

Henry Lawson Drive Stage 1A

Groundwater Impact
Assessment

**Transport for New South
Wales**

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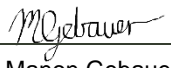
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Executive summary

Summary

Aurecon Australasia Pty Ltd (Aurecon) was engaged by Transport for New South Wales (Transport) to prepare this Groundwater Impact Assessment to support the environmental and planning requirements for the Henry Lawson Drive Stage 1A Upgrade works. A total of 1.3 kilometres (km) of Henry Lawson Drive would be upgraded between Tower Road and Keys Parade and an additional 480 metres (m) along Milperra Road to the Newbridge Road Georges River Bridge tie in (the overall proposal).

The study area covers the overall proposal area and certain aspects to 1 km radius. The study area also encompasses an additional 480 m along Milperra Road and the Newbridge Road Georges River bridge tie in, south of the Bankstown Airport. The proposal area also coincides with identified coastal wetlands and as such, this part of the proposal is deemed designated development and an Environmental Impact Statement (EIS) has been prepared. The Groundwater Impact Assessment supports the Review of Environmental Factors (REF) for the proposal being prepared by Transport under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act) (REF Proposal) and an Environmental Impact Statement being prepared under Division 4.1 of the EP&A Act (EIS Proposal). As such, the Groundwater Impact Assessment also addresses the relevant Secretary's Environmental Assessment Requirements (SEARs) that have been issued for the EIS proposal to address potential risks to the coastal wetlands during construction.

Report objectives

The objective of this report is to consider the construction and operation of the REF and EIS proposals on the groundwater environment. This report includes the assessment of key environmental factors controlling and influenced by groundwater conditions, including climate conditions, local catchments and drainage, geological units, aquifer conditions, soil landscapes, groundwater dependent ecosystems (GDEs), and contamination sources. While the groundwater resource underlies all the proposal areas, the impacts have been identified for direct impact from the REF proposal and the EIS proposal, as well as consideration of indirect impacts from the REF proposal.

Impact assessment

The assessment has identified several terrestrial and aquatic groundwater dependant ecosystems within and around the overall proposal area that have the potential to be disturbed both directly and indirectly by construction and operation of the REF and EIS proposals.

The assessment has also identified (based on the preliminary site investigation (PSI) done for the proposal), several potential sources of groundwater contamination, including:

- Several service stations (potential hydrocarbons and heavy metals)
- Bankstown Airport (potential PFAS)
- Adjacent golf courses (potential nutrients and pesticides/herbicides)
- Influence of acid sulphate soils (ass)
- Higher than average salinity
- Former landfill operations and surrounding land uses

Further discussion on these sources of contamination can be found in the PSI prepared for the REF and EIS proposal.

The overall proposal is located on the eastern side of the Georges River in a floodplain with high flood risk and high salinity hazard and a reasonably undefined interaction with groundwater.

Groundwater levels are currently poorly defined within and around the overall proposal area, with literature-based sources indicating levels in the general area are between 0 metres below ground level (m bgl) and 8 m bgl. Groundwater levels for registered bores near Henry Lawson Drive and Tower Road are between 4.6 to 5.0 m bgl, with a drilled bore for the proposal located around 100m south east of the EIS proposal detected groundwater at 2.8 m bgl. Aquifer vulnerability is considered high due to the unconfined nature of the alluvial deposits which form principal aquifers for the landscape and ecology within and around the study area. Perched systems are likely to be present where shallow but discretely lensed groundwater may be encountered.

The REF proposal and the EIS proposal would interact with groundwater through a number of means during the construction phase:

- Ingress of groundwater into bridge piles during piling works (REF proposal only), trenching for utility relocations (REF proposal only)
- Installation of drainage infrastructure including bioretention basins (REF proposal and EIS proposal areas 1 and 2)
- Excavation and exposure of PASS (primarily in the REF proposal area and EIS proposal area 1)

Potential impacts from the REF proposal and EIS proposal relevant to groundwater may include:

- Direct impacts to aquatic and terrestrial GDEs and coastal wetlands through GDE removal during earthworks and leaching of potential acid sulfate soils into GDE habitats during construction (primarily REF and EIS proposal area 1)
- Indirect impacts to aquatic and terrestrial GDEs and coastal wetlands through stormwater discharges during both construction and operation, leading to burial by sediment and toxicological impacts from potential contaminants mobilised by ground disturbance, accidental spills or lowering of the soil/water pH as a result of leaching of acid sulfate soils (EIS proposal areas)
- Indirect impacts to aquatic and terrestrial GDEs and coastal wetlands through transport of existing contaminant sources through preferential drainage paths (ie backfilled utilities trenches) during construction and operational phases (REF and EIS proposal areas)
- Direct impacts to groundwater levels resulting due to infiltration from bioretention devices and open grass swales to groundwater during construction and operational phases causing water table mounding (REF and EIS proposal areas)
- Direct impacts to groundwater quality resulting from pavement seepage and stormwater leakage to groundwater during construction and operational phases (REF and EIS proposal areas)

REF proposal construction and operation phase **moderate to high** risk impacts were considered to include exposure of ASS and potential of transfer into groundwater, exposure of contamination and transfer into groundwater or exposure of contaminated groundwater, indirect impact to the EIS proposal areas through discharge to groundwater which could affect GDEs and the coastal wetlands. Impacts to interaction with groundwater table include possible mounding from the use of the bio-retention basins at two locations.

EIS proposal construction and operation phase **moderate to high** risk impacts were considered to include GDEs including coastal wetlands that could affect the groundwater resource, exposure of ASS and potential of transfer into groundwater, exposure of contamination and transfer into groundwater or exposure of contaminated groundwater.

Recommendations

Due to the presence of potential impacts and uncertainty around baseline conditions, it has been recommended that baseline groundwater monitoring is undertaken to define existing conditions and undertake further assessment of the potential impacts from the overall proposal on the groundwater quality, groundwater interactions, and groundwater dependent ecosystems. It is recommended that groundwater monitoring encompasses both REF and EIS proposal areas, in particular the three EIS proposal areas to fully satisfy the SEARs which states the assessment should be undertaken with reference to necessary regulatory guidelines.

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1 Introduction

1.1 Proposal background

Transport for NSW (Transport) is proposing the Stage 1A upgrade of Henry Lawson Drive (the overall proposal) about a 1.3 kilometre (km) length of Henry Lawson Drive, including intersection upgrades, between Keys Parade and Tower Road. This includes an upgrade of around 480 metres (m) along Milperra Road to the Newbridge Road Georges River Bridge tie in. The overall proposal is predicted to help ease existing traffic issues and increase traffic capacity at key intersections to help meet growing demand, with residential, commercial and industrial development in the surrounding area expected to increase in the coming years. The broader upgrade of Henry Lawson Drive would be delivered in three stages.

Subject to approval, construction of the overall proposal may commence in early 2023 and would take about two years to complete.

The following report provides a Groundwater Impact Assessment to support a Review of Environmental Factors (REF) for the proposal being prepared by Transport under Division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and an Environmental Impact Statement (EIS) being prepared under Division 4.1 of the EP&A Act. The REF has been prepared for the majority of the proposal, where Transport can approve works under the State Environmental Planning Policy (Infrastructure) 2008 (referred to as the 'REF proposal'). However, as part of the proposal is located within areas mapped as coastal wetlands under the State Environmental Planning Policy (Coastal Management) 2018, this part of the proposal is deemed designated development and is subject to an EIS. The work within mapped coastal wetlands is referred to as the 'EIS proposal'.

Site layout and the REF and EIS proposal areas are presented in Figure 1-1. Further details on the proposal including key features are detailed in Chapter 2.

1.2 Proposal location and setting

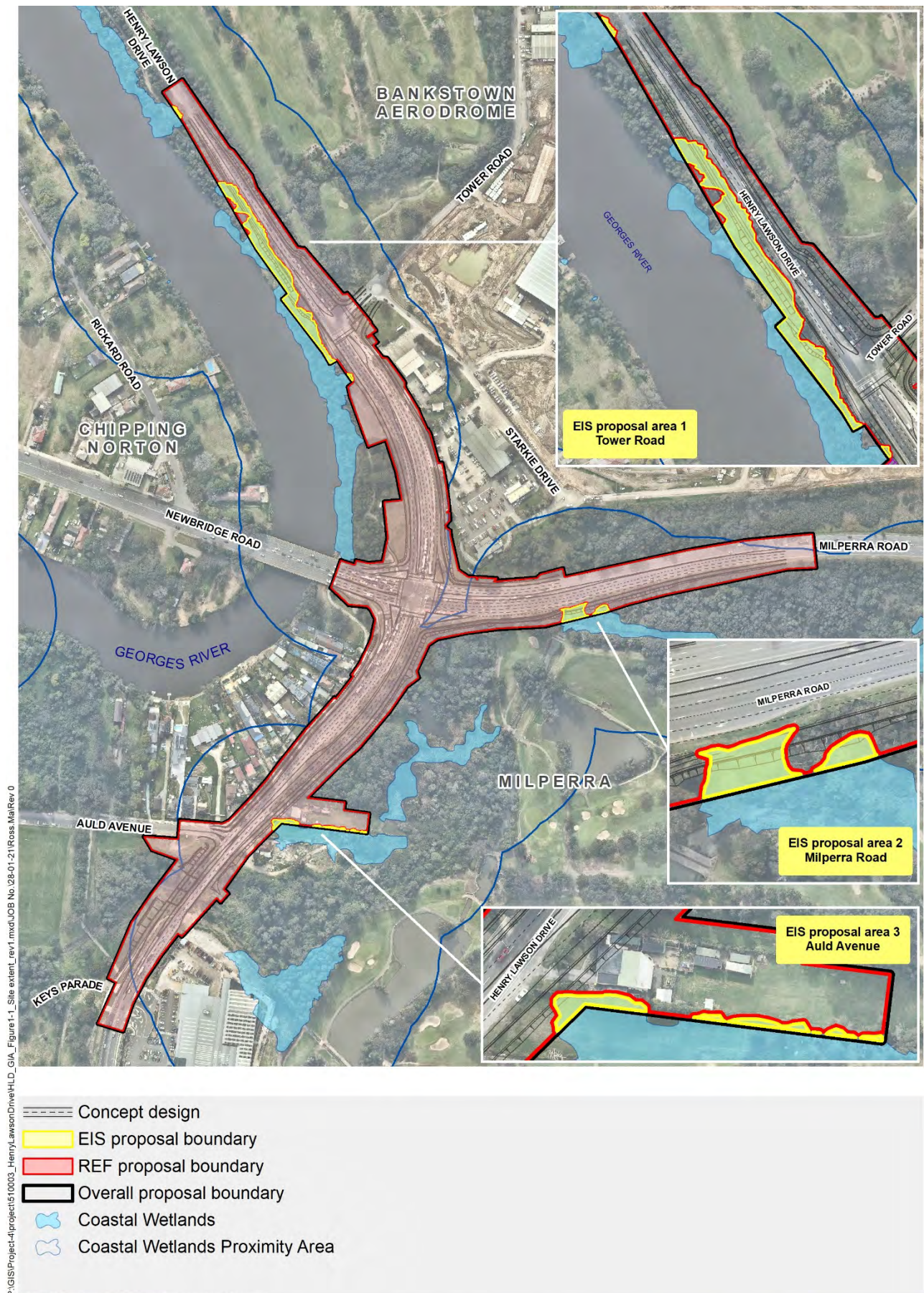
The overall proposal is located around 20 km south west of the Sydney central business district in the City of Canterbury-Bankstown local government area. The overall proposal comprises Henry Lawson Drive and includes intersection upgrades at Tower Road, Newbridge/Milperra Road and Auld Avenue.

