings.

Reinforcement shall be placed and tied (and/or welded) in accordance with the design drawings.

3.5 Concrete Finish

Internal concrete surfaces shall be free of voids and steel trowelled to a smooth finish. External concrete surfaces shall be finished to a non-slip wood trowelled finish.

Concrete edges and corners shall be chamfered to minimise chipping and breaking.

Concrete surfaces shall be level except where a slope is required to form a ramp or to disperse water away from a building or other structure.

4 Cable Route General Requirements

4.1 General

The setting out and the construction of the cable route shall be in accordance with the provisions of this document. Where requirements of this document cannot be met, as a minimum the requirements set out in AS 7664:2020 and AS/CA S009 shall be complied with.

Except as otherwise specified, the main cable route shall be installed on one side of the track (except where there are four tracks or more, in which case the route may be split to run down each side when convenient) and shall cross the track the least possible number of times.

Local cable routes shall be installed as required.

Cable routes shall, so far as possible, follow a constant grade and line.

Rough and uneven ground shall be levelled to the extent necessary to achieve this objective. Where buried route is installed, only sufficient surface levelling to provide access shall be carried out. Levelling work shall not adversely affect railway or natural drainage, or pedestrian or vehicular access routes.

4.2 Location of the Cable Route

Generally, the cable route shall be located as near as possible to the railway boundary. The preferred locations for cable routes are shown on Drawing Nos. SC 09 01/01, SC 09 01/02 and SC 09 01/03.

The following are conditions for cable routes where applicable:

- A minimum distance shall be 3m from the running face of the nearest rail to the cable route (including pits), unless agreed upon and approved by the Area Manager.
- Cable routes shall be parallel to the running lines wherever possible.
- Cable routes shall be located and installed so that it does not divert or interfere with any drainage (railway or natural) or underground services. It shall be ensured that the route will not affect the stability of any embankment or cutting.
- Where waterways, gullies, creeks, or roadways occur beneath the track, cable routes may be attached to existing bridge structures in accordance with Section 7. Where no suitable bridge structure or place of attachment is available, an under bore should be provided in accordance with ETS-13-01.
- Where possible, cable routes shall be on the side of the tracks not occupied by voltage earthed locations carrying above 120V, such as sub-stations, power sectioning huts and transformer locations.
- Cable routes under roadways shall be installed within the railway corridor boundary whenever possible.

Where the cable route cannot be located within the railway corridor, all negotiations with the owners of land affected by the proposal or with Local or Public Authorities shall be carried out by the ARTC Project Manager.

In such instances the detailed site survey drawing shall show the landowner's name and the deposited plan and folio numbers pertaining to the land.

Before construction, proper legal tenure via an easement or licences shall be obtained from the landowner permitting ARTC access in install the cable and gain access in future years for cable renewal/repair. Any special conditions of entry shall be noted in this document. The original of this document shall be managed by ARTC Property, the access updated in ARTC's GIS and advice provided to ARTC's Area Manager for the area concerned.

In the event of a contradiction, clarification can be sought from ARTC Property.

4.3 Types of Cable Route

Table 1: Types of Cable Routes

TYPE	DESCRIPTION	DRAWING NO.
1	Direct buried cable route	SC 09 01/04
2	Re-enterable cable route with cable buried in pipes with pits at regular intervals	SC 09 01/05
3A-3B	Cable buried in rock	SC 09 01/06

Where cables are buried through platforms Type 2. Re-enterable cable route shall be used.

Alternative types of re-enterable cable route may be submitted for consideration in specific circumstances.

4.4 Radius of Bends

The smallest radius bend in any cable route shall not be less than the manufacturers recommended minimum radius for the largest cable to be installed in that route.

4.5 ULX and URX

ULX and URX shall be provided in accordance with ETS-13-01 and with the provisions of Section 10.

4.6 Cable Pits

Cable pits, cable jointing pits and cable turning chambers shall be provided in accordance with the provisions of Section 11.

5 Buried Cable Route

5.1 General

To avoid the need to re-open cable trenches, main and local cables shall be installed in buried cable areas at the same time.

5.2 Depth of Cable Route

Cables and pipe buried in ground shall have a minimum cover of 600mm from the cover strip or topmost pipe to ground level.

The top of cables and pipe buried in the track formation shall be a minimum of 1600mm below rail level.

The form ETS1302F-02 Cable Trench/ULX/URX Inspection Reports (Appendix B) shall be completed.

Where cables are to be installed in ULX and URX pipes the provisions of ETS-13-01 and Section 10 shall apply.

5.3 Shared Trenches

Where communications cables are in the same trench as signalling and power cables, then:

- Communications cables shall be housed in separate pipes.
- The minimum separation between communications cables and signalling and power cables shall be as specified in AS 3000 and AS 7664.
- The communications cables shall be above the signalling and power cables for the total length of the cable run.

5.4 Protective Cover over Signalling and Communications Cables

In the case the minimum cover cannot be achieved due to permanent obstructions (e.g. rock, concrete, other services), alternate protection complying to AS 3000 must be used.

5.5 PVC Cable Marker Tape in Trenches

150mm wide orange colour PVC “DANGER RAILWAY SIGNALLING CABLES” marker tape shall be installed in all trenches 300mm below ground level except where cables are permitted in

shallow trenches due to rock, etc. when the depth of the marker tape shall be not less than 100mm above the protective cover.

5.6 Rock Areas

In rock areas, the cables shall be laid on a bed of sand 100mm thick. (Drawing No. SC 09 01/06).

The depth of cables in rock and shale areas shall be at least 600mm to cover strip or pipe.

The final 150mm of fill in trenches of rock areas shall be stabilised sand, or concrete if in vehicle access roads.

5.7 Cable and Pipe Ploughing – Preparation of Route

The cable route shall be prepared to permit the continuous ploughing of each drum of cable and pipe. Cable route preparation shall include:

- Grading and benching of the route as required enabling the cable and pipe to be buried at a constant depth.
- Drilling of rock/rock-sawing to enable the ground to be ripped.
- The cable route shall be pre-ripped prior to the cable being ploughed.
- Sufficient ripping passes shall be carried out to a depth of at least 150mm below the required cable route, to provide a suitable bed of fines irrespective of type of ground.

If the required depth cannot be ripped, cross ripping shall be carried out to ascertain a possible alternative agreed location for the cable.

Multiple parallel ripping passes shall be carried out where there is an abrupt change in direction of the cable route of 15° or more.

5.8 Cable Ploughing – General

Cable shall be ploughed by mechanical means using the method(s) which will ensure that:

- The maximum loads on the cables are less than 75% of the maximum tensile load recommended by the cable manufacturer.
- The cables or pipes are fed off the drums using mechanical means.
- Immediate automatic detection protection against overstress of the cable is provided.
- Where the cable or pipe undergoes a change in direction during the ploughing operation, a roller or tray is provided to prevent damage to the cable and pipe.
- The size of the roller/tray and feed tube is such that the radius bend in any cable is not less than the manufacturers recommended minimum radius bend for the largest cable being ploughed.
- The cable box is attached to the tyne and can be opened to enable the cable to be removed from the box without the cable being cut.

Cables and pipes shall be installed within a tolerance of ± 50mm of the nominal depth subject to the minimum cover not being less than 600mm.

Communications cable shall be separated as required by AS 3000 and shall be above other cables.

Vibratory ploughing that uses vibrating motions as well as draw bar pull to bury cables **shall not be used**.

Ploughing of cables across sealed or unsealed public roads and sealed private roads is generally not permitted, however:

- Ploughing across sealed or unsealed public roads may occur if acceptable to the relevant road authority (i.e. Council, Government Department, etc.).
- Ploughing across roads may occur if authority is granted by legislation (liaise with road authority should occur).
- Ploughing across unsealed private roads may, however, be permitted within the ARTC rail corridor and with prior approval from the ARTC Project Manager.

Ploughing generally will not be permitted within 1500mm of any water, electrical or communications or gas service or other service carrying dangerous or flammable materials.

5.9 Cable Ploughing – Testing

To demonstrate the ability to correctly plough cables, the first 100m shall be treated as the test section. These cables shall be installed in accordance with the proposed work methods.

The following tests should be carried out on this section of cable route:

- A longitudinal stress test to determine that the cable has been laid without excessive stress.
- Cable route preparation test to determine if the cable route has been adequately pre-ripped.
- Cable position test to determine the accuracy of the location of the ploughed cable and pipe.
- Testing to determine that no physical damage has occurred to the cable cores or insulation or to the pipe.

These tests shall be carried out in conjunction with ARTC's representative. Any unsatisfactory results shall be addressed, and changes shall be made to the ploughing methods.

5.10 Cable Ploughing – Restoration

Restoration work shall be carried out to restore the ploughed route to as near as reasonably possible to its original state. Included in this work is ground stabilisation and cross drainage, where required, to reduce possible future soil erosion.

Restoration work shall include:

- Removal of large rocks brought to the surface during ploughing or ripping.
- Nominal compaction of material left above ground by running a tractor track or rubber tyred vehicle (or similar weight) along the plough line.
- Mechanical compaction of the top 300mm of the ploughed trench in areas where scouring may occur along the main cable route or emergency off-road vehicle access is likely.
- Minimum back-blading to reduce erosion problems.
- Grass seed distribution where of benefit in reducing erosion or restoring appearance.

5.11 Buried Pipes

Pipes shall be rigid UPVC, HD Coreflo or HDPE, with any required jointing being in accordance with the manufacturer's recommended jointing methods. Signalling and Power pipes should be Orange and communication should be white.

Ploughed in pipes shall be flexible and of a mechanical design that will enable satisfactory installation without damage. These pipes shall be fitted with an appropriate draw rope at the time of their installation to allow cables to be drawn through them at a later date.

To ensure the availability of capacity for future works, the minimum diameter of pipes shall be at least three (3) times the cumulative cross-sectional area of the cable route requirements in that area but provision shall be made for the following, as applicable:

- Signalling and power cables shall be in separate pipes to communication cables.
- Cables carrying a voltage above 120V shall be in separate pipe to signalling or communications cable.
- Unless otherwise approved, optical fibre cable shall be in a separate pipe.

Except for directionally bored ULXs and URXs pipes shall be laid parallel and level in a consistent format in the trench and secured in that position.

5.12 Spare Buried Pipes

Spare pipes shall, as a minimum, be provided in the following situations:

- Cable Route
- ULX main route
- URX Main and Local cable route
- Type 2 Cable Route
- Type 3A and 3B

In each situation the level of spare pipe/s provided shall be One or 20% of the number of pipes, whichever is the greater and be rigid UPVC, HD Coreflo or HDPE

All spare pipes shall be tested for correct diameter by pulling a mandrel that is 90% of the internal pipe diameter through the pipe after installation, backfilling and compaction.

Spare pipes shall be cleaned, fitted with an appropriate draw rope with a minimum 2m slack, suitably anchored at each end of the pipe and then sealed with proprietary end caps to prevent the ingress of vermin or dirt, etc.

5.13 Pipes in Platforms and Other Paved Areas

Pipes shall be installed in platforms and other paved areas in accordance with AS 7664:2020 Section 4.5.

Where minimum cover requirements cannot be met and pipes are subject to vehicle loading, a reinforced concrete slab minimum 150mm thick, extending 300mm beyond the pipes on each side shall be provided.

Cable pits for cable pulling purposes shall be provided in platforms in accordance with the requirements of ETS-13-01, Section 10 and Section 11.

5.14 Cable Routes on Embankments

The methods proposed and or used shall be such that there will be no destabilising of the embankment and no erosion in the vicinity of the route.

Excavation and compaction shall be carried out in accordance with Section 2.

5.15 Underground Services of Other Authorities

Where any service including power, telephone, water, sewerage, stormwater, signals, communication, gas or drainage exist and will be affected by the proposed cable route, the buried cable route shall be laid 500mm below the obstacle or, if this is impractical, troughs or pipes shall be laid over the obstacle and continue for 3m each side of the obstacle.

The method to be used shall be determined in consultation with the service Provider.

5.16 Special Earthing Arrangements

Special earthing arrangements may be required for cable trenches in electrified traction areas.

Generally bare copper earth cables shall be installed in cable trenches in areas exposed to 25kv ac electrification.

Stainless steel earth wires shall be installed in cable trenches in all other areas. At a distance midway between location cases or buildings a 10m long gap is to be provided between the ends of the earth wires.

Earth wires within trenches shall not be located within 20m of any voltage earth installation carrying a voltage above 120V.

5.17 Pipes near substations

An ‘earth mat’ is provided around locations with cables carrying above 120V, such as substations, power sectioning huts and transformer locations, as part of the earth protection arrangements.

All cables (signalling and communications) to be installed within 20m of the earth mat shall be run in pipes. Details of the extent of the earthing arrangements around each installation should be provided.

Existing earthing arrangements shall not be disturbed under any circumstances.

5.18 Cable Route Markers

Cable route markers generally in accordance with drawing D08327 shall be installed on all buried cable routes.

In yard areas the markers shall be mounted on posts with 500mm protrusion above ground (or on an adjacent fence line where available). In all other areas markers should be mounted on posts with 1200mm protrusion above ground.

Cable route markers shall be installed at each:

- point where the route changes direction.
- end of ULXs.
- end of URXs.
- end of under creek crossings.

Cable route markers should:

- be installed in intervals no greater than 50m along the route such that two markers are visible at any point along the route.
- be placed close to a fence or other fixed structure and in such a position that they are not likely to be run over by track maintenance or other service vehicles.
- not be placed directly over the cable route.
- not obstruct footpaths, walkways or vehicle access ways.

Cable route markers may be installed on OHW structures where approved. The bonding agent used to attach the marker to the OHWS shall not cause deleterious effects to the structure or its protective coating.

6 GLT Cable Route

6.1 General

GLT shall be manufactured from reinforced concrete or from moulded HDPE, LDPE (MDPE) or GRP (e.g. Vinidex “Railduct 2000”).

If GLT is to be used in an area where vehicle access (railway maintenance vehicles including tractors, front end loaders etc) is possible, the trough and lid shall be capable of carrying a load of 4.5t over a contact area of 100mm x 300mm applied to any part of the lid – or the cable route may be converted to a buried pipe route for that trafficable area.

Communications cables shall not be installed in the same compartment within the GLT as power or signalling cable and cables carrying above 120V shall not be installed in the same compartment as signalling cables.

Concrete troughing shall be accurately manufactured to enable each segment to interlock securely with each other and concrete lids to fit securely on the top of the troughing without rocking.

6.2 Troughing Route Capacity

One or more troughs shall be installed to provide the necessary capacity to accommodate the cables.

To provide for future requirements, 30% spare capacity shall be provided in each compartment of the trough.

6.3 Installation of GLT

GLT shall be installed with the top of the lid approximately at ground level in areas that vehicles can access and with the top of the lid up to 75mm above ground level where vehicles cannot access. GLT runs shall have the least practical number of changes of direction and gradient.