Henry Lawson Drive is a key connection for traffic moving between the Hume Highway, Milperra Road /Newbridge Road and the M5 Motorway. It is also used for local travel trips between residences and services. In terms of heavy vehicle access, Henry Lawson Drive is designated as a B-Double access route that connects surrounding large industrial areas of Milperra, Revesby, Chipping Norton and Moorebank.

The overall proposal is located to the east of the Georges River and surrounding recreational areas. There are a number of Coastal Wetlands within and surrounding the overall proposal associated with the Georges River and associated creeklines.

Residential and recreation zoning and land uses are located to the south west of the proposal, including detached housing, sporting fields and recreational areas. The Bankstown Golf Course and urban bushland areas are located to the south east. Commercial/industrial land use, including retail and commercial developments are present to the north of Milperra Road. The commercial developments back onto the Bankstown Airport and land currently being redeveloped, all of which access Henry Lawson Drive via Tower Road. The Georges River Golf Course is located north of Tower Road.

The study area for the Groundwater Impact Assessment includes the overall proposal boundary as well as assessment of existing groundwater catchments out to one kilometre from the overall proposal.



Henry Lawson Drive Stage 1A Groundwater Impact Assessment

FIGURE 1-1: Site extent

1.3 Purpose and scope of the report

This report has been prepared to support the REF and EIS for the proposal. This report has been prepared in accordance with the Secretary's Environmental Assessment Requirements (SEARs) for the EIS proposal.

The purpose of this report is to describe the overall proposal, to document the likely impacts of the REF and the EIS proposal on the groundwater environment, impacts of the groundwater environment on the proposal and to detail suitable mitigation measures if required.

Key considerations of this assessment with relation to groundwater include:

- Groundwater resource (eg aquifer conditions, resource potential, vulnerability, recharge, levels)
- Groundwater users (eg irrigation, stock and domestic, commercial/industrial, potable water supply)
- Groundwater quality (physical parameters and chemistry)
- Groundwater dependent ecosystems (eg watercourses, wetlands, springs)

The scope of the report includes:

1.3.1 Stage 1: Desktop Assessment

A desktop assessment to determine the hydrogeological characteristics of the groundwater flow system associated with the proposal will be undertaken. It is anticipated that the following will be assessed:

- Characterisation of the catchment (including surface, hydrogeological, geological, water quality and groundwater systems) including:
 - Local topography (based on available +/- 2m resolution state contours – NSW Spatial Services)
 - Drainage (Public NSW Hydrography)
 - Soil landscapes (DPIE 2020)
 - Acid sulfate soils (Naylor et al 1998)
 - Hydrologic soil groups (OEH 2017)
 - Geology (Penrith 1:100 000 Geological Sheet Clark and Jones 1991)
 - Hydrogeology (based on data supplied on espade and SEED Mapping, OEH 2002 and DPIE 2020)
- A description of groundwater conditions within the study area, including occurrence, flow, and quality/chemistry through review of available public access data and from proposed/completed geotechnical investigations
- A review of available public access data to identify boreholes, groundwater dependent ecosystems and groundwater users (if any) within 1 km of the proposal area
- Review of Contamination assessment to reference any known existing water quality issues
- Review of relevant planning instruments, including the Bankstown Local Environmental Plan and DCP, and relevant Water Sharing Plans to contextualise the site relative to sensitive groundwater receiving environments potential constraints on construction and operation of the proposed link road, along with any requirements for licencing/approvals to undertake works
- Review of potential constraints and impacts relevant to key legislation, including the *National Environment Protection Act 2013*, *National Water Quality Management Strategy 2000*, *Water Management Act 2000*, *NSW State Groundwater Quality Protection Policy (1998)*, *NSW Groundwater Dependent Ecosystems Policy (2002)*, *Protection of the Environment Operations Act 1997*, and *NSW Aquifer Interference Policy (2012)*

1.3.2 Stage 2: Impact Assessment

The outcome from desktop assessment will be used to develop a hydrogeological conceptual model (HCM) for the basis for the assessment of the presence or absence of impacts to the proposed works accordance with the procedures in the Practice Note, Aquifer Interference Policy and other relevant legislation and policies assessed in the desktop assessment. This would include:

- Assessment of potential impacts to groundwater resource/quality and groundwater users/receiving environments from construction stage and operational stage activities (including excavations, surface water diversions, temporary changes to drainage conditions) in consideration of Local Environment Plans, Water Sharing Plans and relevant legislation
- Assessment of suitable management measures/mitigation strategies to control potential risks to groundwater resource/quality and groundwater users/receiving environments from construction and operation of the overall proposal. Mitigation strategies would follow a hierarchy of priority, based on the level of potential risk to the environment.

In Chapter 6, construction impacts for the REF proposal area is addressed in Section 6.2.1 and the EIS proposal areas are discussed in Section 6.2.2 that specifically addresses the SEARs.

1.3.3 Secretary's Environmental Assessment Requirements

As sections of the proposal intersect with areas mapped as Coastal Wetlands, an EIS has been prepared to assess the EIS proposal (refer Section 2.2) under Division 4.1 of the EP&A Act. For this EIS, SEARs have been issued by the Department of Planning, Industry and Environment, which describe assessment requirements. The requirements relevant to the Groundwater assessment is presented in Table 1-1.

Table 1-1 Secretary's Environmental Assessment Requirements

| Reference | Requirement | Where addressed |
|--------------------------------|--|--|
| Groundwater and surface water | An assessment of hydrology, and potential impacts on the quality and quantity of surface and groundwater resources with reference to the ANZG (2018) Guidelines for Fresh and Marine Water Quality or equivalent water quality guidelines, | Groundwater - Section 6 Surface water – refer to separate surface water report |
| Contamination and soil quality | Downstream impacts of contaminated soils on aquatic ecology | Consideration of indirect impacts on groundwater dependent ecosystems (GDEs) are in Section 6. Further details on contaminated soils are addressed in the PSI. Further details on impacts to aquatic ecology are addressed in the BAR. |

2 Proposal details

As discussed in Section 1.3, this report addresses groundwater impacts of the REF and EIS proposal areas for the Henry Lawson Drive stage 1A upgrade. This chapter details the key features of the overall proposal.

2.1 Key features of the REF proposal

Key features of the REF proposal are:

- Widening Henry Lawson Drive from two to four lanes
- Upgrading the signalised intersection of Henry Lawson Drive and Tower Road including:
 - An additional right turn lane from Tower Road onto Henry Lawson Drive;
 - A new channelised short left-turn lane from Henry Lawson Drive (southbound) onto Tower Road
 - An additional right turn lane from Henry Lawson Drive (northbound) onto Tower Road; and
 - Retaining the pedestrian crossing across Henry Lawson Drive on the southern side of the intersection.
- Upgrading the signalised intersection of Henry Lawson Drive and Milperra Road /Newbridge Road including:
 - An additional right turn lane on the Milperra Road and Newbridge Road approaches to Henry Lawson Drive
 - An additional through lane on the Henry Lawson Drive southbound approach
 - The removal of the bus only lane on Milperra Road to provide an additional right turn lane on the Henry Lawson Drive northbound approach.
- Removing the dedicated left turn slip lane into the ALDI and fast-food area with access being retained via a standard property driveway
- Retaining the existing bus stop on Milperra Road (eastbound) and moving the westbound bus stop 20 m to the west
- Altering access to Auld Avenue to a “left in/left out” only configuration
- Installing a new Henry Lawson Drive road bridge (over Milperra Drain) to the south of Auld Avenue (referred to as the Auld Avenue bridge) to carry northbound traffic and retaining the existing bridge for southbound traffic
- Constructing new footpaths on the eastern side of Henry Lawson Drive to connect Tower Road to the existing bus stop on the eastbound lanes of Milperra Road and a new footpath on the southern side between Henry Lawson Drive to the bus stop on the westbound lanes of Milperra Road
- Widening the shared user pathway between Flower Power (Keys Parade) and Newbridge Road to 3 m and reconstructing footpaths along the western side of Henry Lawson Drive, where required
- Adjusting existing drainage, including lengthening culverts, installing new drainage infrastructure and water quality controls
- Relocating utilities (including electrical, gas, water and telecommunications)
- Final roadworks including pavement, kerb and gutters, signs, lighting and line marking
- Ancillary work for the proposal including, but not limited to road furniture, tie-in works, landscaping, earthworks and the like
- Temporary ancillary compounds, stockpile sites and associated facilities.

2.2 Key features of the EIS proposal

The EIS proposal area are comprised of three areas as identified on Figure 1-1. Key features of the EIS proposal are identified in the following list.

2.2.1 EIS proposal area 1 – Henry Lawson Drive opposite Tower Road

The key features of EIS proposal area 1 are:

- Widening of Henry Lawson Drive northbound lanes
- Installing of fill embankments along the edge of the new carriageway to meet existing ground levels
- Extending existing stormwater culvert and installing outlet scour protection measures
- Installing additional stormwater drainage infrastructure and water quality treatments
- Installing a vegetated swale along the toe of the new fill embankment
- Adjusting the existing shared path to suit the new re-alignment and to connect it back to the existing path
- Installing road furniture, including road safety barriers

2.2.2 EIS proposal area 2 – Milperra Road opposite Bankstown Airport

The key features of the EIS proposal area 2 are:

- Installing a new bus stop relocated from its existing position on Milperra Road
- Installing a section of a new footpath to the bus stop (connecting to the remainder of the new path to Henry Lawson Drive – REF proposal)
- Installing fill embankments along the edge of the new carriageway to meet existing ground levels
- Extending existing stormwater culvert and installing outlet scour protection measures
- Installing additional stormwater drainage infrastructure connecting to the outlet of the extended culvert
- Installing road furniture, including road safety barriers

2.2.3 EIS proposal area 3 – Henry Lawson Drive opposite Auld Avenue

The key features of the EIS proposal area 3 are:

- Removing of existing ancillary structures
- Installing temporary fencing, flagging of exclusion boundaries and temporary erosion and sediment controls for use as an ancillary facility and construction area
- Installing fill embankments along the edge of the new carriageway to meet existing ground levels
- Stabilising the ground surface following the completion of construction to minimise erosion.

2.3 Construction methodology

Construction activities would be carried out in accordance with a construction environmental management plan (CEMP) to ensure work complies with Transport's commitments and legislative requirements. Detailed work methodologies would be identified by the construction contractor.

Construction of both the REF and EIS proposal (where relevant) is expected to involve the following activities:

- Establishment works including ancillary facilities, construction access areas and the implementation of environmental, traffic and pedestrian controls
- Utility adjustment works

- Existing building and fencing removal
- Clearing and grubbing
- Earthworks (including piling)
- Widening and pavement works
- Bridge and drainage works
- Pedestrian pathway, intersection crossing, and shared path works
- Landscaping and finishing works
- Removal of ancillary facilities and site rehabilitation

Based on the proposal activities, works are expected to involve moderate ground disturbance. Moderate earthworks and excavation activities are anticipated during the construction of the road upgrade, an estimated excavation volume is 185 m³ (for both the REF and EIS proposals). The upgrade is intended to tie in with the existing roadway and maintain the existing road level, which is within a flat lying floodplain area. Road shoulders will be incorporated into the design, allowing for minimal cut and fill areas and major earthworks.

The ground disturbance activities are anticipated to be undertaken at the Tower Road intersection in the north of the proposal area, and for the duplication of the existing bridge structure to the south of Auld Avenue. Minor filling to level the roadway near Tower Road is required to level the ground surface. Additional filling would be required west of Tower Road intersection to also create flat surface for the shared use path. Piling activities to support the new Auld Avenue bridge (northbound) will be required, approximate piling depth is 30m below ground level (to be confirmed at detailed design). A bored cast in-situ piling method is to be used for piling in this area.

Excavation and works that may pose a risk to groundwater are shown in Table 2-1.

Table 2-1 Excavation and works impacts to Groundwater

| Works | Groundwater resource impacts | Groundwater quality impacts |
|---------------------------------|---|---------------------------------------|
| Earthworks | Grading and compaction of materials to required levels | Foundation treatments, where required |
| | Removal of topsoil and disposal | |
| Bridge and drainage works | Construction of new bridge structure involving piling, concrete pours and placement of pre-cast elements | |
| | Excavation of trenches and pits for drainage, delivery of and placement of precast pipe and pits, filling of trenches and compaction. | |
| Landscaping and finishing works | Progressive landscaping would be undertaken throughout the construction. This would include the spreading of topsoil and mulch and planting | |
| Ancillary facilities | Upgrade stormwater drainage | - |
| | Provide temporary compound sites during works and decommission site offices and remove facilities, equipment and materials at completion | |

3 Relevant legislation

3.1 Water Management Act (2000)

The overall objective of the *Water Management Act 2000* (WM Act) is “sustainable and integrated management of the State’s water” (DLWC 2001). Water sharing plans are the main tool through which the WM Act achieves its objectives. The main principles of the WM Act are as follows:

- Water sources, floodplains and dependent ecosystems (including groundwater and wetlands) should be protected and restored and, where possible, land should not be degraded
- Habitats, animals and plants that benefit from water or are potentially affected by managed activities should be protected and (in the case of habitats) restored
- The water quality of all water sources should be protected and, wherever possible, enhanced
- The cumulative impacts of water management licences and approvals and other activities on water sources and their dependent ecosystems, should be considered and minimised
- Geographical and other features of aboriginal significance should be protected
- Geographical and other features of major cultural, heritage or spiritual significance should be protected
- The social and economic benefits to the community should be maximised
- The principles of adaptive management should be applied, which should be responsive to monitoring and improvements in understanding of ecological water requirements

In relation to water sharing:

- Of water from a water source must protect the water source and its dependent ecosystems
- Of water from a water source must protect basic landholder rights
- Or extraction of water under any other right must not prejudice the principles set out in the above paragraphs

In relation to drainage management:

- Drainage activities should avoid or minimise land degradation, including soil erosion, compaction, geomorphic instability, contamination, acidity, waterlogging, decline of native vegetation or, where appropriate, salinity and, where possible, land should be rehabilitated
- The impacts of drainage activities on other water users should be avoided or minimised

In relation to controlled activities:

- The carrying out of controlled activities must avoid or minimise land degradation, including soil erosion, compaction, geomorphic instability, contamination, acidity, waterlogging, decline of native vegetation or, where appropriate, salinity and, where possible, land must be rehabilitated
- The impacts of the carrying out of controlled activities on other water users must be avoided or minimised

In relation to aquifer interference activities

- The carrying out of aquifer interference activities must avoid or minimise land degradation, including soil erosion, compaction, geomorphic instability, contamination, acidity, waterlogging, decline of native vegetation or, where appropriate, salinity and, where possible, land must be rehabilitated
- The impacts of the carrying out of aquifer interference activities on other water users must be avoided or minimised.

Elements of the WM Act (including relation to drainage management, aquifer interference activities) and general principles for design specific to the overall proposal have been considered in this assessment to inform potential construction and operational phase risks of the proposal.

3.2 Protection of the Environment Operation Act (1997)

The *Protection of the Environment Operation Act 1997* (POEO Act) is administered by the Department of Planning, Industry and Environment (DPIE). The POEO Act regulates air and water pollution, noise control and waste management. A core provision under the POEO Act is the issuing of environmental protection licences.

The proponent engaged in scheduled activities is required to hold an environmental protection licence and comply with conditions of that licence. The proposal is not a scheduled activity as it does not meet relevant criteria for road construction under item 35 of Schedule 1 of the POEO Act.

Under the POEO Act, there is a legal responsibility to ensure that runoff leaving a site meets an agreed water quality standard, including water being discharged from sedimentation ponds after storm events.

3.3 Aquifer Interference Policy (2012)

The NSW AIP (DPI Office of Water, 2012) is the NSW Government's policy for the licensing and assessment of aquifer interference activities.

Under the WM Act, an aquifer is defined as a geological structure or formation, or an artificial landfill that is permeated with water or is capable of being permeated with water. The WM Act defines aquifer interference as an activity that involves any of the following:

- The penetration of an aquifer
- The interference with water in an aquifer
- The obstruction of the flow of water in an aquifer
- The taking of water from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations
- The disposal of water taken from an aquifer in the course of carrying out mining or any other activity prescribed by the regulations

The proposal does not intend to extract large quantities of groundwater triggering the need to apply for a water extraction licence for construction needs or for domestic purposes during construction. Elements of the NSW AIP (in particular obstruction of flow of water in an aquifer and penetration of an aquifer) have been considered in this assessment to determine required construction and operational phase mitigation measures associated with the overall proposal.

3.4 The NSW Groundwater Protection Policy

The NSW Groundwater Protection Policy (NSW GQPP) (Department of Land & Water Conservation, 1998) adopts the principles outlined in the NSW State Groundwater Policy Framework document in relation to groundwater quality protection, and specifically the following management principles:

- All groundwater systems should be managed so that the most sensitive identified beneficial use (or environmental value) is maintained
- Town water supplies should be afforded special protection against contamination
- Groundwater pollution should be prevented so that future remediation is not required
- For new developments, the scale and scope of work required to demonstrate adequate groundwater protection shall be commensurate with the risk the development poses to a groundwater system and the value of the resource
- A groundwater pumper shall bear the responsibility for environmental damage or degradation caused by using groundwaters that are incompatible with soil, vegetation or receiving waters
- Groundwater dependent ecosystems will be afforded protection
- Groundwater quality protection should be integrated with the management of groundwater quantity

- The cumulative impacts of developments on groundwater quality should be recognised by all those who manage, use, or impact on the resource
- Where possible and practical, environmentally degraded areas should be rehabilitated, and their ecosystem support functions restored.

The policy identifies management tools to achieve groundwater protection, some of which would be relevant to the proposal, including the use of groundwater management plans, groundwater vulnerability mapping and groundwater monitoring. The proposal area passes through potential groundwater dependent ecosystems (GDEs) which are afforded special protection under the NSW GQPP. Further consideration of GDEs is in Section 5.5.1.

3.5 National Water Quality Management Strategy

The 3.5 National Water Quality Management Strategy (NWQMS) was developed collectively by the states, territories and Commonwealth during the 1990s by the Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resources Management Council of Australia and New Zealand (ARMCANZ).

The NWQMS (ANZECC 2000) provides a nationally consistent approach to water quality management and the information and tools to help water resource managers, planning and management agencies, regulatory agencies and community groups manage and protect their water resources.

The NWQMS comprises a description of policies, principles and guidelines for end users and water sources. The main policy objective of the NWQMS is to achieve sustainable use of water resources, by protecting and enhancing their quality, while maintaining economic and social development.

The NWQMS process involves development and implementation of a management plan for each catchment, aquifer, estuary, coastal water or other water body, by community and government. These plans focus on the reduction of pollution released into coastal pollution hotspots and other aquatic ecosystems around the country. Local government, community organisations and other agencies implement these plans using the NWQMS to protect agreed environmental values.

Guidelines are numerous and cover all aspects of water quality, including but not limited to ambient and drinking water quality, groundwater, stormwater, sewerage systems, and effluent management.

The NWQMS consists of some 21 guideline documents which broadly cover ambient and drinking water quality, monitoring, groundwater, rural land uses and water quality, stormwater, sewerage systems and effluent management for specific industries. Two new publications were released in 2001:

- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000)
- Australian Guidelines for Water Quality Monitoring and Reporting (2000)

These publications provide a new approach for deriving water quality guidelines, objectives and targets. They provide highly detailed and comprehensive information for water quality monitoring and management in Australia and New Zealand. Each publication is discussed in more detail in the following sections.

Construction and operational phases of the overall proposal have the potential to impact water quality within the Georges River and associated waterways. As such, it is recommended to integrate water quality management strategies (consistent with NWQMS) as part of this overall proposal, in such that the environmental values of the sensitive receiving waterways are not adversely impacted.

3.6 NSW Groundwater Dependent Ecosystem Policy

The NSW GDEP (Department of Land & Water Conservation, 2002) provides a framework for the sustainable management of groundwater. It adopts the following principles for the management of GDEs in NSW:

- The scientific, ecological, aesthetic and economic values of GDEs, and how threats to them may be avoided, should be identified and action taken to ensure that the most vulnerable and the most valuable ecosystems are protected.

- Groundwater extraction should be managed within sustainable yield of aquifer systems, so that the ecological processes and biodiversity of their dependent ecosystems area maintained and/or restored. Management may involve establishment of threshold levels that are critical for ecosystem health, and controls on extraction in the proximity of groundwater dependent ecosystems.
- Priority should be given to ensuring that sufficient groundwater of suitable quality is available at the time when it is needed, for:
 - Protecting ecosystems which are known to be, or are most likely to be, groundwater dependent.
 - For the GDEs which are under an immediate or high degree of threat from groundwater-related activities.
- Where scientific knowledge is lacking, the Precautionary Principle should be applied to protect GDEs. The development of adaptive management systems and research to improve understanding of these ecosystems is essential to their management.
- Planning, approval and management of development and land use activities should aim to minimise adverse impacts on GDEs by:
 - Maintaining, where possible, natural patterns of groundwater flow and not disruption groundwater levels that are critical for ecosystems.
 - Not polluting or causing adverse changes in groundwater quality.
 - Rehabilitating degraded groundwater systems where practical.

The policy contains management principles and methods to protect GDEs which have been considered and applied where GDEs are potentially encountered during the construction of the overall proposal.