The method to be used for change in direction of GLT route shall be determined by the extent of the angular change in direction and the minimum bending radius of the largest cable in the route. The GLT may either be cut in a series of angles, or a turning chamber may be used. Moulded or formed bends or similar shall be used with HDPE or LDPE trough.

Particular care shall be taken in the construction of a GLT route on banks and sloping sites to ensure that the supporting ground will not be eroded during periods of rain.

Where GLT is being installed near a running line it shall be positioned such that it will not obstruct or be likely to be damaged by, the removal and replacement of railway sleepers. GLT to be

installed within 3m of the face of the nearest running rail shall be installed such that the top of the GLT lid is not higher than 200mm below the underside of adjacent sleepers.

6.4 Drainage

In the installation of GLT special care is necessary to ensure that track and other drainage on ARTC's property is not affected. Ramps over drains, ducts and pipes under the GLT route shall be provided as directed.

Where GLT could act as a barrier to slow the dispersal of water during wet periods, drainage ducts shall be installed under the GLT following consultation with geotechnical personnel. These shall be located at vantage points to enable the quick dispersal of storm water.

Drainage ducts may be constructed from inverted GLT, pre-cast concrete box drains or PVC or HDPE pipes.

6.5 Lids

Where the laying of cables is part of the same contract as the construction of the cable route the GLT lids shall be installed after all the cables are laid, otherwise the lids shall be fitted as the GLT laying progresses. The GLT shall be thoroughly cleaned prior to installing lids.

If the GLT is in the vicinity of pedestrian walkways, etc, it may be required to fit the lids as the work progresses and reopen the GLT when required for cable laying.

After the cables are laid all cable entry points to GLT shall be sealed with an approved compound to prevent the entry of rodents and vermin. If the laying of cables is not part of the construction of the cable route contract, the cable-laying contractor shall be responsible for sealing the cable entries and refitting the lids after cable laying.

7 GST Cable Route

7.1 General

GST is the least preferred method of cable route construction and shall be used only where there is no viable alternative. GST shall be constructed from steel; hot dip galvanised to AS 4792 with a coating mass equal to Z430 or better.

The trough shall conform to the minimum base metal thicknesses for the various size ranges.

Troughs with a side wall height of 140mm or more shall have a stiffening rib in each side wall.

The bottom and sides of GST shall be provided with a continuous 9mm thick lining of stable thermal insulating material, such as fibre-reinforced cement, for fire protection.

Thermal insulation shall be continuous so that no cable is exposed to the base metal of the troughing. Any gaps in the thermal insulation shall be sealed with suitable thermally nonconductive, non-flammable sealant or cement.

In restricted areas, and only where clearance limitations demand it, such as in tunnels and along platform walls, slim-line cable ladders may be used in lieu of the steel troughing in accordance with the provisions of Section 8.

GST shall be generally constructed using 6m long lengths of troughing. Shorter length troughing may only be used to accommodate changes in direction of the route, or to suit equipment positions, or to accommodate heavier/larger GST with the approval of ARTC Project Manager.

Cable jointing bays shall be provided as required to ensure that there is no net reduction in trough capacity where cable joints occur and the bays shall be supported to prevent any deflection or twist of the jointing bay or cable route.

GST on walls or in tunnels shall be positioned such that the access to staff refuge recesses is not obstructed.

Steel cable troughing or support brackets shall not be fixed to or installed at such a distance that there might be a risk of 'flashover' in the event of a fault in the OHWS.

Where any metallic troughing or ladder passes within 2m of any OHWS, it shall be fitted with an insulated joint at least 2m distant from each side of the OHWS.

Steel troughing shall not be installed within 1500mm of the overhead wiring.

7.2 Troughing Route Capacity

One or more troughs shall be installed to provide the necessary capacity to accommodate:

- Main and local signalling.
- Power cables carrying 120V (nominal) or below
- Allowance of not less than 30% spare capacity to provide for future requirements.

Additional and separate troughs shall be provided for:

- Power cables carrying above 120V.
- Communications cable

7.3 Bends

The minimum radius of all bends in the steel troughing route shall comply with the requirements of Section 4.

All bends shall be smooth and rounded to prevent damage to or pressure on cables due to sharp corners or edges.

Changes in direction in the vertical or horizontal plane of the troughing route shall be at a maximum angle of 22.5° in all cases. Where, for example, 90° bends are required, they shall be made up of four 22.5° bends.

7.4 Expansion Joints and Insulated Sections

Troughing expansion joints shall be installed in the troughing runs at intervals of not greater than 50m and each expansion join shall provide for change in length for a temperature range -5° to 60°C.

Care shall be taken to ensure that the troughing is fixed to the troughing support brackets at the expansion joint only and arranged so that the troughing between expansion joints is free to expand and contract with temperature changes.

To minimise the effects of induced currents in steel troughing, insulated saddle joints shall, in addition to the requirements of clause 8.1, be installed in steel troughing runs at intervals of not greater than 300m and at each end of steel bridges when the route is attached to or supported by the bridge.

The insulated joints shall be arranged to provide a gap of 30mm between the ends of adjacent lengths of steel troughing

Care shall be taken to ensure that the troughing is fixed to the troughing support brackets at the expansion joint only and arranged so that the troughing between expansion joints is free to expand and contract with temperature changes.

7.5 Mounting Brackets and Fittings

Troughing support brackets, fixing and other fittings shall be of sufficient strength to support the troughing without permanent deflection when loaded to full capacity with cable plus incidental loads of up to 100kg applied at any point on the trough. A safety factor of not less than three (3) shall be applied to the brackets.

All components shall be protected against corrosion or made of corrosion resistant materials that will provide a service life of at least 20 years.

Troughing brackets shall generally not extend past the side of the trough by more than 25mm.

7.6 Troughing on Posts

Free standing GST shall be mounted on posts set in the ground to a depth of at least one third of the total length of each post or 500mm, whichever is the greater. All posts shall be vertical.

Posts shall be spaced so that any trough attached to the posts will not deflect or distort when loaded with the incidental load at the midpoint of the span. Post spacing shall be consistent except where a reduction is necessary for change of direction, support of a joint bay or termination of route.

Where post spacings in excess of 2m are proposed, proof of the capacity of the smallest trough in the route to support the specified loadings shall be submitted.

Posts shall be of sufficient section to support and shall not move in the ground with a vertically applied load of 250kg and/or with a load of 150kg applied horizontally to the top of the post in any direction.

The minimum height from ground level to the bottom of the lowest trough on a post line shall be 500mm.

The maximum height from ground level to the top trough on a post line shall be determined on the site survey.

7.7 Troughing on Railway Bridges or Viaducts

Where necessary to run a GST cable route on railway bridge structures or viaducts it may be attached to the structures subject to approval by ARTC and the Structures Specialist responsible for the relevant line section or corridor.

The structures asset manager will give direction as to which types of anchors or attachments are suitable for the particular structure in each case.

7.8 Troughing on Rock Faces

Support shall be sought from geotechnical personnel as to the most appropriate form of anchoring device to fix GST to open rock faces in the ARTC corridor.

The brackets and braces shall be of sufficient strength and the depth of penetration into the rock face shall be sufficient to support the loadings and safety factor specified in Section 7.

Spacing shall also comply with the requirements of Section 7.

The minimum height to the bottom of the lowest trough from ground level shall be 500mm.

Troughing attached to rock faces shall have a minimum clearance between trough and the rock face of 25mm.

7.9 Troughing on Walls

Support shall be sought from the Structures Specialist as to the most appropriate form of anchoring device to fix GST to existing walls in the ARTC corridor.

The brackets shall be of sufficient strength to support the loadings and safety factor specified in Section 7.

Spacing shall also comply with the requirements of Section 7.

The minimum clearance between the troughing and wall shall be 25mm.

7.10 Troughing in Tunnels or through Underbridges with Limited Clearances

In tunnels and through underbridges where clearances are limited at low level or where the troughing would interfere with access to refuges, the route shall be mounted on the wall at a height not less than 3800mm above rail level.

If the required clearances cannot be obtained using GST in a limited clearance area cable ladders may be used to carry the signalling, communications and power cables.

7.11 Troughing across Culverts etc

It is not permissible to install a cable route under culverts, gullies, stormwater channels, etc or to use above ground troughing on posts. A bridge structure to support the GST shall be used.

The bridge structure shall be wide enough to carry the number of troughs required and be of sufficient strength to avoid permanent deflection under the weight of all troughs plus 100% cable load in each trough plus two incidental loads of 150kg, one at 1/3 span and one at 2/3 span. A safety factor of at least three (3) shall be applied.

The bridge structure shall be supported on bearing plates, fixed at one end and free to expand/contract at the other. Matched expansion joints shall be provided in each trough.

7.12 Transition between GST/GLT/Buried Cable Route

An acceptable arrangement for transition between the GST and GLT is shown on Drawing Nos. SC 09 01/07 and SC 09 01/08.

The transition between GST and ULX and URXs, shall be made with a purpose-built adaptor manufactured to the same material standards applying to accommodate all pipes, including spares, from the buried cable route, ULX or URX, and shall extend from the cable route to within 300mm of ground level.

The void between the adaptor and the pipes shall be sealed.

Modifications to the GST route to accommodate the adaptor shall not result in cables being unsupported over lengths exceeding 600mm.

Acceptable arrangements for GST entering pits are as shown on Drawing No. SC 09 01/09.

7.13 Troughing Arrangements at Entries to Location Cases

The preferred arrangement for cable entries to location cases under typical site conditions are illustrated in Drawing Nos. SC 09 01/10 – SC 09 01/11 – SC 09 01/12. These arrangements shall be applied as far as possible for cable entries to all location cases.

7.14 Fitting of Lids

Lids shall be fitted onto steel troughing and secured with stainless steel strapping, one 100mm from each end of each lid plus additional straps as required to ensure a maximum of 2m intervals between straps.

Lids shall not be fitted until the cables have been inspected and approved.

8 Cable Ladder Cable Route

8.1 General

Cable ladder shall be provided where clearance limitations prevent the installation of GST or other types of cable route, such as in tunnels and along platform walls.

Cable ladder shall be manufactured from marine grade aluminium or stainless steel or, in areas that are not subject to ground water leaching through the tunnel or platform wall, galvanised steel.

Ladder widths should generally be restricted to either 150mm, 300mm, 450mm or 600mm. However other widths may be used if space limitations dictate.

Cable ladder shall not be installed within 1500mm of the overhead wiring, except where the tunnel profile precludes this clearance being achieved.

The ladder shall be of adequate strength to support the cable route when full to capacity with cable plus an additional load of 10%, or 10kg whichever is greater, without permanent deflection.

Cable ladder cable route shall be generally constructed using the maximum available lengths or cable ladder. Shorter lengths of cable ladder shall only be used to accommodate changes in direction of the route, or to suit equipment positions.

Cable ladder cable route shall be constructed and the ladder supported in accordance with the manufacturer's specifications or recommendations.

8.2 Cable Ladder Environment

Cable ladder cable route is generally required in areas where clearance limitations demand it. These areas include tunnels and along platform walls. The environment in tunnels and platform walls suffer from:

- Contaminated groundwater carrying highly corrosive products leaching through the wall.
- Stray electrical currents.
- High levels of ground borne vibration.
- High velocity winds with buffering from train movements.

The design, construction of and the materials used in the cable route, shall be suitable for this environment.

8.3 Cable Ladder Capacity

One or more cable ladders shall be installed to provide the necessary capacity to accommodate all the main and local signalling cables, and power cables carrying 120V (nominal) or below in the cable route plus an allowance of not less than 30% spare capacity to provide for future requirements.

8.4 Bends

The minimum radius of all bends in the ladder route shall comply with the requirements of Section 4.

All bends shall be smooth and rounded to prevent damage to or pressure on cables due to sharp corners or edges.

Changes in direction in the horizontal and vertical planes of the ladder route shall be constructed using the appropriate preformed bends and tees from the ladder manufacturer's range.

8.5 Joints, Expansion Joints and Insulation Gaps

Joints in the cable ladder shall use the appropriate splice plate from the ladder manufacturer's range and be fixed using the recommended size of fastener. Fastener material shall not corrode or cause corrosion of the cable ladder in the environment in which it is installed.

Expansion joints shall be installed in the cable ladder route at intervals of not greater than 100m using appropriate splice plates and purpose designed fasteners. Attachment to brackets between expansion joints shall be purpose designed to permit movement of the ladder due to change in temperature.

Air gaps of 30mm to 40mm shall be installed in the cable ladder route at intervals of not more than 300m.

8.6 Mounting Brackets and Fittings

Cable ladder brackets, supports and fittings shall be of sufficient strength to support the loading specified in Section 7, without deflection or distortion of bracket or support.

Ladder support arrangements shall be agreed by the corridor engineer/manager.

Cable ladder brackets and supports shall be constructed of materials that are compatible with the ladder material and will not result in electrolytic corrosion under the installed environment.

All bolts shall include self-locking nuts or other nut locking methods.

8.7 Cable Ladder in Tunnels or Through Under-bridges

Cable ladder and ladder supports and brackets in tunnels or under-bridges shall be installed clear of water springs, seepage and weep holes. Support centres shall not exceed 2m except where it can be proven that the type of cable ladder to be used and the support system is capable of carrying longer spans with the loading specified in Section 8.

A minimum clearance of 25mm shall be maintained between the cable ladder and the walls of the tunnel or under-bridge.

Unless otherwise approved, main cable ladder shall be mounted such that the lowest part of the ladder is a minimum 3800mm above rail level. The ladder shall not obstruct access to personnel refuge recesses under any circumstances.

Cable ladder on an irregular or rough finished tunnel wall (such as a shotcrete finished wall) shall be maintained in generally straight alignment by using standoff pillars as necessary.

Cable ladder, fittings, brackets, supports and lidding shall be securely fixed and fastened before trains are permitted to run on the track adjacent to the installation.

8.8 Transition between Cable Ladder / Cable Ladder / GST / GLT / Buried Route

The transition between different cable ladder sizes shall be made using purpose-built adaptors from the ladder manufacturer's product range.

The transition between cable ladder and GST, GLT, pits or buried route including ULX and URX shall be made using purpose-built adaptors fabricated from the same material as the cable ladder.

The adaptor for ULX and URX shall be of sufficient size to accommodation all pipes from the ULX or URX, including spare pipes and shall extend from the cable route to within 300mm of ground level.

The void between the adaptor and the pipes shall be sealed.

Modifications to the cable ladder to accommodate the adaptor shall not result in cables in the cable ladder being unsupported over lengths exceeding 600mm.

8.9 Cable Ladder & Connection to Local Cable Route/Equipment

The connection of the main cable ladder route to local cable route and equipment shall be made using purpose-built tee pieces from the ladder manufacturer's product range.

8.10 Cable Installation

Cables shall be attached to the cable ladder using stainless steel cable ties at intervals not exceeding 600mm.

The cables shall be installed neatly in the cable tray and shall be laid in such a manner that minimises the need for cables to cross other cables.

8.11 Cable Ladder Covers

Cable ladder covers are only required where the bottom of the cable ladder is less than 2.4m above the adjacent rail level unless otherwise specified.