3.7 National Environment Protection Measures (2013)

The Commonwealth National Environment Protection Council Act 1994, and complementary State and Territory legislation allow the National Environment Protection Council to make National Environment Protection Measures (NEPMs). The NEPM is a set of national objectives designed to assist in protecting or managing particular aspects of the environment.

Of particular relevance in the context of this investigation and report is the National Environment Protection (Assessment of Site Contamination) Measure, December 1999, as amended April 2013 (ASC NEPM).

The goal of the site contamination measure is to establish a nationally consistent approach to the assessment of site contamination to ensure sound environmental management practices by the community which includes regulators, site assessors, environmental auditors, landowners, developers and industry.

The NEPM also aims to ensure adequate protection of human health and the environment, where site contamination has occurred, through the development of an efficient and effective national approach to the assessment of site contamination.

Soils and groundwater impacted by potential contamination, either as a result of the overall proposal, or encountered by the proposal, have been considered and assessed within this report.

4 Environmental values and guidelines

The NSW Water Quality Objectives are the agreed environmental values and long-term goals for NSW's surface waters. They set out:

- The community's values and uses for our rivers, creeks, estuaries and lakes (ie healthy aquatic life, water suitable for recreational activities like swimming and boating, and drinking water); and
- A range of water quality indicators to help us assess whether the current condition of our waterways supports those values and uses.

There are two kinds of water quality objectives (WQOs) that are applicable to the Proposal site:

- Catchment specific objectives based on the maintenance of environmental values; and
- Default guideline values (DGVs) included in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018) which provide a threshold or a range of desired values to achieve WQOs for different community values including aquatic ecosystems, human health and primary industries.

Default guideline values have been derived for fresh and marine waters but not for groundwater or brackish or hypersaline surface waters.

For the Georges River catchment, there are four main sub-catchment categories, each with a set of environmental values that describe the water quality goals relevant to each sub-catchment. *The Independent Inquiry into the Georges River – Botany Bay System* (Healthy Rivers Commission, 2001) determined that the Proposal is located within a sub-catchment classified as a 'waterway affected by urban development'.

The key Water Quality Objectives (WQOs) and nominated environmental values relevant to the Georges River include:

- **Protection of Aquatic Ecosystems:** ecological condition of waterways and the riparian zone. Physical and chemical water quality stressors that cause degradation of aquatic ecosystems. For the purpose of this assessment, indicators include nutrients, dissolved oxygen, pH, metals, salinity and turbidity.
- **Protection of Visual Amenity:** aesthetic qualities of waters. For the purpose of this assessment, indicators include transparency, odour and colour.
- **Protection of primary and secondary contact recreation:** water quality for activities, such as swimming, boating and wading where primary contact recreation implies direct contact with the water via bodily immersion or submersion with a high potential for ingestion (eg swimming, diving and water skiing), and secondary contact recreation implies some direct contact with the water would be made but ingestion of water is unlikely (eg boating, fishing and wading). Bacteriological indicators are used to assess the suitability of water for recreation.

The NSW WQOs relevant to the proposal include the estuary conditions are summarised in Table 4-1 and include target concentrations for total phosphorus, total nitrogen, chlorophyll-a, turbidity, electrical conductivity, dissolved oxygen and pH.

Table 4-1 Summary of WQO ecological triggers for estuaries

| Trigger | Estuaries |
|---------------------------------|--|
| Total phosphorus (µg/L) | 30 |
| Total nitrogen (µg/L) | 300 |
| Chlorophyll-a (µg/L) | 4 |
| Turbidity (NTU) | 0.5-10 |
| Electrical conductivity (µS/cm) | - |
| Dissolved Oxygen (% saturation) | 80.110 |
| pH | 7.0-8.5 |
| Temperature | Default trigger values are provided in ANZECC 2000 guidelines. An unnatural change in temperature (>80%ile, <20%ile) is the default trigger value. |

| Trigger | Estuaries |
|-----------------------------------|---|
| Chemical contaminant or toxicants | The trigger values for toxicants for typical slightly–moderately disturbed systems (ANZECC and ARMCANZ, 2000) are summarised in Table 4-2 |
| Biological assessment indicators | This form of assessment directly evaluates whether management goals for ecosystem protection are being achieved. Many potential indicators exist. |

Table 4-2 presents select default guideline values (DGVs) for toxicants commonly found in surface waters in areas affected by urban development. The trigger values for the DGVs identified in Table 4-2 are based on the 95% species criteria (for slightly to moderately disturbed systems) in line with the desired condition of ecosystem and associated level of protection.

DGVs represent criteria to be achieved under chronic exposure scenarios. DGVs are not discharge criteria and should not be used as such.

Table 4-2 Select default guideline values – Toxicants (ANZG, 2018)

| Chemical | Trigger value (mg/L) |
|---------------------|----------------------|
| Aluminium (pH >6.5) | 0.055 |
| Ammonia | 0.9 |
| Arsenic (III) | 0.024 |
| Arsenic (V) | 0.013 |
| Benzene | 0.95 |
| Cadmium | 0.0002 |
| Chromium | 0.001 |
| Copper | 0.0014 |
| Ethylbenzene | 0.08 |
| Lead | 0.0034 |
| Manganese | 1.9 |
| Mercury | 0.00008 |
| Nickel | 0.011 |
| Napthalene | 0.016 |
| Toluene | 0.18 |
| Xylene | 0.035 |
| Zinc | 0.008 |
| TRH C6-C40 | 10 |

5 Physical environment

5.1 Climate

A review of access data available through the Bureau of Meteorology (BOM) – Monthly Statistics: Climate Data Online (<http://www.bom.gov.au/climate/data/>) indicates that the nearest BOM weather station with sufficient coverage of rainfall data is located in Bankstown, (Bankstown Airport AWS) NSW approximately 3km from the overall proposal area.

The local rainfall values for the local area have been calculated from the long-term record (1968-2020). Key rainfall statistics for each calendar month over this period is summarised in Table 5-1 and presented in Figure 5-1 alongside monthly evaporation totals.

Table 5-1 Monthly Rainfall Statistics – Milperra Bridge (Georges River) (1968 - 2020)

| Statistic | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual median | Annual total |
|-----------|-------|-------|-------|-------|-------|-------|------|-------|------|-------|-------|-------|---------------|--------------|
| Average | 93.0 | 107.5 | 100.6 | 82.4 | 63.6 | 79.6 | 44.3 | 49.6 | 44.4 | 60.3 | 75.4 | 67.2 | 67.2 | 866.4 |
| Median | 74.6 | 77.0 | 82.1 | 53.8 | 54.5 | 55.4 | 31.2 | 24.8 | 34.8 | 40.0 | 67.8 | 55.3 | 54.9 | 885.8 |
| 10%ile | 25.2 | 21.0 | 25.8 | 9.5 | 9.8 | 15.5 | 3.6 | 4.9 | 6.4 | 9.4 | 19.6 | 14.4 | 12.1 | 568.2 |
| 90%ile | 189.2 | 226.0 | 208.2 | 204.7 | 134.7 | 174.7 | 97.6 | 127.5 | 93.2 | 156.8 | 136.9 | 123.2 | 146.9 | 1153.8 |



Figure 5-1 Range of total monthly rainfall and evaporation (1969-2019)

Figure note: Data taken from years with total datasets. Whiskers show 10th and 90th percentiles. Boxes depict median values, upper and lower quartiles. Trend lines reflect monthly averages.

Correlation of the available rainfall data has shown that there is generally a seasonal cyclic variation in total monthly rainfall amounts, which is skewed towards the Summer and Autumn seasons. The data shows general evidence of 'wetter' (November to June) and 'drier' (July to October) periods through comparison of monthly and annual medians. It is noted that there is a high variance in total monthly rainfall between October and June correlating with a greater annual variability for these months.

Evaporation shows a strong seasonal trend and low variability, with highest evaporation rates in December and January and lowest evaporation rates in June and July. Evaporation data also shows that median monthly evaporation exceeds the median rainfall throughout the year, with December and January having the highest evaporation rates of the year and greatest departure from total rainfall.

Maximum and minimum monthly temperatures are presented in Figure 5-2. Analysis of all the climate records indicate a temperate climate with warm to hot summers (average maximum temperatures around 29°C) and cooler winter periods with average maximum temperatures below 20°C and minimum temperatures averaging around 6°C.

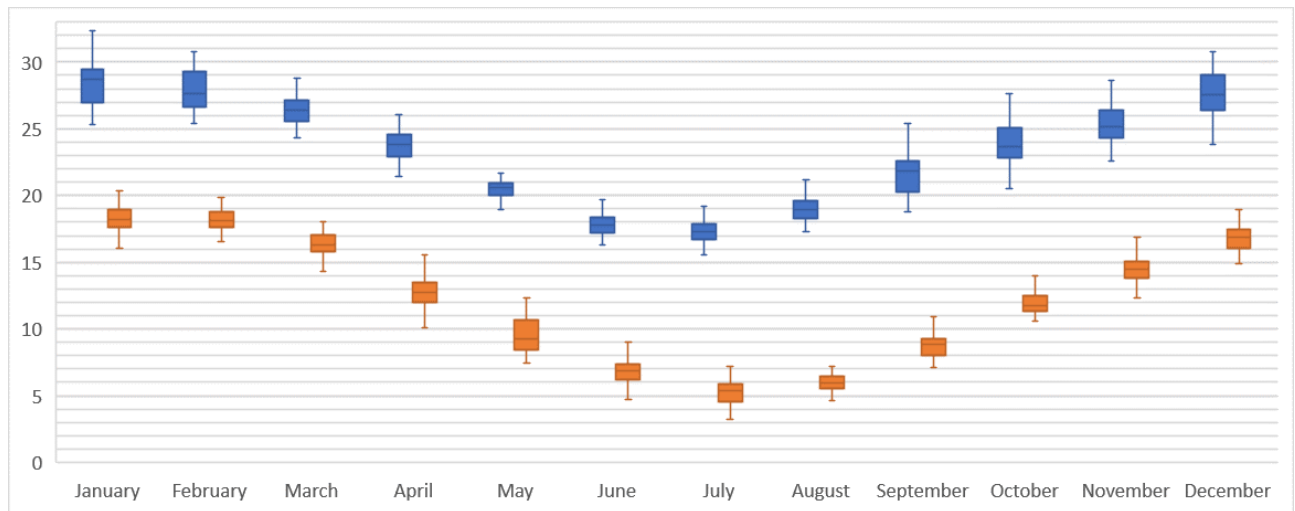


Figure 5-2 Monthly maximum and minimum temperature ranges for Bankstown Airport AWS (1969-2019 excluding 1994 due to low data record)

5.2 Local topography

Topography within the proposal area and surrounding suburbs is presented in Figure 5-3.

The overall proposal area sits within a natural low point in the region, at the base of the valley associated with the Georges River. The proposal area itself is roughly 0 m AHD to 8 m AHD in elevation and is relatively flat and consistent across the study area. The average height for the largest stretch of road within the proposal is 5 m AHD with Georges River at 0 m AHD. The eastern side of the overall proposal area has a high elevation that the western side with the general local topography sloping westward towards the base of the Georges River Valley.