Covers shall not be fitted until the cables have been inspected and approved by the Site Supervisor. A record of this is to be attached to the site installation documentation for referencing by ARTC's representative.

Cable ladder covers shall overlap the adjacent covers by a minimum of 20mm (away from the direction of normal train movements) and shall be secured with stainless steel straps, one 100mm from each end of each lid plus additional straps as required to ensure a maximum of 600mm intervals between straps for 600mm wide ladder and a maximum of 800mm intervals between straps for other ladder widths.

9 Metal Pipe Cable Route

A metal pipe cable route shall only be used where there is no alternative and, unless otherwise approved by ARTC, only for local cable route.

The pipe shall be a 50mm minimum diameter nominal bore medium galvanised steel pipe (AS 1074). Where attached to a platform coping wall or tunnel walls, stainless steel full saddles at centres not exceeding 1500mm shall be used. Saddle connections shall also be installed adjacent to each side of any change in direction of the pipe and adjacent to any connection to equipment.

Saddles, other than those at changes in direction, shall allow for pipe expansion and contraction. Where necessary, an expansion sleeve shall be provided in the pipe.

10 ULX and URX

10.1 General

ULX and URX shall be constructed by thrust boring except where access for boring machinery is not available or the nature of the terrain or the size of ULX or URX renders boring impractical. Boring shall, in principle, be in accordance with the Australian Railways Association code of practice.

All ULX and URX shall be lined with Class 12 uPVC or HDPE pipes.

All main cable route ULX and URX shall include a minimum of 25% spare capacity with the minimum spare pipe requirements being in accordance with Section 5.

Where a single large diameter pipe is installed by boring, spare capacity in this pipe, provided it is not less than 50% of the cross-sectional area, may be accepted in place of additional pipes. Following the cable installation the spare capacity in large pipes shall be sealed at each end of the pipe.

Steel pipe shall not be used for a ULX under, or in the vicinity of, any electrified track.

Spare pipes shall be cleaned, fitted with a suitable draw rope suitably anchored at each end of the pipe and then sealed with proprietary end caps to prevent the ingress of dirt, etc.

10.2 Depth of ULX/URX

The top of ULX pipes shall be a minimum of 1600mm below rail level or 600mm below ground level whichever is the deeper.

The top of URX pipes shall be not less than 600mm below road or natural ground level whichever is the deeper. Buried route on each end of the ULX or URX shall be graded as required to line up with the ULX or URX pits or cable route.

Pipes shall be provided in the ULX and URX to segregate the various cables as specified under Section 4.

The use of water to soften the under track or under road formation for boring purposes is not permissible.

10.3 ULX or URX by Trenching

Where it is not practical to install a ULX or URX by the boring process, the ULX or URX shall be installed by trenching, backfilling and compaction in accordance with the provisions of Section 2, as applicable.

In continuous rock areas, permission may be given for the depth of ULX and URX to be reduced. In such cases the pipes shall be placed in a trench chased into the rock and encased in concrete with a minimum concrete cover of 150mm.

The form ETS1302F-02 shall be completed during the construction of the ULX and be attached to site installation records for review by ARTC's Representative.

The following inspections shall be carried out:

- Three days after the construction of the ULX to determine if there is any subsidence and remedy where necessary.

- Three days after any remedial work to determine if the subsidence has been halted and remedy where necessary.
- Two weeks after construction of the ULX if there is subsidence or other defect and remedy as necessary.

In each case, ARTC's Representative shall be immediately advised if any defect is found.

10.4 ULX

Trenched ULX should be located at least two sleeper spacings from any rail joints and be a minimum of 2m clear of the movable parts of switches and of the V-crossing of any points leads.

ULX pipes shall extend not less than 4m beyond the outer rail on each side of the track except where the ARTC rail corridor ends within 4m or there is a physical obstruction that precludes this requirement.

A cable pit, in accordance with the provisions of Section 11, shall be provided at each end of main cable route ULX pipes.

10.5 URX

When it is necessary to install a cable route under a roadway it shall be planned and constructed so as to cause the minimum disruption to the users of the roadway.

URX pipes shall extend under the nature strips and pathways into ARTC property on each side of the roadway sufficiently to provide a cable pit at each end of the URX that is wholly within ARTC property. Where the URX is wholly within ARTC property, the cable pits shall be at least 2.4m clear of the roadway edge.

Where ARTC property is unfenced or where the URX is wholly within ARTC property, bollards should be installed on the roadside of the pits to protect them from vehicular traffic. This is subject to approval by the ARTC Project Manager.

11 Cable Pits, Cable Jointing Pits and Cable Turning Chambers

11.1 General

Sizes and specifications for pits and cable turning chambers shall be in accordance with ESA-11-04, otherwise mentioned within this document.

Except where the width of the ARTC rail corridor precludes, pits shall not be located within 3m from the nearest rail of any track unless agreed upon and approved by ARTC Asset Management Authority.

11.2 Cable Separation in Pits

All cables shall be separated in accordance to AS 3000 as a minimum.

Communication cables shall not occupy pits with signalling or power cables unless the separations specified in Section 5 are maintained by fixed cable trough, ladder, tray or conduit within the pit.

Power cables carrying above 120V shall not be installed in the same pit with signalling cables or power cables carrying 120V (nominal) or below. The only exception is where the pit is used exclusively for cable hauling and does not serve any installation, jointing or termination function.

Where hauling-only pits are used, power cables carrying above 120V may pass through the same pit as signalling cables and power cables carrying 120V (nominal) or below. The following shall be provided for hauling-only pits:

- Power cables carrying above 120V are to be grouped together and enclosed in an orange-coloured covering.
- All cables are clearly labelled with the voltage(s) carried.

No other cables shall be placed in jointing pits containing cables carrying above 120V.

11.3 Location of Cable Pits

Cable pits shall be provided:

- At each end of main cable route ULX and URX.
- Where Type 2 cable route is specified, being placed not greater than 300 metre intervals.
- Where Type 3 cable route is specified, being placed at intervals of not greater than 300 metres.
- At interfaces with other type cable routes.
- Where determined by the CSR design.
- Where noted on the site survey installation drawings.
- At entries to equipment buildings

The maximum distance between pits shall be governed by the gradient of the route, changes in route direction, maximum allowable cable pulling tension and the drum length of cable.

Note: The construction of these will form part of the work covered by the relevant building Standard ESS-07-03 Installation of Trackside Equipment

11.4 Location of Cable Jointing Pits

Cable jointing pits shall be provided wherever:

- Optic fibre cable is to be jointed, and a suitable communications cable termination cabinet does not exist.
- Cable carrying above 120V is to be jointed.

Having regard to the need to have vehicular access for the splicing of optical fibre cables, cable jointing pits shall, where possible, be positioned where road access is available.

11.5 Location of Cable Turning Chambers

Cable turning chambers shall be installed in GLT, GST and cable ladder routes wherever cables are required to change direction sharply and either:

- The minimum bend radius for the cable cannot be achieved within the GLT, GST or cable ladder or,
- The cable is likely to bear heavily against sharp edges at the bend.

Additional cable turning chambers shall be installed, as noted on site survey drawings or called for in the Installation Drawings.

11.6 Construction of Cable Pits, Cable Jointing Pits and Cable Turning Chambers

Cable pits and cable turning chambers may be made from precast concrete, concrete cast in situ, brick, concrete block, HDPE, glass reinforced plastic (GRP), glass reinforced cement (GRC) or polyester cement depending on size, location and the loading to which the pit cover will be subject.

Table 2: Types of Pits and Cable Turning Chambers and Their Minimum Requirements

TYPE	MINIMUM REQUIREMENTS
Concrete	Shall have concrete floor > 75mm
Concrete block, brick	Shall have concrete floor > 75mm and shall include appropriate steel reinforcement
GRP, GRC, polyester, cement	Bedded on stabilised sand > 75mm thick
Cast in situ concrete ≤ 1500mm deep	Wall thickness > 100mm with 1 layer of F82 galvanised mesh reinforcement (cover = 50mm)
Cast in situ concrete > 1500mm deep	Wall thickness > 150mm with 2 layers of F82 galvanised mesh reinforcement (cover = 50mm)

Pits associated with GST to location case interface shall have minimum dimensions of 600mm x 600mm as shown on Drawing No. SC 09 01/12.

The depth of pits and cable turning chambers shall be to suit the depth of buried cables, pipes, as applicable.

The top of each pit or cable turning chamber shall be 100mm to 200mm above the surrounding ground level except on platforms, paved areas, pathways or roadways, sealed or unsealed, where the top of lids shall be flush with the surrounding ground level and the pit and lid shall be load rated to the vehicular or pedestrian load applying to the location.

All cable entries into pits and cable turning chambers shall have large radius rounded edges to prevent damage to cables during installation and to eliminate the danger of cables bearing on sharp corners or edges after installation. The ends of pipes and conduits shall be de-burred and chamfered.

Where pipes or GLT enter pits or cable turning chambers the pipe ends or GLT shall be encased in concrete for a distance of not less than 300mm to hold them securely in position.

A suitable bracket or tray shall be built into the side of each cable joining pit for securing the optical fibre cable joint unit. This shall be 200mm from the top of the pit on the opposite side to the cable route.

Drainage arrangements shall be provided at the base of each pit and cable turning chamber. These shall include installing drainage pipes to the nearest approved railway drain or to a public stormwater drain or natural drainage course, where possible. If no suitable drains exist a gravel drainage sump or pipe to the side of an embankment, shall be installed where applicable. Gravel drainage sumps shall consist of 20mm aggregate with a minimum depth of 300mm.

To provide for the support of cables in the vertical plane purpose made brackets and fittings shall be supplied and installed, at intervals of not greater than 600mm. Alternatively, cable trays or ladders may be used.

11.7 Erosion of Embankments

Where pits and cable turning chambers are installed on embankments, protection against erosion around and adjacent to the pit and special drainage arrangements shall be provided to ensure that there will be no undermining or deterioration of the embankment during periods of heavy rain.

12 Cable Installation

12.1 General

Cable routes shall be inspected by the Site Supervisor prior to installation of the cables and again after cable installation and prior to backfilling of trenches or fitting of lids, as applicable.

Cables shall be laid in accordance with the cable laying diagrams which shall nominate cable sizes to provide a minimum of two spare cores or 10% spare cores in each cable, whichever is the greater.

Communications cable shall be installed under the direct supervision of a person licensed by the Australian Communications and Media Authority. Communication cables shall be installed in accordance with AS/CA S009.

12.1.1 Communications

A means of direct communication shall be provided between cable gang pulling members to ensure that cables are not overstressed or otherwise damaged during installation.

12.1.2 Protection of Cables

Cables shall not be placed in any position, prior to laying, where they may be run over by vehicles or other machinery or where they are laying on sharp objects or over sharp edges. If a cable is run over at any time or otherwise damaged, then that cable shall be replaced before it is laid into the trench or troughing.

Cables shall be laid neatly, flat and parallel in trenches and troughing.

Special care shall be taken at bends or corners in the cable route and at entries into relay rooms and equipment buildings to prevent the interlocking or bunching of cables.

12.1.3 Order of Laying

In buried cable route, ULXs and URXs, communications cables shall be installed in the shallowest pipes whilst all other cables shall be installed in the deepest pipes prior to using other pipes. Pipes shall be sealed immediately following cable installation.

Cables shall be arranged to permit easy access for the installation of additional cables in the future.

Main cables shall be laid first in trenches and troughing with the local cables laid on top.

12.1.4 Separation

Communications cables in GLT shall be in a separate compartment within the GLT except where the communications cable is housed in a pipe or duct in which case it may be in the same compartment as signalling and power cables carrying 120V (nominal) or below.

Communications cables in above ground troughing shall be in a separate trough.

Communications cables, if housed in a pipe or duct may be run in the same cable tray or ladder as signalling and cables carrying 120V (nominal) or below.

Power cables carrying above 120V in GLT shall be in a separate compartment to all other cables and power cables carrying above 120V in GST shall be in a separate trough to all other cables.

12.1.5 Bonding Cables

In buried cable areas only long series bonds (longer than 8m) shall be laid in the main or local cable trenches and terminated at each end in bootleg risers located at a distance of 2.5m from the nearest rail.

12.1.6 Length of Cables

Sufficient length shall be allowed on the cable ends for the cables to be run to their final destination and be terminated on equipment, equipment racks, MDF blocks etc., as applicable.

Ends of cables (excluding fibre optic cables) to be jointed shall overlap a minimum of 1m.

Ends of fibre optic cables shall overlap a minimum of 5m. In areas of poor access, additional cable overlap shall be provided.

A minimum of 1m cable slack should be provided in the pits to assist with minor cable repairs.

12.1.7 Cable Joints

Joints in cables shall be kept to an absolute minimum. There shall be no joints in cables within flood prone areas, under roads or railway tracks, in buildings, in tunnels or within 10m of any earth mat. Cable lengths shall be arranged accordingly and cable termination boxes provided where necessary.

Un-terminated ends of all cables shall be neatly coiled and securely fixed to prevent damage and shall be sealed with approved heat shrink end caps to prevent the ingress of moisture before and after the cables are laid.

12.2 Protection of Cables During Installation

Signalling and communications cables shall be installed by hand pulling or by using mechanical tension limiting winches.

The limits of the mechanical properties of the cables as specified by the cable manufacture, particularly the maximum tensile rating, the maximum twist, the crush and impact resistance and the recommended minimum bending radius of each cable, shall not be exceeded.

The minimum bending radius for any cable shall be the cable manufacturer recommended minimums for pulling and for fixed installation.

During cable pulling, cable drums shall be supported on a horizontal shaft and turned by manually or mechanically rotating the drums to feed out the cable. Drums shall not be rotated by pulling the cable.

Cables shall not be flaked off the drum under any circumstances.

Cables shall be fully supported clear of the ground and other cables during pulling operations by the use of cable rollers.

Pipes into which cable is to be hauled shall be proven for adequate bore and cleanliness prior to cable installation by drawing a test mandrel 240mm long and 90% of the nominal internal

diameter of the pipes through the pipes prior to cable hauling. “Polywater” or equivalent approved lubricant shall be used to lubricate all cables being hauled through pipes or conduits.

Cable shall not be laid on or pulled over any projection, edge or corner or subjected to any localised compression.

When pulling cable through pits, rollers or guides shall be used to prevent the cable from rubbing on the ends of conduits, pipes or on concrete surfaces.

Extreme care shall be exercised in handling optical fibre cable as tension, crushing, kinking and bending outside the manufacturer’s limits will cause irreparable damage to the optical fibres.

Optic fibre cable shall be fitted with hauling eyes. When the cable requires hauling a minimum twist draw rope shall be fitted to the hauling eye via a purpose fit swivel. Connection to the cable by any other means will not be permitted.

A flexible tube shall be used for protecting and leading the optic fibre cable down to a duct entrance.

12.3 Cable Marking

During the cable installation process a form of permanent and unique identification shall be applied to both ends of every length of cable. This shall be as near as possible to the ends of the cables but clear of any part which may be trimmed off when the cables are terminated.

This cable identification shall remain clearly legible on completion of the installation and remain so for a minimum period of 10 years to facilitate future cable identification requirements.

Cable identification codes shall be in a format agreed with ARTC’s representative.

12.4 Sealing of Cable Entries

Following the installation of cables, all cable entries to location cases, equipment housings, small buildings etc shall be sealed.

The seal shall be constructed using a re-enterable fire-resistant material.

13 Testing of Cables

13.1 General

All cables shall be tested on the drum before laying to ensure compliance with the cable specification ESA-11-01 Cables for Railway Signalling Applications – General Requirements.

14 Cable Routes interfacing with Railway Access Road

14.1 General

Railway access roads are required to permit unrestricted access for track maintenance machinery or other vehicles. They shall be installed as shown on a plan included with the installation drawings.

14.2 Cable Route Intersection with Access Roads

Where a railway access road intersects with an area where buried cables are being installed at the standard depth of 600mm generally no special arrangements are required at that location and backfilling shall be carried out in accordance with Section 2.

Where the access road intersects with an above ground troughing route, the cables shall be run in buried pipes with pits each side of the roadway, generally in accordance with Section 5.

Where the access road intersects with a GLT route, pipes and pits may be used or the GLT may be laid 150mm below ground and be protected with a reinforced concrete slab.

14.3 Construction

Unless stated otherwise, access roads shall be a minimum of 3000 mm wide.

The access road construction is to be limited to the clearing of the 3000 mm wide strip plus any earthen drainage necessary to prevent water accumulating on the road. Drainage pipe work and sealing of the road is not required, but cross drainage to minimise erosion on slopes is a requirement.

The surface of access roads shall consist of a 100 mm thick compacted layer of road base, except where the road is over natural rock formations.

15 Removal of Redundant Material, Waste and Surplus Spoil

15.1 General

All redundant material, waste and surplus spoil shall be removed in accordance with the contractual obligations of the engagement under the guidance of the ARTC representative. These items may be stockpiled at locations nominated by ARTC's representative and then shall be disposed of progressively and expeditiously. Only if the spoil is not contaminated, it may be spread in the corridor to form a maintenance access surface in agreement with the ARTC Project Manager.

The work shall include the removal and disposal of any environmentally hazardous material or any equipment contained therein.

16 Detailed Site Survey Drawing

Where a Detailed Site Survey (DSS) drawing is undertaken, it shall be in accordance with ESS-25-01 and show all details necessary for the construction of the cable route unless identified otherwise.

The DSS drawings shall be prepared prior to commencing work on site and should be amended during the course of construction to reflect the installed and final As-Built arrangements.

In low-risk environments where interaction with existing or future services is unlikely, a reduced or simplified design package may be adopted without undertaking a full DSS. This reduction in detail shall be justified through a risk assessment and approved by ARTC.

As-Built information for new constructed cable routes shall be captured on DSS drawings where undertaken or on existing signal cable running plans.

17 Appendix A: Cable Search Form ETS1302F-01 (example only)

Safety and Systems (Track & Civil) - Form
ETS-13-02 Construction of Cable Route and Assoicated Civil Works
Form number: ETS1302F-01

CABLE SEARCH FORM

To be forwarded in duplicate with site plans to the ARTC representative

---

Part (1) to be completed by Enquirer

It is proposed to excavate/bore/grade in the section ..... and/or

in the exact area shown/marked on the attached site plan.

Name: ..... Location: .....

Company: ..... Phone: ..... Date: .....

Part (2) to be completed by ARTC Representative

A) THERE ARE NO ARTC CABLES IN THE SPECIFIED AREA

Name: ..... Phone: .....

Designation: ..... Date: .....

B) THERE ARE ARTC CABLES IN THE SPECIFIED AREA

The cables are * **underground / * on peg line / * in ground level troughing**, the location of which is indicated on the attached copy of the site plan.

(Cross out whichever is not applicable)*

If you will be excavating near the ARTC cables:

Please contact ARTC's nominated representative below by phone and advise date and time of excavation (14 days notice required)

Name: ..... Phone: .....

Designation: ..... Date: .....

Example Only

18 Appendix B: Cable Route Inspection Report ETS1302F-02 (example only)

TRENCHING / ULX / URX INSPECTION SHEET

Project: Inspection Sheet No:

IWP No: Date:

LOCATION:	SIGNALLING PLAN:
EQUIPMENT NO:	DSS:

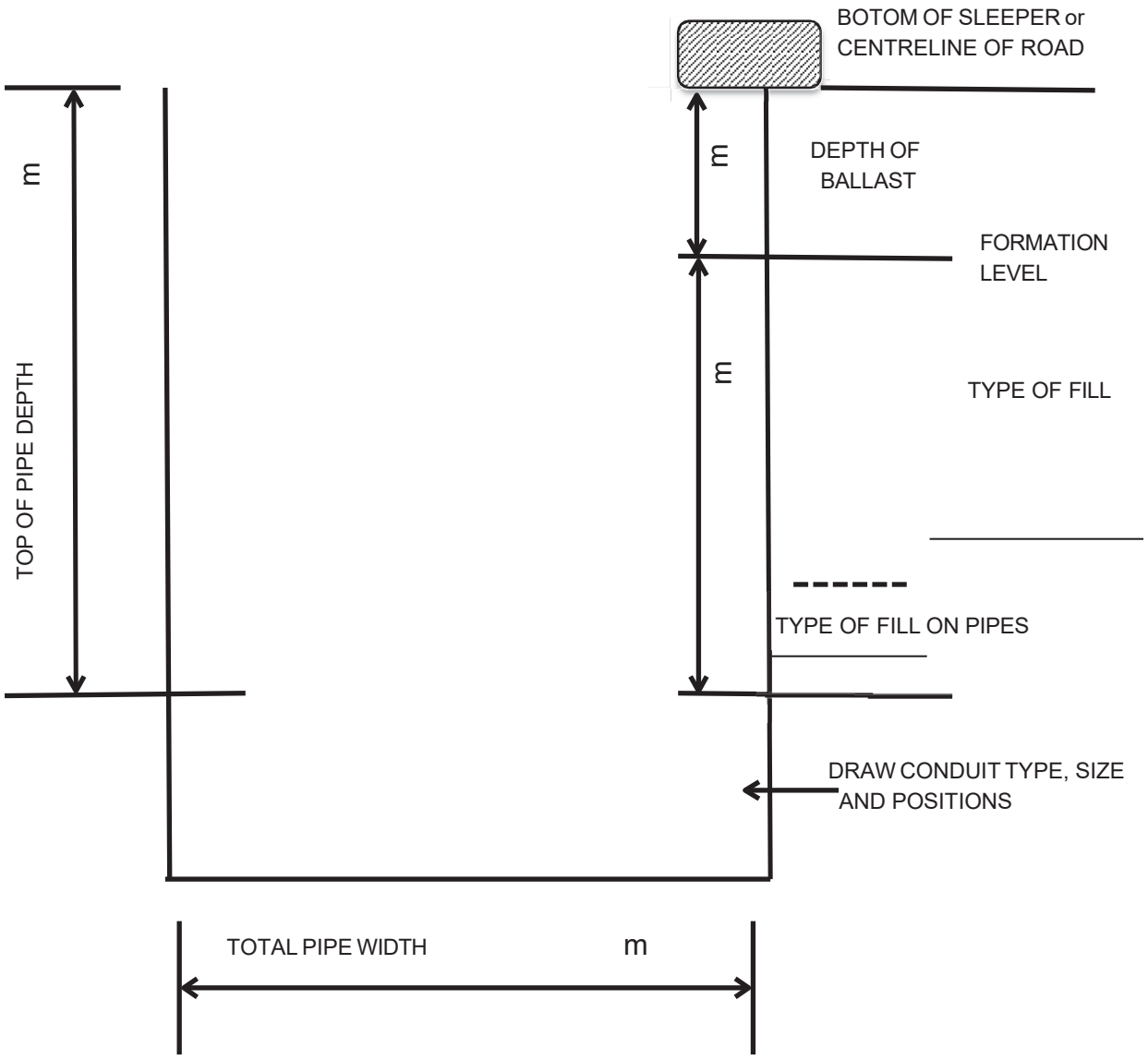
No	INSPECTION ACTIVITY/ACCEPTANCE CRITERIA	METHOD OF INSPECTION	VERIFIED or TESTED BY			COMMENTS
			Result	Init.	Date	
1	Conforms to Detailed Site Surveys	Measure				
2	Depth to top of Pipe / Cable	Measure prior to backfill	mm			
	Trench 600mm min		mm			
	Open Cut ULX 1600mm below		mm			
	Bored ULX / URX		mm			
3	Bedding sand - rock areas	Yes/No	mm			
4	Pipe sizes and number correct to DSS.'s	Visual prior to backfill				
5	Conduits - flat and parallel	Visual				
6	Fill - nothing larger than 50mm	Visual				
7	Direct buried cable - flat and parallel	Visual				
8	Direct buried cable – Vinidex Installed	Visual				
9	Compaction Required (Provide results if Yes)	Visual				
10	Marker tape	Measure	mm			
11	Ballast – clean and tamped - ULX	Visual				
12	Cable Route Markers	Visual				
13	Conduits proved for continuity	Visual				
14	Fill humped above ground level	Visual				
15	Ground Area restored	Visual				
16	Spoil - remove to stockpile	Visual				
17	Distance from the centerline of the nearest structure	Structure type:	mm			

Remarks/Remedial Action Required:

Work Status Statement The equipment described above has been installed and parameters recorded in accordance with the applicable standards.		**Received/Checked/Action Statement**	
Name:		Name:	
Position:		Position:	
Signature:		Signature:	
Date:		Date:	

ULX/URX FINAL CROSS SECTION

(DRAW PIPE ARRANGEMENT)



Remarks/Remedial Action Required:	Follow Up Inspection:

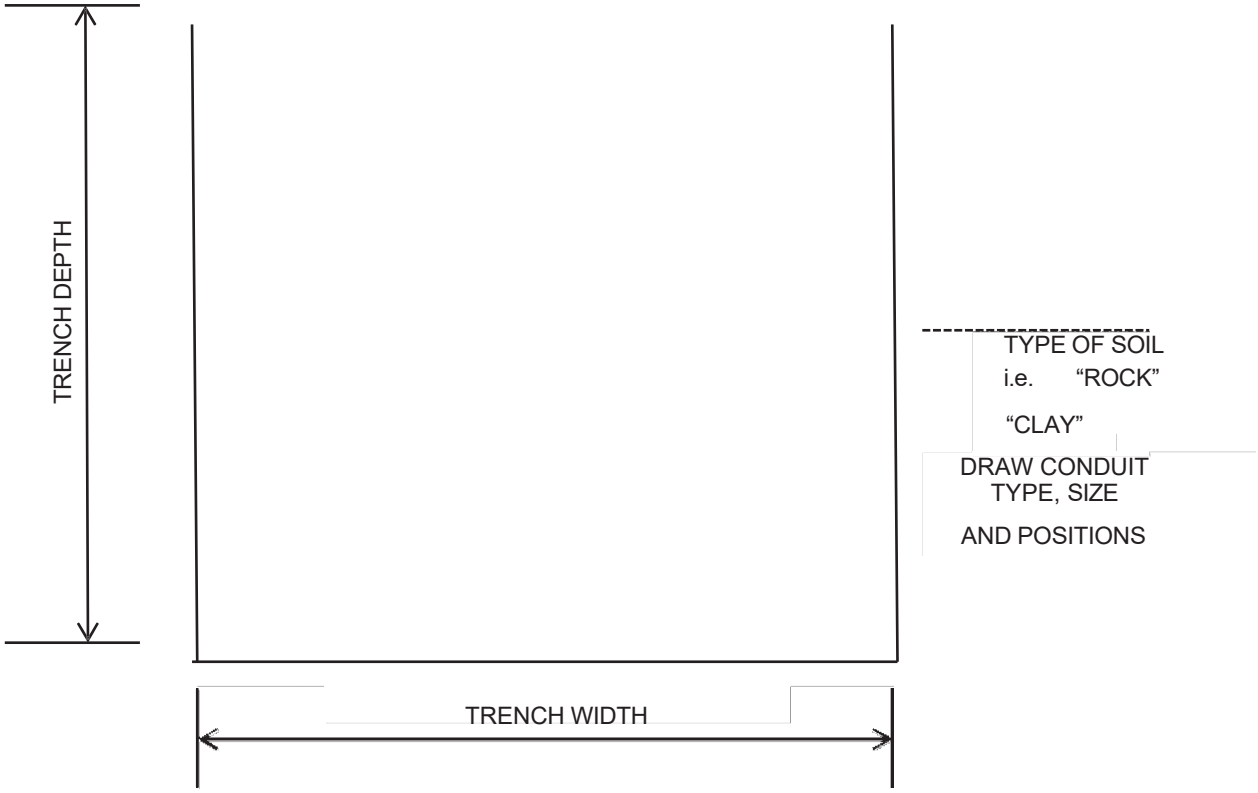
Work Status Statement The equipment described above has been installed and parameters recorded in accordance with the applicable standards.		**Received/Checked/Action Statement**	
Name:		Name:	
Position:		Position:	
Signature:		Signature:	
Date:		Date:	

Appendix B: Cable Route Inspection Report ETS1302F-02 (example only)