Generally, elevation increases to the south and north of the overall proposal, with the higher elevated suburbs of Villawood and Voyager Point above the river valley. A more gradual increase in elevation is seen to the west of proposal area following Cabramatta and Maxwells Creeks.

5.3 Land use

The overall proposal area is currently a two-lane roadway with additional turning lanes at the major intersections of Milperra Road/Newbridge Road and at Tower Road. Additional traffic lanes expanding the road to four lanes total are present between Tower Road and the intersection with Milperra/Newbridge roads and extend south to just north of Auld Avenue. Overhead traffic lights and signage structures are present at the main intersection and leading up to it in each direction. A dual lane bridge spans the George's River tributary between Auld Avenue and Keys Parade. A shared walking and bicycle path runs along the banks of the Georges River.

The overall proposal area is largely covered with constructed roadways and associated ground cover. Topsoil consisted of mostly vegetated land (grass covering) with patches of bare earth. Some roadside vegetation is noted, however is largely confined to the western side of the roadway where the walking and bicycle path runs.

Two constructed golf courses are present in the north off Tower Road (closest point 5m from proposal area), and south east off Milperra Road (approximately 100m from proposal area) and a bushland area between the proposal and the golf club. An off-leash dog area is located to the west of the proposal near the Auld Avenue intersection (approximately 370 m). Other surrounding land uses include a number of petrol stations adjacent to the proposal (7-Eleven, located 10m east off Henry Lawson Drive, Shell located 200 m West of the proposal off Newbridge Road) and commercial retail strip along Henry Lawson Drive north of the Milperra Road intersection (10m east of Henry Lawson Drive), and some residential housing directly adjacent to Henry Lawson Drive south of Newbridge Road.



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- EIS proposal area
- REF proposal area
- Contours (10m)
- Contours (2m)

Source: Aurecon, TfNSW, Spatial Services, Nearmap



1:28,000
0 250 500m

Projection: GDA 1994 MGA Zone 56

Henry Lawson Drive Stage 1A Groundwater Impact Assessment

FIGURE 5-3: Site topography

Current land use of the EIS proposal areas include coastal wetlands that are zoned as public recreation zoning and infrastructure (roadway). EIS proposal area 1 is within the riparian vegetation zone adjacent to the Georges River and comprises part of an existing public pathway for active transport. EIS proposal area 2 is vegetated Crown land adjacent to Milperra Road and EIS proposal area 3 forms part of a private residential property.

5.4 Local catchment and drainage features

5.4.1 Regional surface water environment

The overall proposal is located within the Georges River catchment which drains a 930km², including parts of 14 local government areas, and covers a significant portion of the Greater Metropolitan Region (Department of Planning, Industry and Environment, 2018). The Georges River itself extending approximately 60km south-west of Sydney. The waters of the Georges River catchment, having come together from such widespread sources as Wollongong and Wollondilly in the south and Blacktown in the north, ultimately flows eastwards into Botany Bay.

The Georges River catchment is one of Australia's most urbanised and developed catchments and this has led to poor health throughout most of the catchment. Land use within the catchment varies, and includes residential, industrial, agricultural, mining and Defence activities, and protected areas such as drinking water catchments and conservation areas.

5.4.2 Drainage features

The overall proposal follows an established roadway within a low-lying and generally flat floodplain of the Georges River. The proposal alignment itself is located within the High risk flood zone a relatively flat and poorly drained area, with the majority of overland flow expected to pool in the lower lying areas of the roadway, before draining to the Georges River to the west (Bewsher Consulting 2004, BMT WBM 2017) (refer Figure 5-5).

Based on an inspection undertaken by Aurecon on 28 September 2020, a storm water culvert was observed on the embankment of the Georges River at the northern side of the study area (forming part of the REF proposal area and the EIS proposal area 1). This was flowing east to west from the Georges River Golf Course, under Henry Lawson Drive and into Georges River. The flow from this drain is assumed to be ephemeral as a result of storm waters collected within the Bankstown Golf Course. These drains are expected to impact surficial flow towards the Georges River, and may provide a preferential pathway for subsurface, shallow water.

Photos from the proposal area inspection showing these drainage channels are included in Appendix B. Dial Before You Dig Plans from council records and plans showing drainage and other underground utilities are provided in Appendix C.

Further drainage features included; a large artificial culvert and drainage line located in the north, which was flowing under Henry Lawson Drive west towards Georges River, another drainage line is running north east to south west adjacent to Henry Lawson Drive and the Georges River Golf Course refer (refer Figure 5-5). At the time of inspection, surface water ponding was observed.

There is a culvert and artificial drainage line in the east, which flows ephemerally from the Bankstown Airport towards Milperra Road and Bankstown Golf Course, and a large drainage line carrying stormwater running north to south along Henry Lawson Drive was observed (refer Figure 5-5). The culvert, which passes under Milperra Road, is within the REF proposal area and the EIS proposal area 2.

EIS proposal areas 1 and 2 have Strahler order 1 stream flowing from the existing culverts under the roadways, in both cases the culverts are upstream of the coastal wetlands.

5.4.3 Surface water flows and flooding

The Georges River is perennial and tidally influenced at the point adjacent to the proposal and flows south under estuarine/tidal conditions. Recent water level data from Milperra 2 (ID 213405B) station (DPIE 2020) are presented in Figure 5-4, showing the diurnal oscillations in water levels in response to tides, and the tidal range (m AHD).

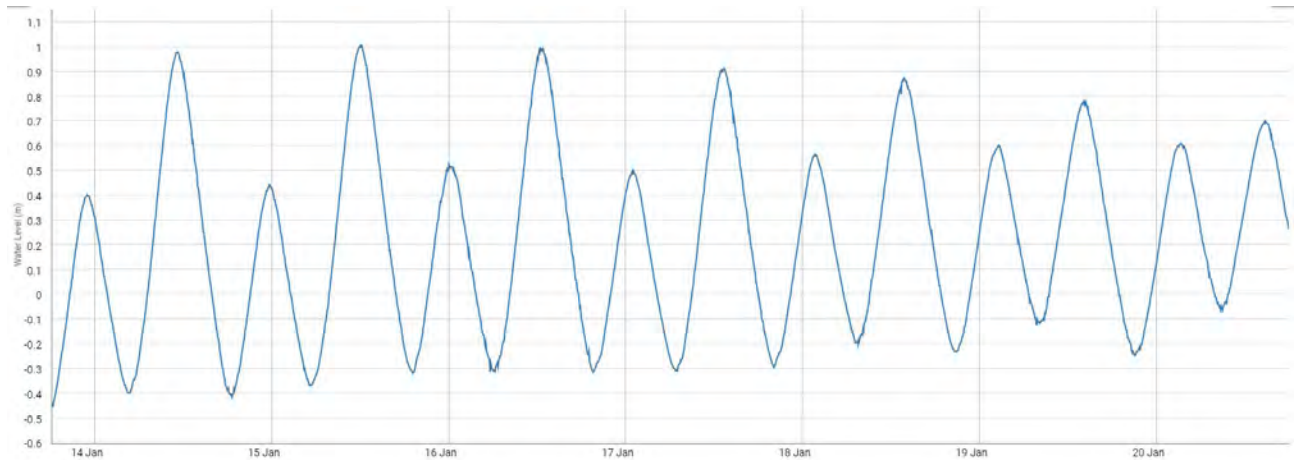


Figure 5-4 Water level from Milperra 2 (14 January to 20 January 2021) (Station ID 213405B)

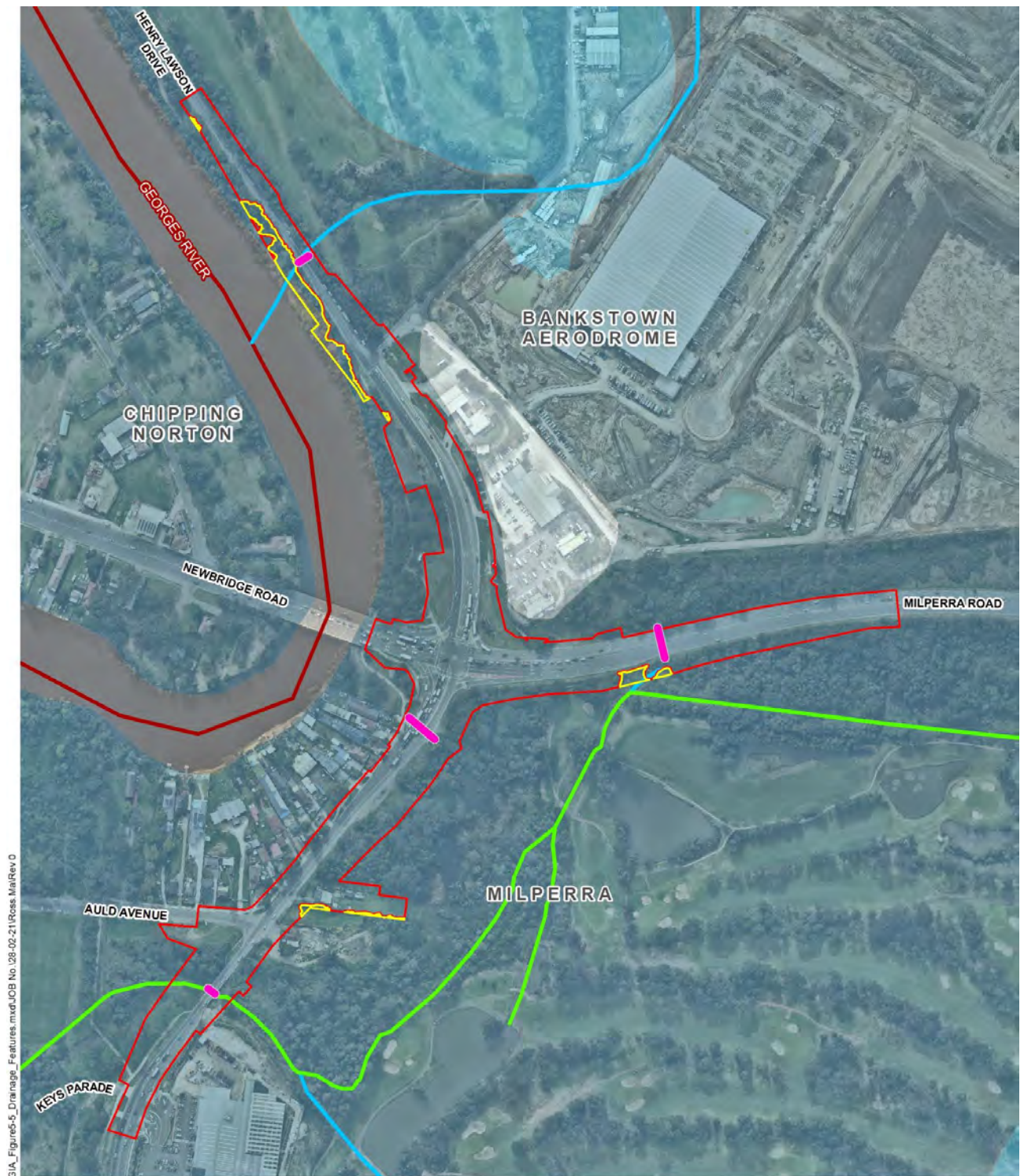
The floodplain area, including the proposal alignment, is noted to have severe flooding occur, including a large flood event in February 2020 (Georges Riverkeeper 2020). Past floods have been recorded irregularly; however recent records show that flooding frequency has increased since the urbanisation of the Milperra/Liverpool region.