BCR TRENCHING REPORT SHEET

TRENCH	Kms	DATE COMPLETED
BCR		

FINAL CROSS SECTION

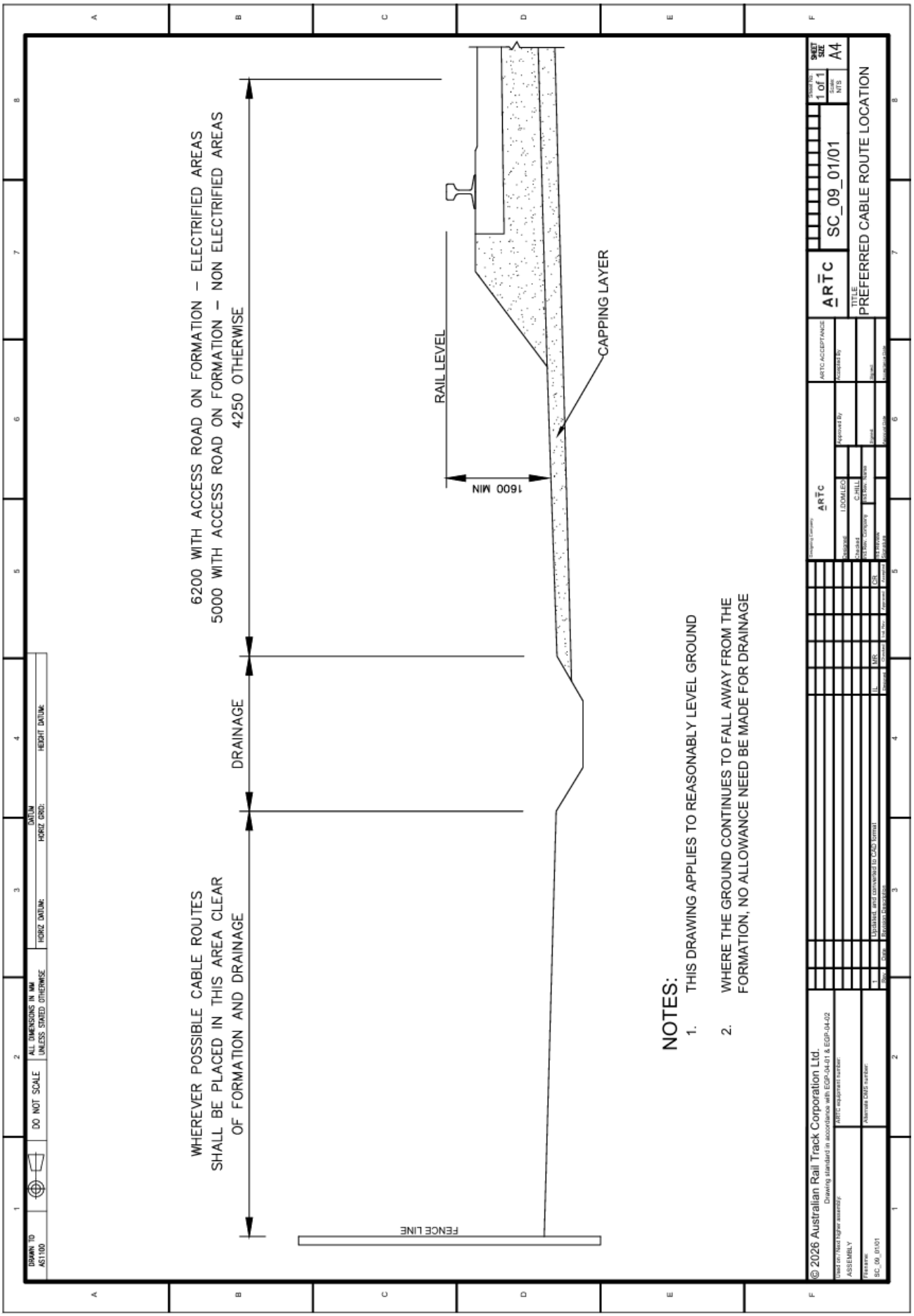


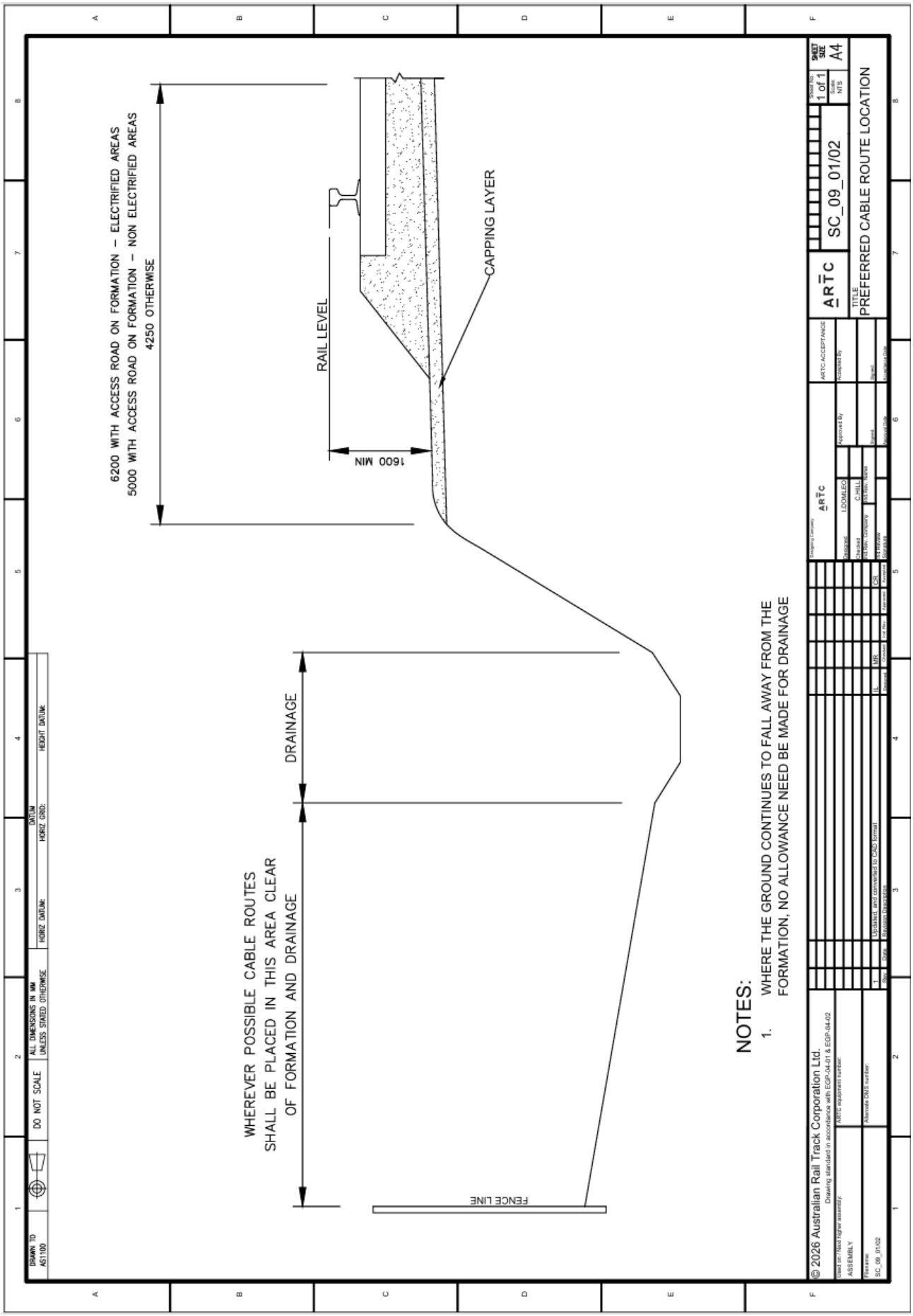
1. Kilometre Mark: _____
2. Shoring Used – YES/NO Baulks Used – YES/NO
3. Follow Up Inspection (1) 24 Hrs_____(2) 72 Hrs_____ (3) 2 Weeks _____
4. Length of Trench: _____m No of Pipes: _____Size of Pipes: _____
5. Method of compaction _____
6. Draw plan view of trench (Incl. any other services)

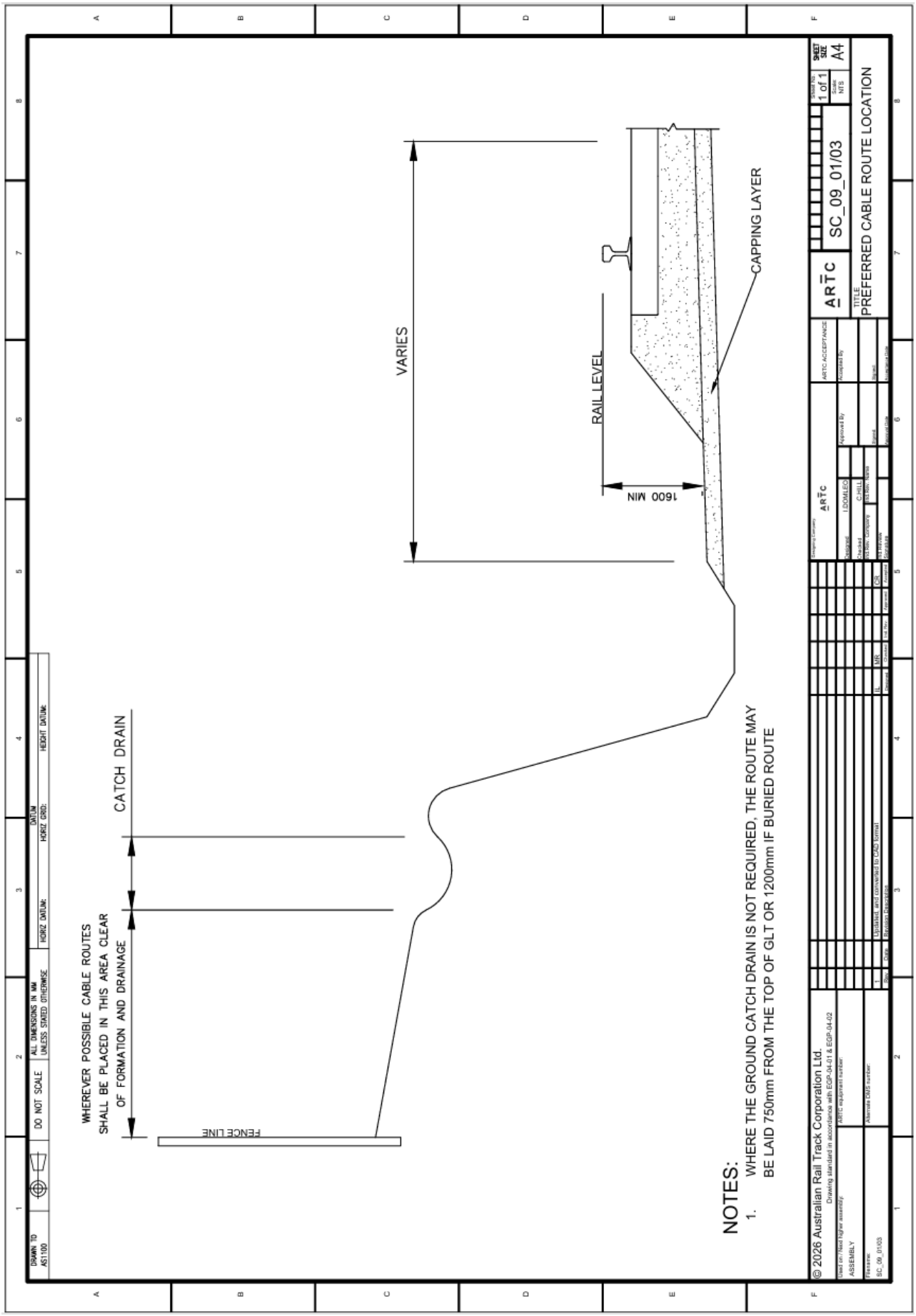
Remarks/Remedial Action Required:	
Work Status Statement The equipment described above has been installed and parameters recorded in accordance with the applicable standards.	**Received/Checked/Action Statement**
Name:	Name:
Position:	Position:
Signature:	Signature:
Date:	Date:

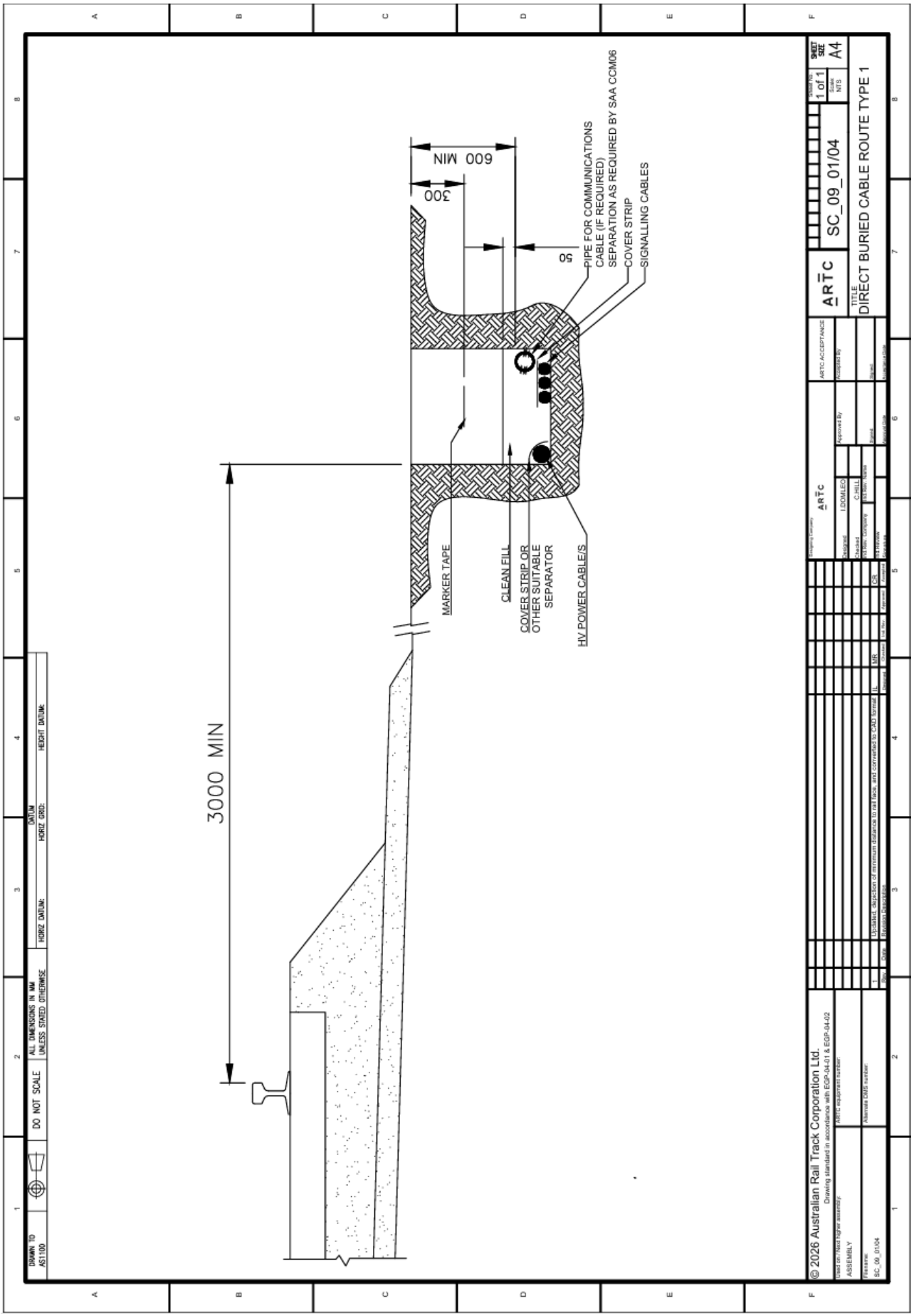
19 Appendix C: Drawings

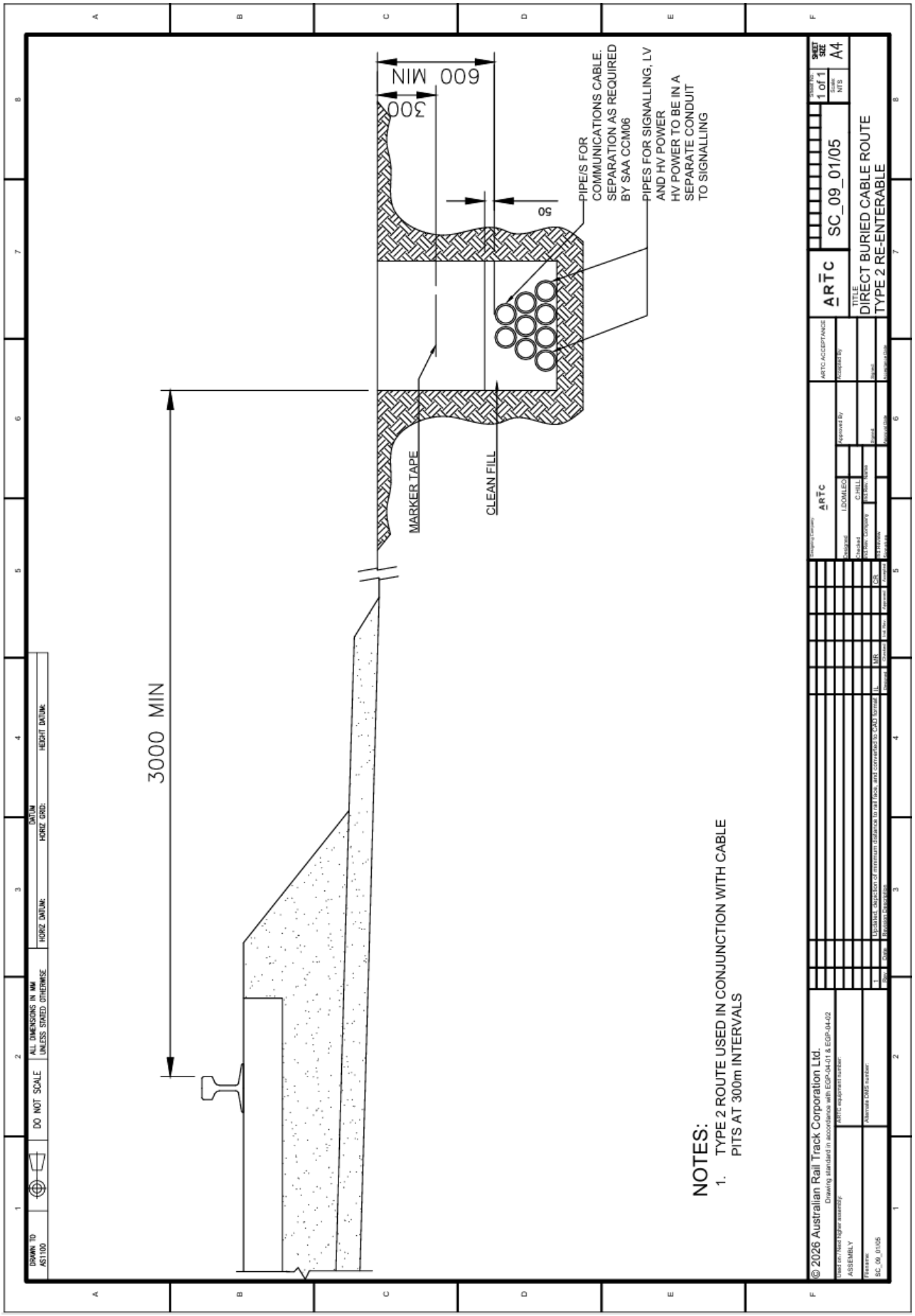
Number	Title
SC 09 01/01	Preferred Cable Route Location
SC 09 01/02	Preferred Cable Route Location
SC 09 01/03	Preferred Cable Route Location
SC 09 01/04	Direct Buried Cable Route – Type 1
SC 09 01/05	Direct Buried Cable Route – Type 2 (Re-enterable)
SC 09 01/06	Direct Buried Cable Route – Type 3A and 3B
SC 09 01/07	GST/GLT Interface – typical arrangements
SC 09 01/08	GST/Buried Cable Route Interface – typical arrangements
SC 09 01/09	GST/PIT Interface – typical arrangements
SC 09 01/10	Buried Cable Route/Location Case – typical arrangements
SC 09 01/11	GLT/Location case – typical arrangement
SC 09 01/12	GST/Location case – typical arrangements
D08327	Cable Route Marker Plate

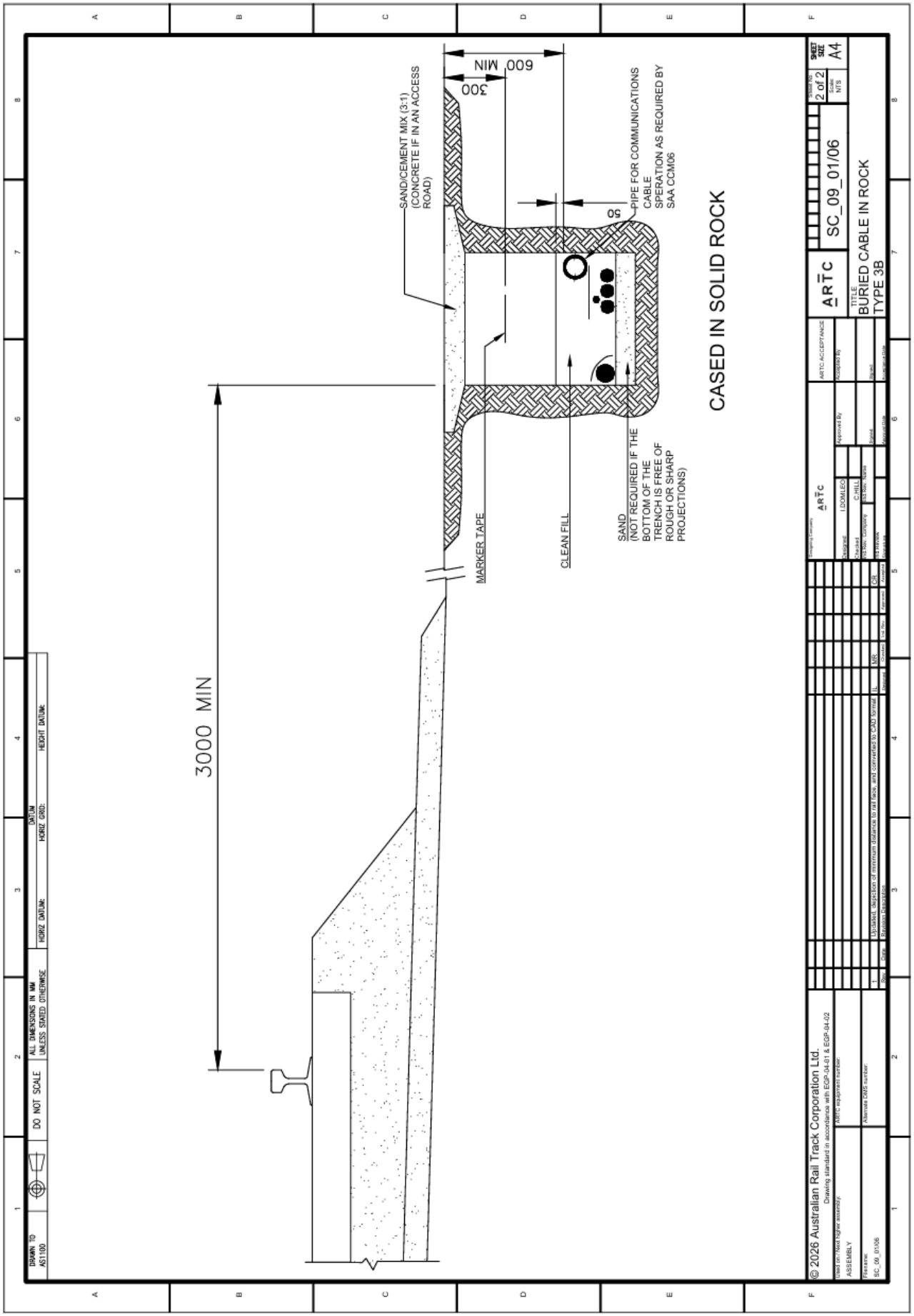

6200 WITH ACCESS ROAD ON FORMATION – ELECTRIFIED AREAS
5000 WITH ACCESS ROAD ON FORMATION – NON ELECTRIFIED AREAS
4250 OTHERWISE
DRAINAGE
WHEREVER POSSIBLE CABLE ROUTES SHALL BE PLACED IN THIS AREA CLEAR OF FORMATION AND DRAINAGE
RAIL LEVEL
1600 MIN
CAPPING LAYER
FENCE LINE
NOTES:
1. THIS DRAWING APPLIES TO REASONABLY LEVEL GROUND
2. WHERE THE GROUND CONTINUES TO FALL AWAY FROM THE FORMATION, NO ALLOWANCE NEED BE MADE FOR DRAINAGE
DO NOT SCALE
ALL DIMENSIONS IN MM UNLESS STATED OTHERWISE
DRAWN TO AS1100
HORIZ DATUM:
HORIZ GRID:
HEIGHT DATUM:
© 2026 Australian Rail Track Corporation Ltd.
Drawing standard in accordance with EGP-04-01 & EGP-04-02
ARTC ACCEPTANCE
SC_09_01/01
1 of 1
A4
TITLE
PREFERRED CABLE ROUTE LOCATION
I.DOMLEO
C.HILL

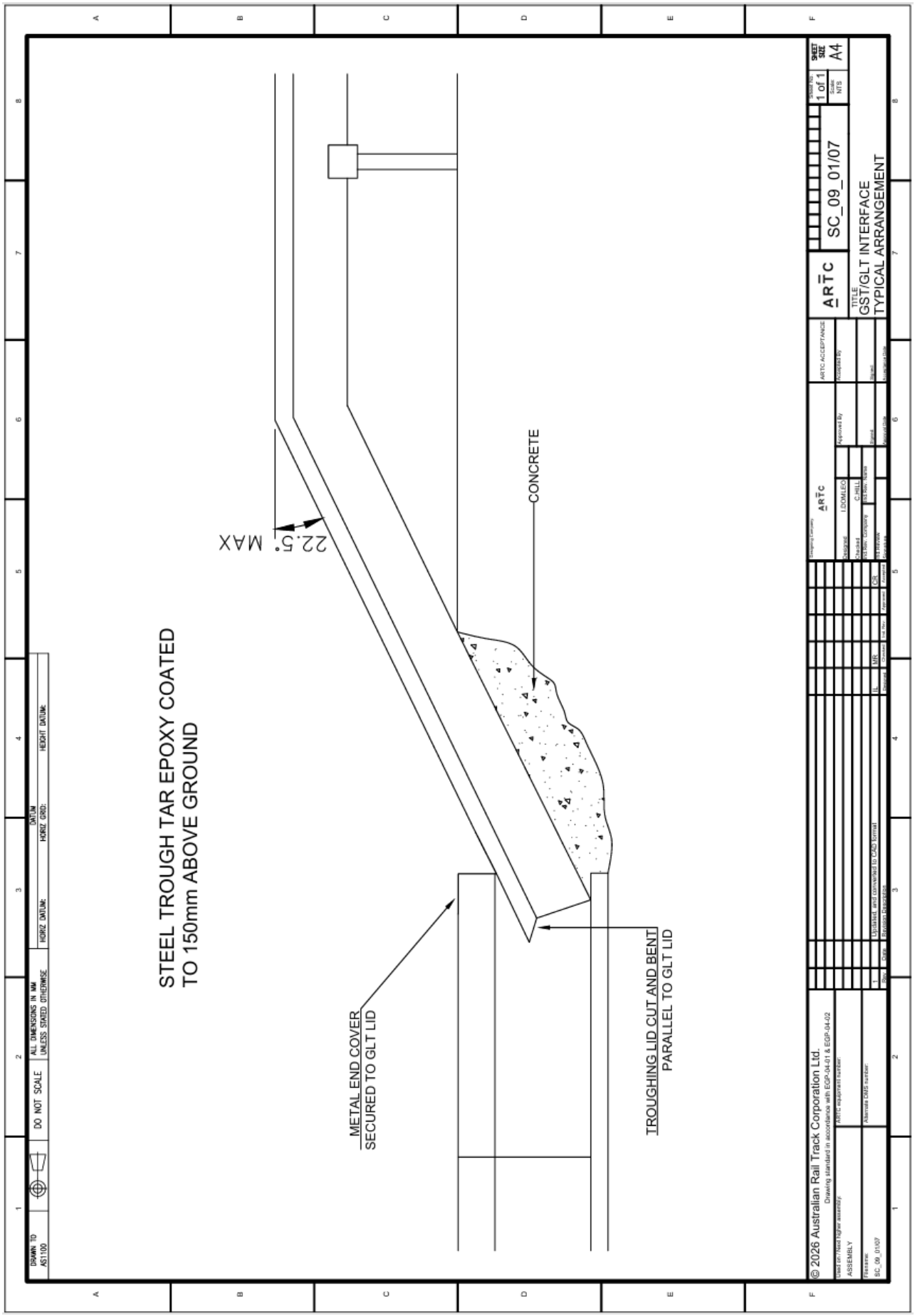

6200 WITH ACCESS ROAD ON FORMATION – ELECTRIFIED AREAS
5000 WITH ACCESS ROAD ON FORMATION – NON ELECTRIFIED AREAS
4250 OTHERWISE
RAIL LEVEL
1600 MIN
CAPPING LAYER
DRAINAGE
WHEREVER POSSIBLE CABLE ROUTES
SHALL BE PLACED IN THIS AREA CLEAR
OF FORMATION AND DRAINAGE
FENCE LINE
NOTES:
1. WHERE THE GROUND CONTINUES TO FALL AWAY FROM THE FORMATION, NO ALLOWANCE NEED BE MADE FOR DRAINAGE
© 2026 Australian Rail Track Corporation Ltd.
ARTC
SC_09_01/02
PREFERRED CABLE ROUTE LOCATION
A4
1 of 1
DO NOT SCALE
ALL DIMENSIONS IN MM UNLESS STATED OTHERWISE
DRAWN TO AS1100