Significant flooding occurred in April 1988 and reported a peak height of 4.90 m (Maddocks, 2001). 1 in 100-year floods were reported in the region in 1897 and 1900 where peak heights of around 8-9 m AHD were reported (Bewsher Consulting 2004, BMT WBM 2017).

Overland runoff is expected to flow into the floodplain from areas of higher elevation, namely the north and south of the proposal alignment. The proposal area is noted to have poor drainage as it sits within the flood plain for the Georges River, and can become inundated from overland runoff downwards to the proposal area, and from river flooding at times of high rainfall (Bewsher Consulting 2004, BMT WBM 2017).

Flood risk mapping presented in Figure 5-5 is the flood risk presented in Georges River floodplain risk management plan. The EIS and the REF proposal areas exist within the high flood risk area. This is defined as land below the 100 year flood that is either subject to a high hydraulic hazard (ie provisional high hazard in accordance with the criteria outlined in the Floodplain Management Manual) or where there are significant evacuation difficulties. Due to its location, the proposal areas are subject to high hydraulic hazard.

Detailed analysis of hydrology and flooding as a result of the overall proposal has been assessed in Henry Lawson Drive Upgrade – Stage 1A Flood Assessment Report (Lyll & Associates, 2021).



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- EIS proposal boundary
- REF proposal boundary
- Existing culverts

Strahler Stream Order

- 1
- 2
- 7

Flood Risk Precinct

- High risk precinct - Land below the 100 year flood that is either subject to a high hydraulic hazard or where there are significant evacuation difficulties
- Medium risk precinct - Land below the 100 year flood that is not subject to a high hydraulic hazard and where there are no significant evacuation difficulties
- Low risk precinct - All other land within the floodplain (ie. within the PMF extent) but not identified as either in a high flood risk or medium flood risk precinct
- Normal waterway area - Area included in high flood risk

Flood Risk Data Source: "Georges Riverfloodplain Risk Management Study & Plan - Volume 1 May 2014"

Notes:

1. The extent of flood inundation shown is approximate only. It is based on available survey and topographic data.
2. Mapping does not include local stormwater flooding.

Source: Aurecon, TfNSW, Spatial Services, DPIE, Neamap



1:5,250
0 50 100m

Projection: GDA 1994 MGA Zone 56

Henry Lawson Drive Stage 1A Groundwater Impact Assessment

FIGURE 5-5: Drainage features

5.5 Wetlands

The EIS proposal areas contains several areas of identified coastal wetlands, and the REF proposal area passes through the coastal wetland proximity area under the State Environmental Planning Policy (Coastal Management). There are no coastal wetlands within the REF proposal area. Coastal wetlands were identified in the north west along the Georges River (EIS proposal area 1) and south east along smaller tributaries (EIS proposal areas 2 and 3). In general, coastal wetlands are identifiable based on the dominance of six key vegetation types:

- Mangroves
- Salt marshes
- Melaleuca forests
- Casuarina forests
- Sedgeland
- Brackish and freshwater swamps
- Wet meadows

Wetlands along the proposal alignment are displayed in Figure 5-6 and further details on the groundwater dependent ecosystems (including vegetation communities) within the overall proposal area are discussed in the following section.

5.5.1 Groundwater dependent ecosystems

GDEs rely on groundwater for some or all of their water requirements. Six types of Groundwater Dependent Ecosystems have been identified in Australia:

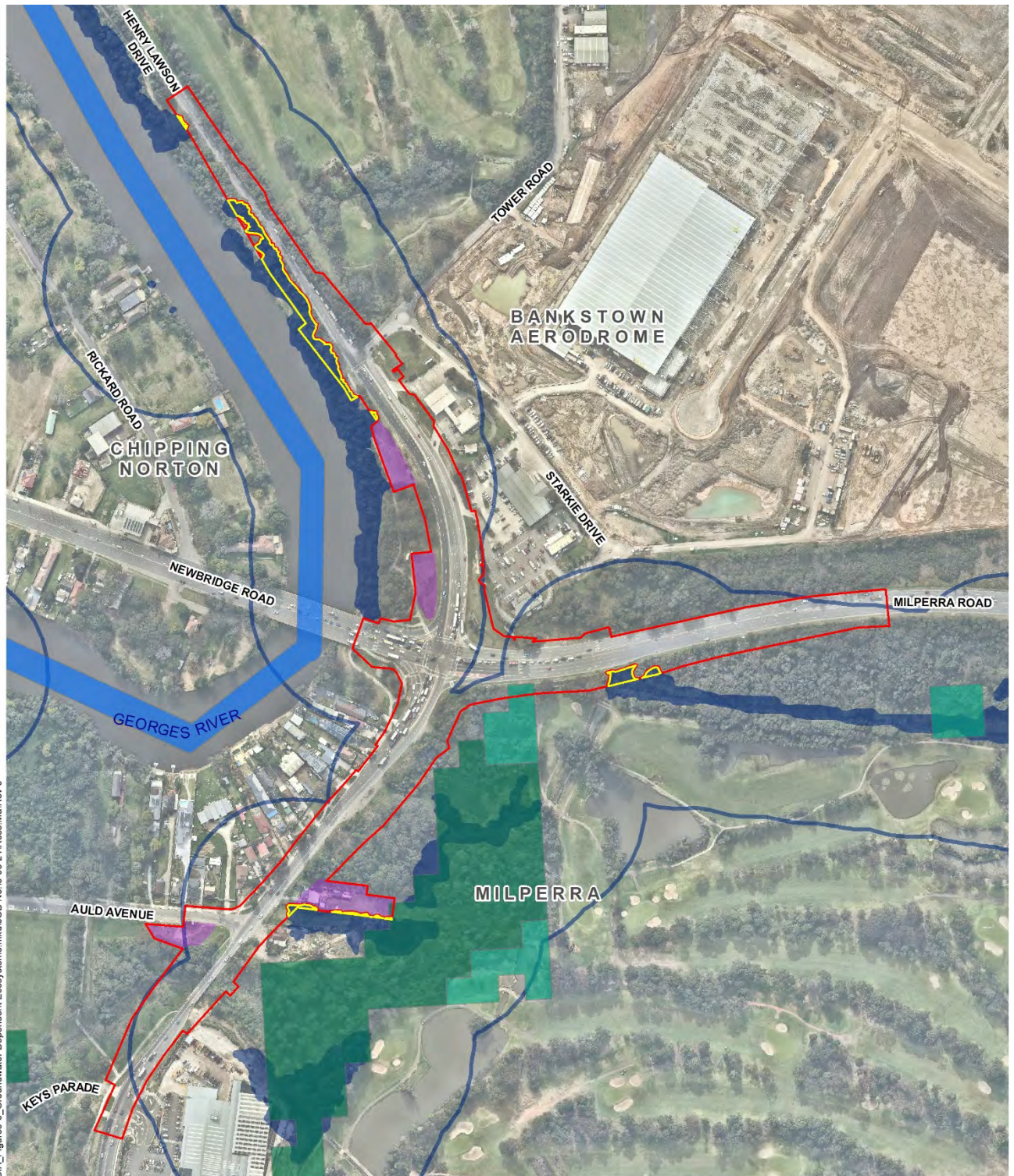
- Terrestrial vegetation that relies on the availability of shallow groundwater
- Wetlands such as paperbark swamp forests and mound springs
- River baseflow systems where groundwater discharge, provides significant baseflow component to the river
- Aquifer and cave ecosystems where life exists independent of sunlight
- Terrestrial fauna, both native and introduced species, that rely on groundwater as a source of drinking water
- Estuarine and near-shore marine systems, such as coastal mangroves, salt marshes and seagrass beds, which rely on the submarine discharge of groundwater

A search of the BOM Groundwater Dependent Ecosystem Atlas found that a number of GDEs are present within the study area.

The search identified high potential aquatic GDEs within the study area. A high potential for terrestrial GDEs was also noted within the study area, particularly to the south of the Milperra Road intersection, and west of Keys Parade within the parkland areas abutting the Georges River. Areas of subterranean GDEs were not mapped within the study area.

It is considered likely that coastal wetlands along the riparian zone of the Georges River (EIS proposal area 1) comprise (in part) aquatic GDEs. Coastal wetlands are intersected by the proposal along Milperra Road and along Henry Lawson Drive north of Newbridge Road, and would be disturbed as part of site activities (refer Figure 1-1).

GDEs occurring in the study area are displayed in Figure 5-6. It is assumed that general direction of groundwater flow is towards the Georges River. The aquatic GDEs and a small section of moderate potential GDE are hydraulically downstream of the proposal.



- EIS proposal area
 REF proposal area
 Potential compound sites
Coastal Wetland Management
 Coastal Wetlands
 Coastal Wetlands Proximity Area

- Groundwater Dependent Ecosystems (Aquatic)**
 High potential GDE - from national assessment
Groundwater Dependent Ecosystems (Terrestrial)
 High potential GDE - from national assessment
 Moderate potential GDE - from national assessment

Source: Aurecon, TfNSW, Spatial Services, Nearmap



1:5,250
0 50 100m

Projection: GDA 1994 MGA Zone 56

Henry Lawson Drive Stage 1A Groundwater Impact Assessment

FIGURE 5-6: Groundwater Dependent Ecosystems

The Biodiversity Development Assessment Report (WSP, 2021), undertaken for the EIS proposal identified the following vegetation communities that are considered GDEs in the proposal areas:

- Cumberland River-flat Forest
- Cumberland Swamp Oak Riparian Forest
- Coastal Freshwater Lagoon
- Coastal Swamp Paperbark – Swamp Oak Scrub
- Estuarine Swamp Forest
- River Mangrove

5.6 Soil landscapes

5.6.1 Soil types

The overall proposal area is within the Soil Landscapes of the Penrith 1:100,000 Sheet (1984) and are shown in Figure 5-7.

The overall proposal area is underlain with yellow podzolic soils along the western boundary of the study area. Soils are characterised as poorly drained coarse loamy sands ranging from very dark greyish brown to a greyish yellow brown colour to medium clays appearing yellowish brown with a grey mottling.

5.6.2 Acid sulfate soils

Acid sulfate soils (ASS) are natural sediments that contain iron sulphides, formed from the process of sulfate reduction that often naturally occur in lakes, rivers, wetlands and oceans. ASS are most commonly found in coastal and estuarine wetlands, however, can also occur inland in waterways, wetlands and drainage channels. ASS develop in waterlogged, saline and anaerobic conditions. ASS are benign when left undisturbed in a waterlogged environment. When ASS are exposed to air, the iron sulphides react with atmospheric oxygen and water to produce sulphuric acid. Exposure to air occurs in response to a reduction in water levels within the hydromorphic zone of soils (eg during droughts and dredging operations).