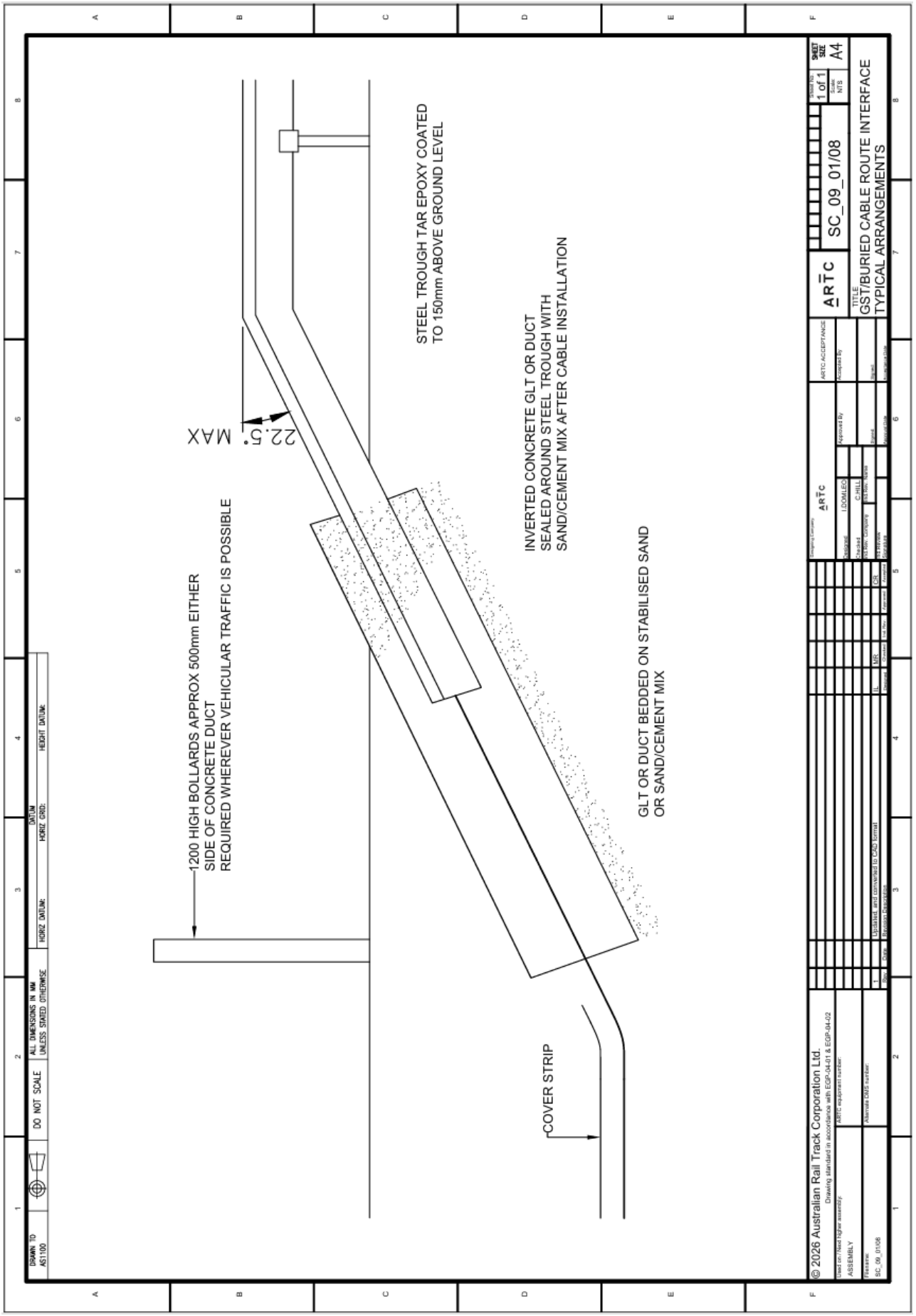

NOTES:
1. WHERE THE GROUND CATCH DRAIN IS NOT REQUIRED, THE ROUTE MAY BE LAID 750mm FROM THE TOP OF GLT OR 1200mm IF BURIED ROUTE
WHEREVER POSSIBLE CABLE ROUTES SHALL BE PLACED IN THIS AREA CLEAR OF FORMATION AND DRAINAGE
CATCH DRAIN
FENCE LINE
VARIES
RAIL LEVEL
1600 MIN
CAPPING LAYER
PREFERRED CABLE ROUTE LOCATION
SC_09_01/03
A4
© 2026 Australian Rail Track Corporation Ltd.

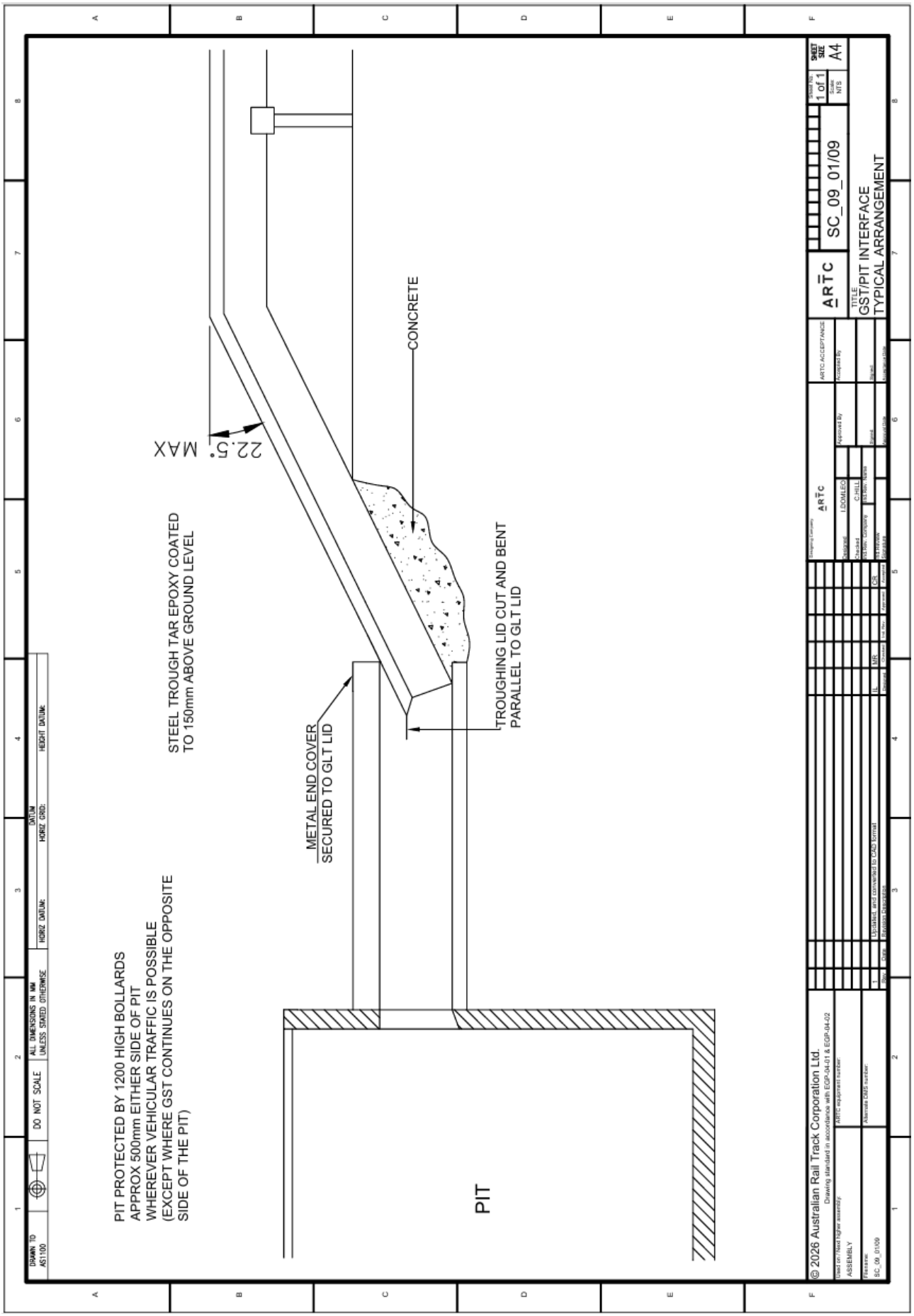

600 MIN
300
50
PIPE FOR COMMUNICATIONS CABLE (IF REQUIRED)
SEPARATION AS REQUIRED BY SAA CCM06
COVER STRIP
SIGNALLING CABLES
3000 MIN
MARKER TAPE
CLEAN FILL
COVER STRIP OR OTHER SUITABLE SEPARATOR
HV POWER CABLE/S
DIRECT BURIED CABLE ROUTE TYPE 1
SC_09_01/04
A4
© 2026 Australian Rail Track Corporation Ltd.

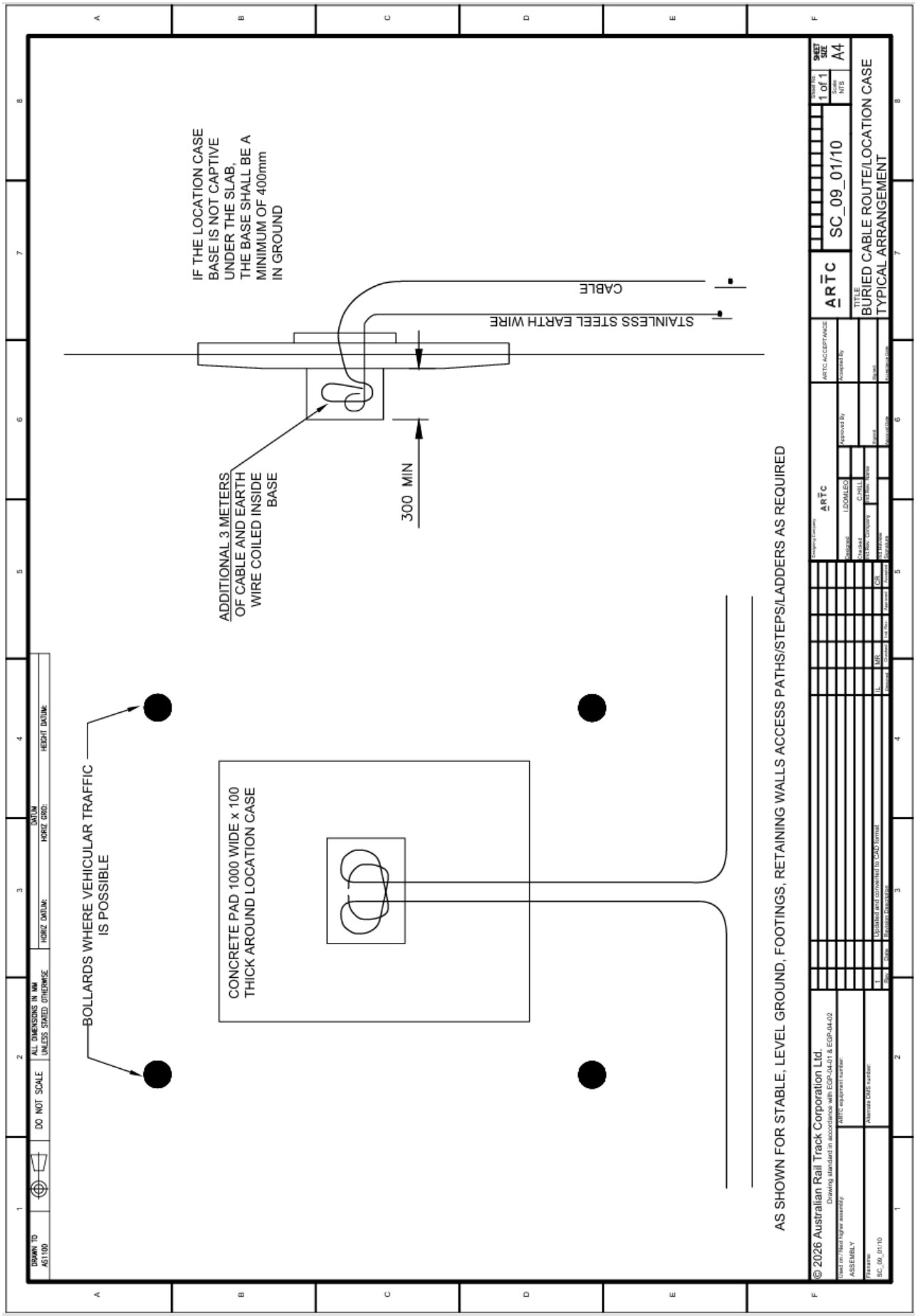

600 MIN
300
50
PIPE/S FOR COMMUNICATIONS CABLE. SEPARATION AS REQUIRED BY SAA CCM06
PIPES FOR SIGNALLING, LV AND HV POWER HV POWER TO BE IN A SEPARATE CONDUIT TO SIGNALLING
MARKER TAPE
CLEAN FILL
3000 MIN
NOTES:
1. TYPE 2 ROUTE USED IN CONJUNCTION WITH CABLE PITS AT 300m INTERVALS
DIRECT BURIED CABLE ROUTE
TYPE 2 RE-ENTERABLE
SC_09_01/05
© 2026 Australian Rail Track Corporation Ltd.

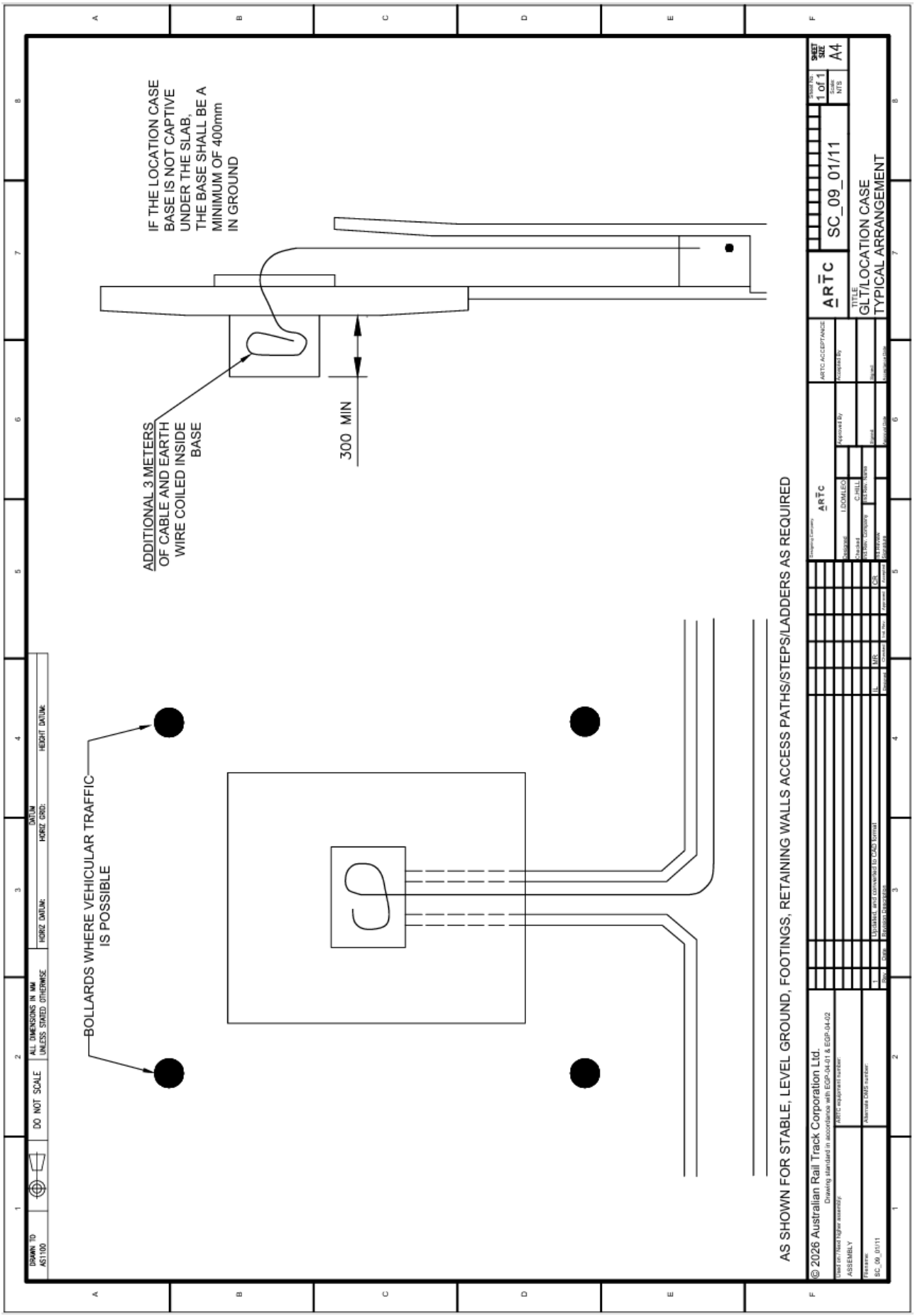

CASED IN SOLID ROCK
SAND/CEMENT MIX (3:1)
(CONCRETE IF IN AN ACCESS
ROAD)
600 MIN
300
50
PIPE FOR COMMUNICATIONS
CABLE
SPERATION AS REQUIRED BY
SAA CCM06
MARKER TAPE
CLEAN FILL
SAND
(NOT REQUIRED IF THE
BOTTOM OF THE
TRENCH IS FREE OF
ROUGH OR SHARP
PROJECTIONS)
3000 MIN
SC_09_01/06
BURIED CABLE IN ROCK
TYPE 3B
SHEET SIZE A4
2 of 2
Scale NTS
DO NOT SCALE
ALL DIMENSIONS IN MM
UNLESS STATED OTHERWISE
DRAWN TO AS1100
© 2026 Australian Rail Track Corporation Ltd.
Drawing standard in accordance with EGP-04-01 & EGP-04-02