The production of sulphuric acid can cause major cations and anions (such as Na^+ , Mg^{2+} , Ca^{2+} , Cl^- , SO_4^{2-}), trace elements and metal ions (including Fe^{3+} and Al^{3+}) to be released and become mobile.

Inland ASS risk is determined by presence of waterways, wetlands and drainage channels and dryland salinity. The alignment is considered high risk for inland ASS, given the presence of extensive floodplain soils and proximity to major waterway channels and wetlands.

A review of the eSPADE and the Department of Planning and Environment ASS Risk Map indicates that the REF proposal area is located within a high probability 2 - 4 m below ground surface and areas of high probability >4 m below ground surface. EIS proposal area 1 is located within a high probability 2 - 4 m below ground surface, with EIS proposal area 2 located on areas of high probability >4 m below ground surface. EIS proposal area 3 has a low risk of encountering ASS. Much of the area near Bankstown Airport is disturbed terrain and does not fall within a classification for ASS risks. A map of the ASS risks within the proposal area is presented in Figure 5-8. A review of the Henry Lawson Drive Upgrade Stage 1A and Stage 1B Strategic Geotechnical Factual Report concludes that laboratory results from that assessment are consistent with PASS and ASS in the area.

Refer to the PSI prepared for the overall proposal for further discussion of ASS.

5.6.3 Salinity hazard

Salinity refers to the movement and concentration of salt in soil and natural waters. Saline soils are generally rich in chlorides, sulfates or carbonates. Sources of salt include retreating seas, rain, wind and rocks. In cases of retreating seas, where areas were historically covered by an inland sea and underwent evaporation, large quantities of salt remained in the sediment resulting in saline soils. Ocean salt is carried by strong winds, which fall in rain and are absorbed into soils and sediments. Salts are present within rocks which can be released into sediments through weathering, where the action of rainwater, temperature and biological activity break down and dissolve rocks. Soil salinity affects the structure, water movement, microbial and plant diversity of soils.

A review of information available through eSPADE indicates the overall proposal area is generally located in an area of medium land salinity (eSpade Mapping).

The overall proposal is located in the Parramatta/Georges River Hydrogeological Landscape, discussed further in Section 5.8, as a result of being located next to the Georges River (eSpade 2020).

Across the majority of the REF proposal area, EIS proposal area 1 and part of EIS proposal area 3, land salinity is high. This is because of the tidal influence on extensive floodplains and alluvial plains with some ponding along the Georges River, and the periodic wetting and drying of the alluvial floodplain sediments which allows for cycling of the salts. The remainder of the REF proposal area and EIS proposal area 2, salinity risk is moderate. Salt export across the overall proposal area is high. Waterlogging and the constant flux of water draining through the hydrogeological landscapes (HGL) carry dissolved salts from the sediments. The impact of sulfate soils adds to salt load (eSpade 2020).

A review of the Henry Lawson Drive Upgrade Stage 1A and Stage 1B Strategic Geotechnical Factual Report concludes that laboratory results from that assessment are consistent with high salinity identified via eSPADE in the area.

Therefore, salt hazard is high due to the high likelihood of occurrence and severe potential impact in the areas closest to the Georges River (western side of proposal) (refer Figure 5-9).

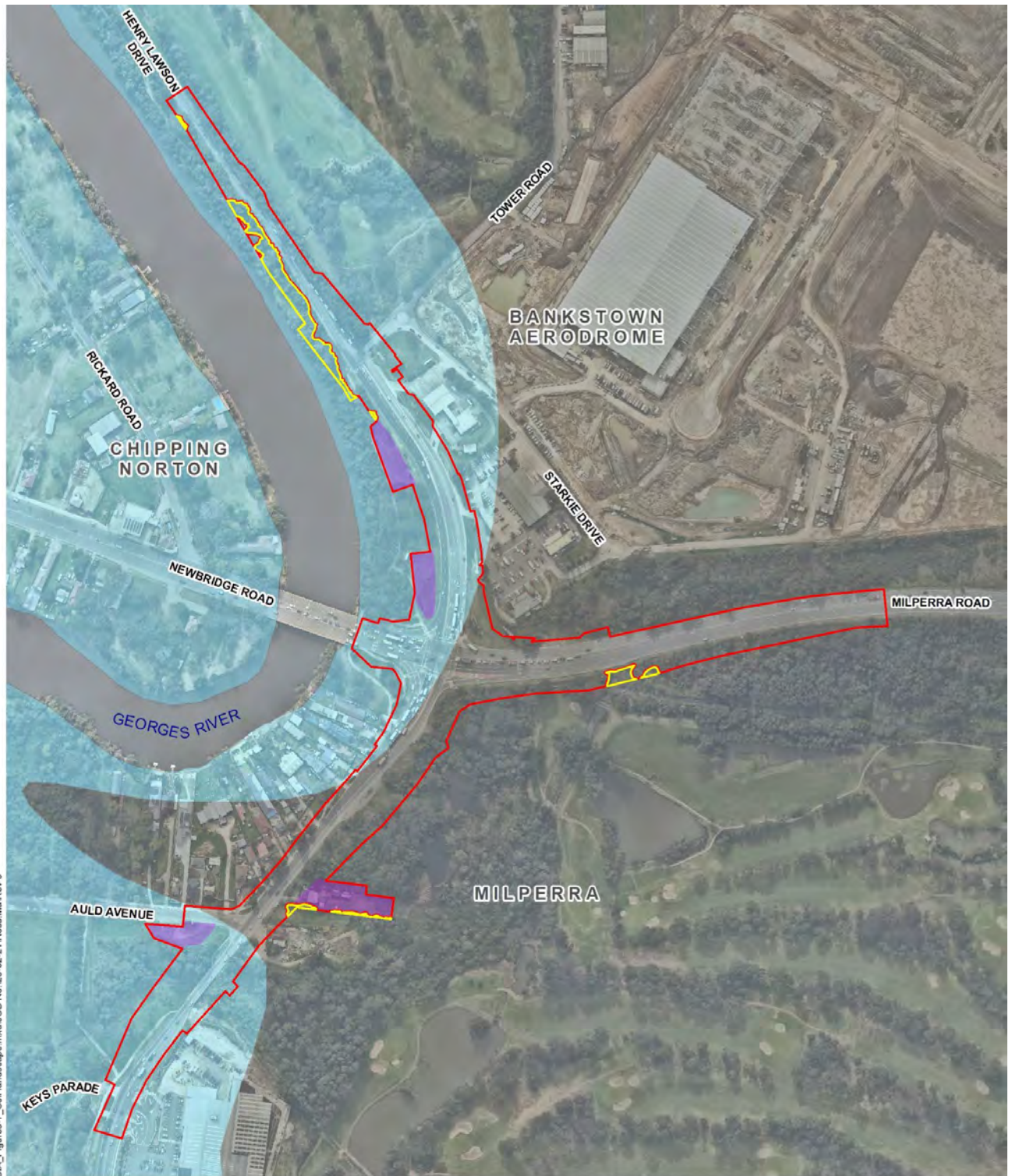
5.6.4 Hydrologic soil groups and permeability

Most of the west and southern areas of the REF proposal area (and all of EIS proposal area 1) have been classified as hydrologic group C soils. Hydrologic group C soils have slow infiltration rates when thoroughly wetted and consisting chiefly of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine texture.

Group C soils have a slow rate of water transmission, with a saturated hydraulic conductivity of 0.000001 m/s to 0.00001 m/s in their least transmissive layer where a water impermeable layer exists between 50 and 100 cm, and a saturated hydraulic conductivity between 4×10^{-7} m/s and 4×10^{-6} m/s in their least transmissive layer where the water impermeable layer is deeper than 100cm. This reports as soils with 'slow infiltration' rates. Permeability for the soil profile is expected to be quite low due in the southern portion of the alignment.

Soils around the Bankstown Airport in the eastern portion (including part of the REF proposal area and all of EIS proposal areas 2 and 3) are considered disturbed and any natural hydrologic properties have not been assessed.

Hydrologic soil groups along the proposal alignment are shown in Figure 5-10.



- EIS proposal area
 - REF proposal area
 - Potential compound sites
- Soil Landscapes**
- Disturbed Terrain
 - Richmond

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Source: Aurecon, TfNSW, Spatial Services, Nearmap

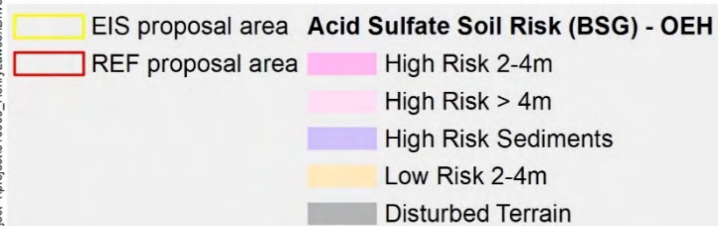
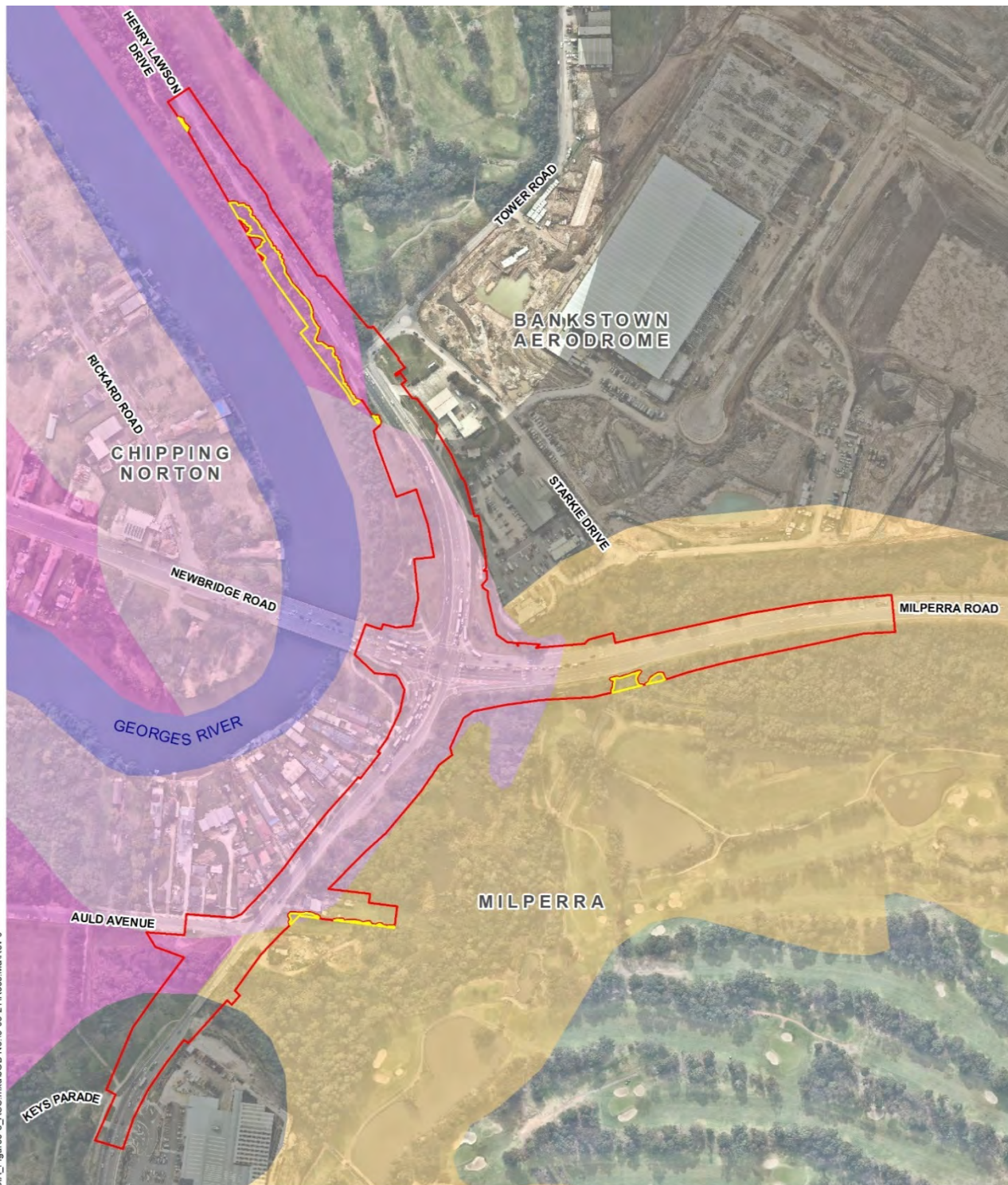