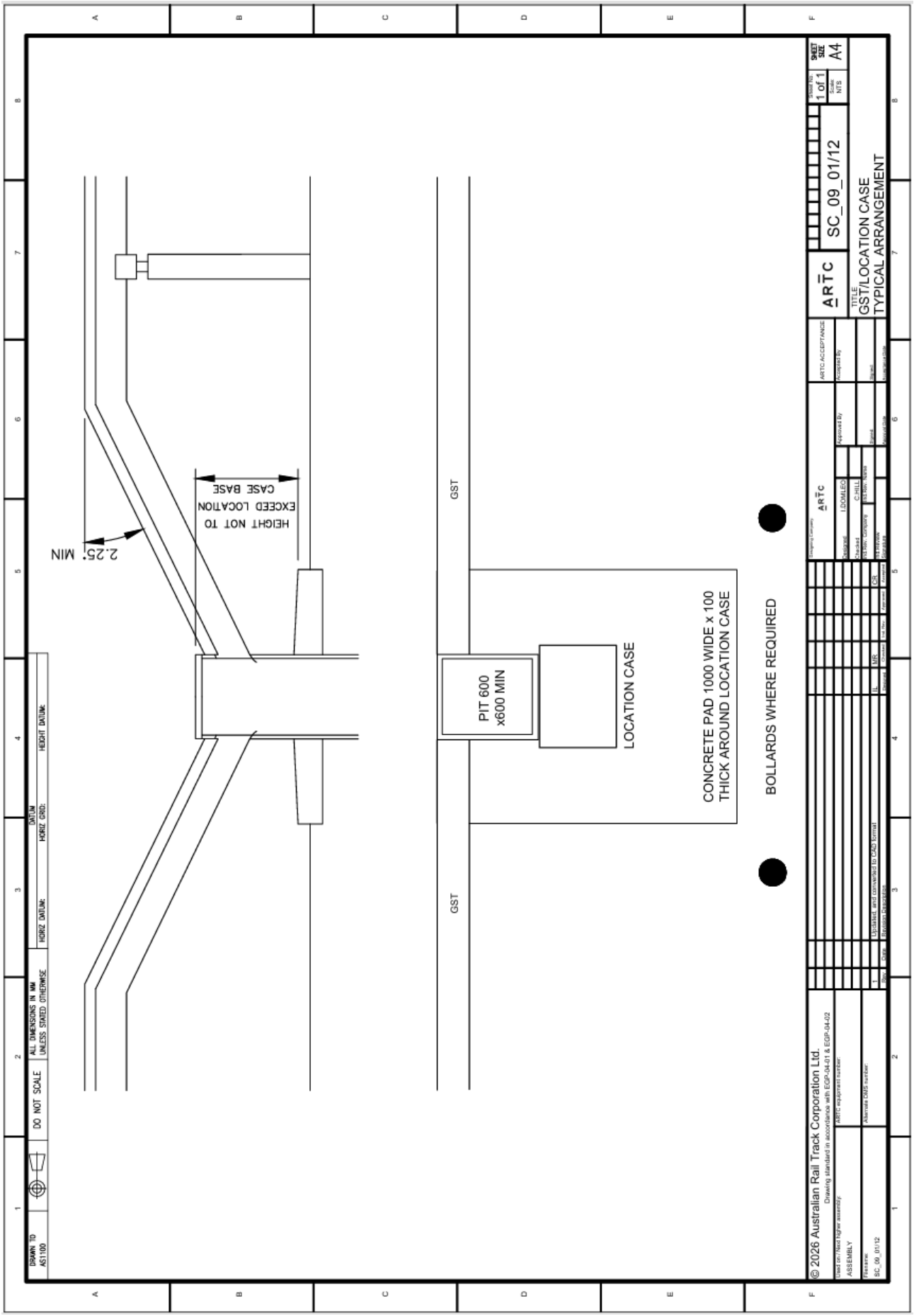

STEEL TROUGH TAR EPOXY COATED
TO 150mm ABOVE GROUND
22.5° MAX
CONCRETE
METAL END COVER
SECURED TO GLT LID
TROUGHING LID CUT AND BENT
PARALLEL TO GLT LID
GST/GLT INTERFACE
TYPICAL ARRANGEMENT
SC_09_01/07
A4
© 2026 Australian Rail Track Corporation Ltd.

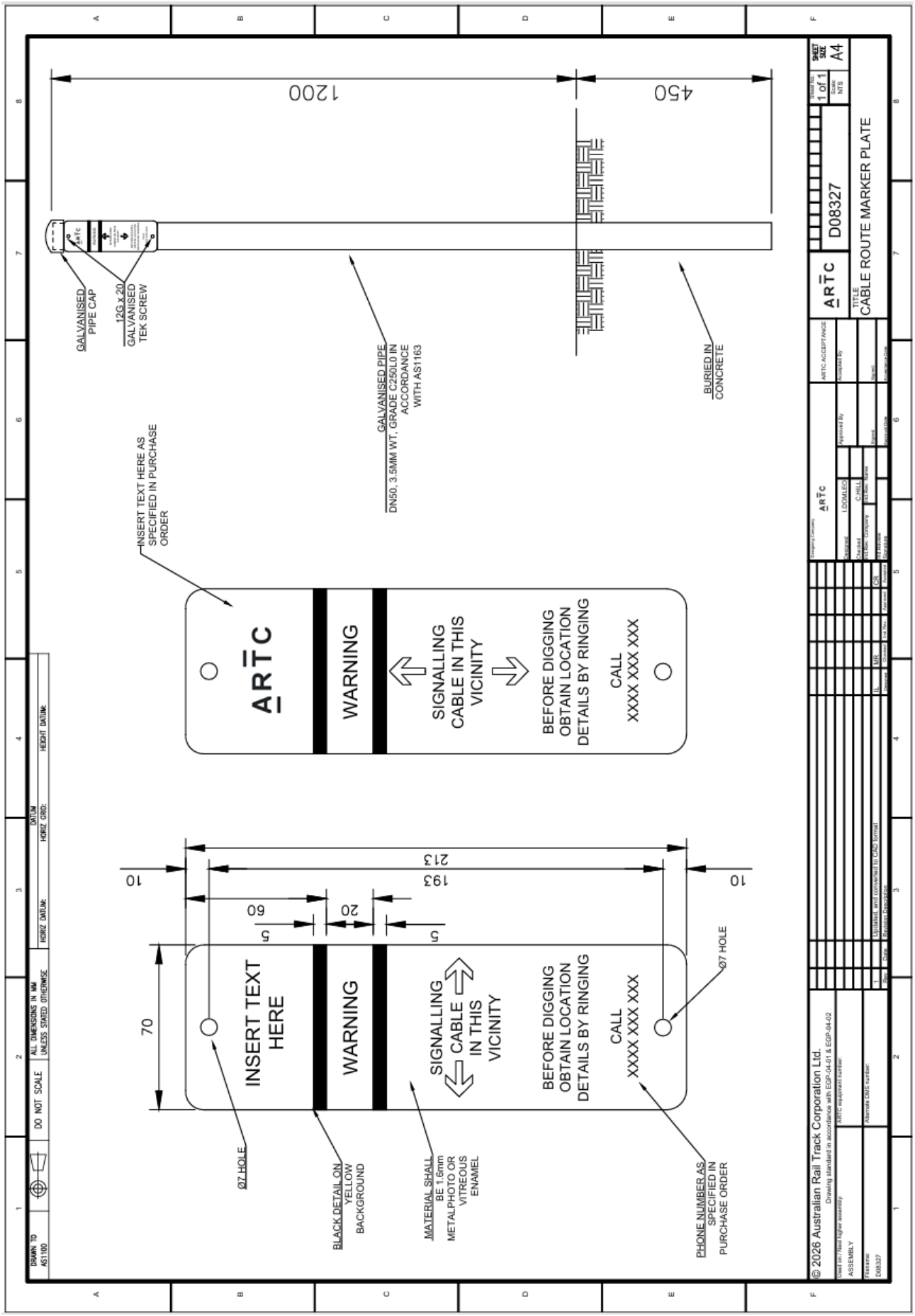

STEEL TROUGH TAR EPOXY COATED
TO 150mm ABOVE GROUND LEVEL
22.5° MAX
1200 HIGH BOLLARDS APPROX 500mm EITHER
SIDE OF CONCRETE DUCT
REQUIRED WHEREVER VEHICULAR TRAFFIC IS POSSIBLE
INVERTED CONCRETE GLT OR DUCT
SEALED AROUND STEEL TROUGH WITH
SAND/CEMENT MIX AFTER CABLE INSTALLATION
GLT OR DUCT BEDDED ON STABILISED SAND
OR SAND/CEMENT MIX
COVER STRIP
© 2026 Australian Rail Track Corporation Ltd.
SC_09_01/08
GST/BURIED CABLE ROUTE INTERFACE
TYPICAL ARRANGEMENTS
A4


PIT PROTECTED BY 1200 HIGH BOLLARDS
APPROX 500mm EITHER SIDE OF PIT
WHEREVER VEHICULAR TRAFFIC IS POSSIBLE
(EXCEPT WHERE GST CONTINUES ON THE OPPOSITE
SIDE OF THE PIT)
STEEL TROUGH TAR EPOXY COATED
TO 150mm ABOVE GROUND LEVEL
22.5° MAX
CONCRETE
METAL END COVER
SECURED TO GLT LID
TROUGHING LID CUT AND BENT
PARALLEL TO GLT LID
PIT
GST/PIT INTERFACE
TYPICAL ARRANGEMENT
SC_09_01/09
A4
1 of 1
NTS
© 2026 Australian Rail Track Corporation Ltd.


IF THE LOCATION CASE BASE IS NOT CAPTIVE UNDER THE SLAB, THE BASE SHALL BE A MINIMUM OF 400mm IN GROUND
CABLE
STAINLESS STEEL EARTH WIRE
300 MIN
ADDITIONAL 3 METERS OF CABLE AND EARTH WIRE COILED INSIDE BASE
BOLLARDS WHERE VEHICULAR TRAFFIC IS POSSIBLE
CONCRETE PAD 1000 WIDE x 100 THICK AROUND LOCATION CASE
AS SHOWN FOR STABLE, LEVEL GROUND, FOOTINGS, RETAINING WALLS ACCESS PATHS/STEPS/LADDERS AS REQUIRED
SC_09_01/10
BURIED CABLE ROUTE/LOCATION CASE TYPICAL ARRANGEMENT
© 2026 Australian Rail Track Corporation Ltd.


IF THE LOCATION CASE BASE IS NOT CAPTIVE UNDER THE SLAB, THE BASE SHALL BE A MINIMUM OF 400mm IN GROUND
ADDITIONAL 3 METERS OF CABLE AND EARTH WIRE COILED INSIDE BASE
300 MIN
BOLLARDS WHERE VEHICULAR TRAFFIC IS POSSIBLE
AS SHOWN FOR STABLE, LEVEL GROUND, FOOTINGS, RETAINING WALLS ACCESS PATHS/STEPS/LADDERS AS REQUIRED
SC_09_01/11
GLT/LOCATION CASE TYPICAL ARRANGEMENT
© 2026 Australian Rail Track Corporation Ltd.


GST
GST
PIT 600
x600 MIN
LOCATION CASE
CONCRETE PAD 1000 WIDE x 100
THICK AROUND LOCATION CASE
BOLLARDS WHERE REQUIRED
HEIGHT NOT TO
EXCEED LOCATION
CASE BASE
2.25↑ MIN
SC_09_01/12
GST/LOCATION CASE
TYPICAL ARRANGEMENT
A4
DO NOT SCALE
© 2026 Australian Rail Track Corporation Ltd.


1200
450
GALVANISED PIPE CAP
12G x 20 GALVANISED TEK SCREW
GALVANISED PIPE DN50, 3.5MM WT, GRADE C250L0 IN ACCORDANCE WITH AS1163
BURIED IN CONCRETE
INSERT TEXT HERE AS SPECIFIED IN PURCHASE ORDER
ARTC
WARNING
SIGNALLING CABLE IN THIS VICINITY
BEFORE DIGGING OBTAIN LOCATION DETAILS BY RINGING
CALL XXXX XXX XXX
213
193
10
10
60
20
5
5
70
INSERT TEXT HERE
WARNING
SIGNALLING CABLE IN THIS VICINITY
BEFORE DIGGING OBTAIN LOCATION DETAILS BY RINGING
CALL XXXX XXX XXX
Ø7 HOLE
Ø7 HOLE
BLACK DETAIL ON YELLOW BACKGROUND
MATERIAL SHALL BE 1.6mm METALPHOTO OR VITREOUS ENAMEL
PHONE NUMBER AS SPECIFIED IN PURCHASE ORDER
DRAWN TO AS1100
DO NOT SCALE
ALL DIMENSIONS IN MM UNLESS STATED OTHERWISE
HORIZ DATUM:
DATUM
HORIZ GRID:
HEIGHT DATUM:
© 2026 Australian Rail Track Corporation Ltd.
Drawing standard in accordance with EGP-04-01 & EGP-04-02
ARTC ACCEPTANCE
D08327
TITLE
CABLE ROUTE MARKER PLATE
1 of 1
A4