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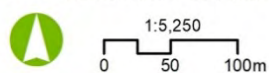
Projection: GDA 1994 MGA Zone 56

Henry Lawson Drive Stage 1A **Groundwater Impact Assessment**

FIGURE 5-7: Soil landscapes



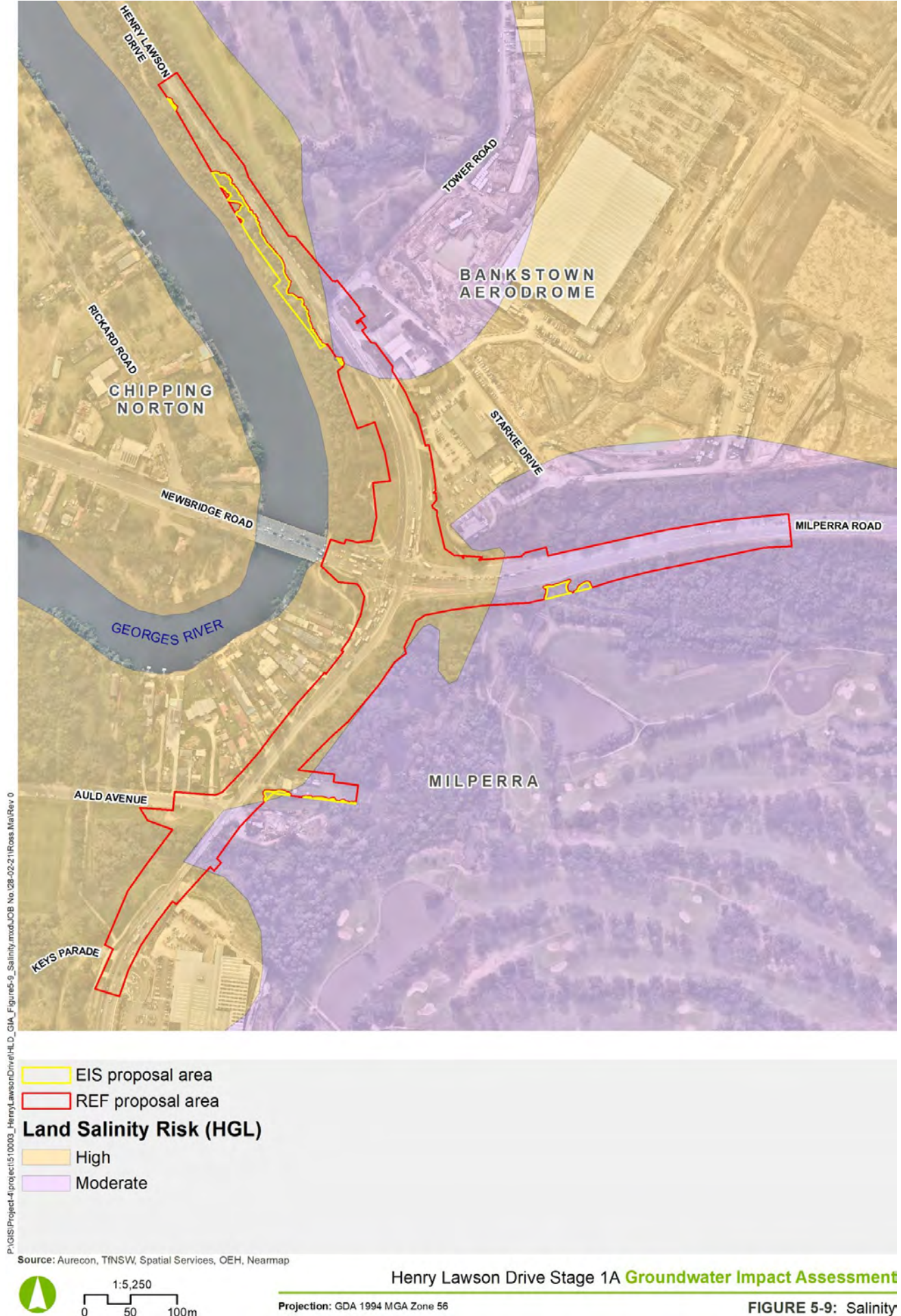
Source: Aurecon, TfNSW, OEH, Spatial Services, Nearmap

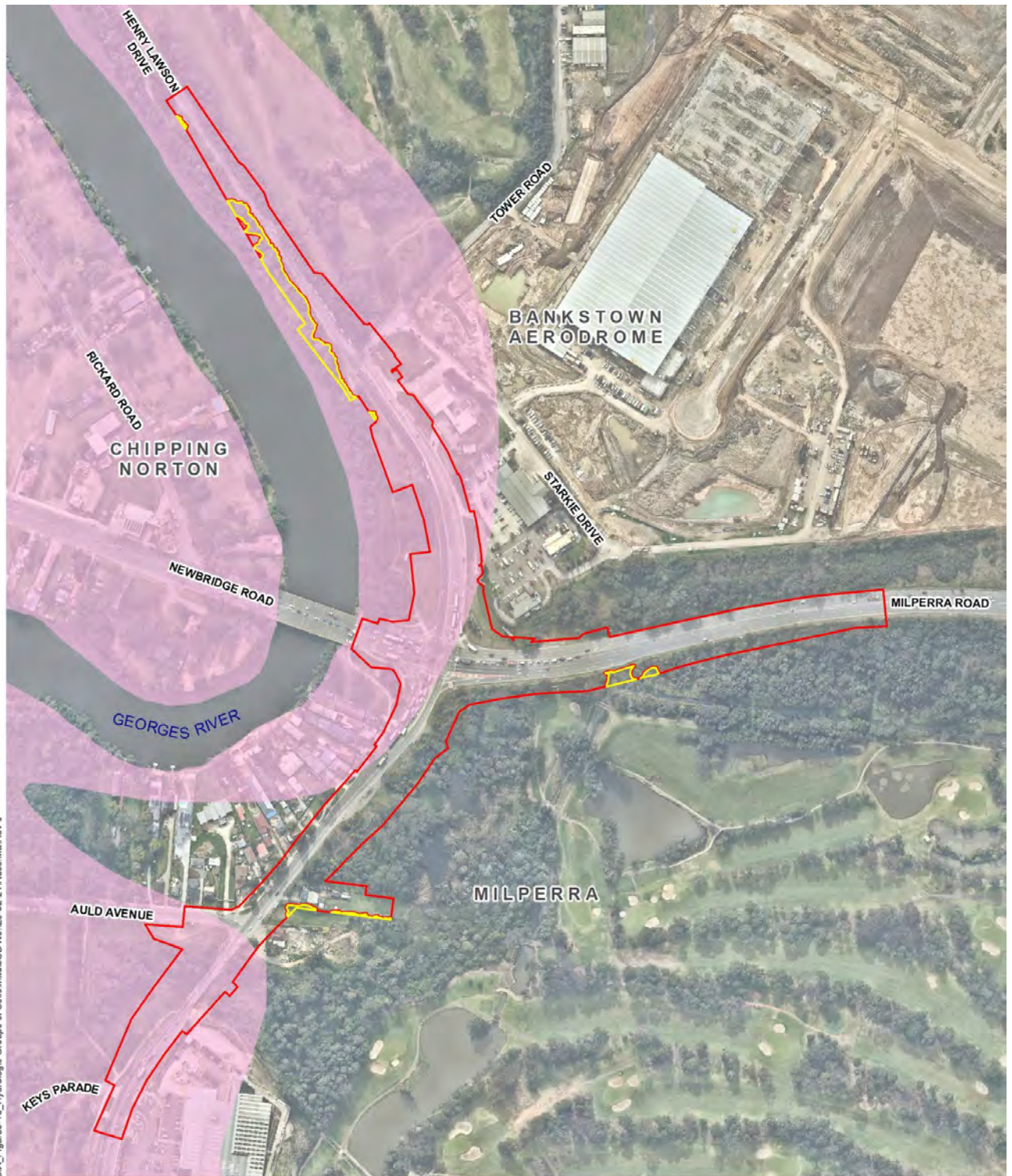


Henry Lawson Drive Stage 1A Groundwater Impact Assessment

Projection: GDA 1994 MGA Zone 56

FIGURE 5-8: Acid Sulfate Soil risks





- EIS proposal area
- REF proposal area
- Hydrologic Soil Group**
- C Slow infiltration

Source: Aurecon, TINSW, Spatial Services, Nearmap



1:5,250
0 50 100m

Projection: GDA 1994 MGA Zone 56

Henry Lawson Drive Stage 1A **Groundwater Impact Assessment**

FIGURE 5-10: Hydrologic groups of soils

5.7 Geology

5.7.1 The Penrith 1:100 000 Geological Sheet

The Penrith 1:100 000 Geological Sheet shows the overall proposal area is underlain by an alluvium, gravel, sand, silt and clay. Sandstone and shale with some sandstone beds are also mapped east of the study area and west over the Georges River.

5.7.2 Seamless and coastal quaternary geology maps

The Penrith 1:100 000 Quaternary Geology (Clark and Jones, 1991) map shows the proposal area is underlain by a number of undifferentiated lithologies. These are illustrated below in Figure 5-11. The following units were noted in proximity to the proposal alignment:

- Quartz sand, silty sand, silt and clay
- Clayey quartzose sand and clay
- Dark grey to black claystone-siltstone and fine sandstone-siltstone laminate from the Wianammatta Group
- Medium grained sand, clay, silt

A summary of geological units across the overall proposal area is presented in Table 5-2.

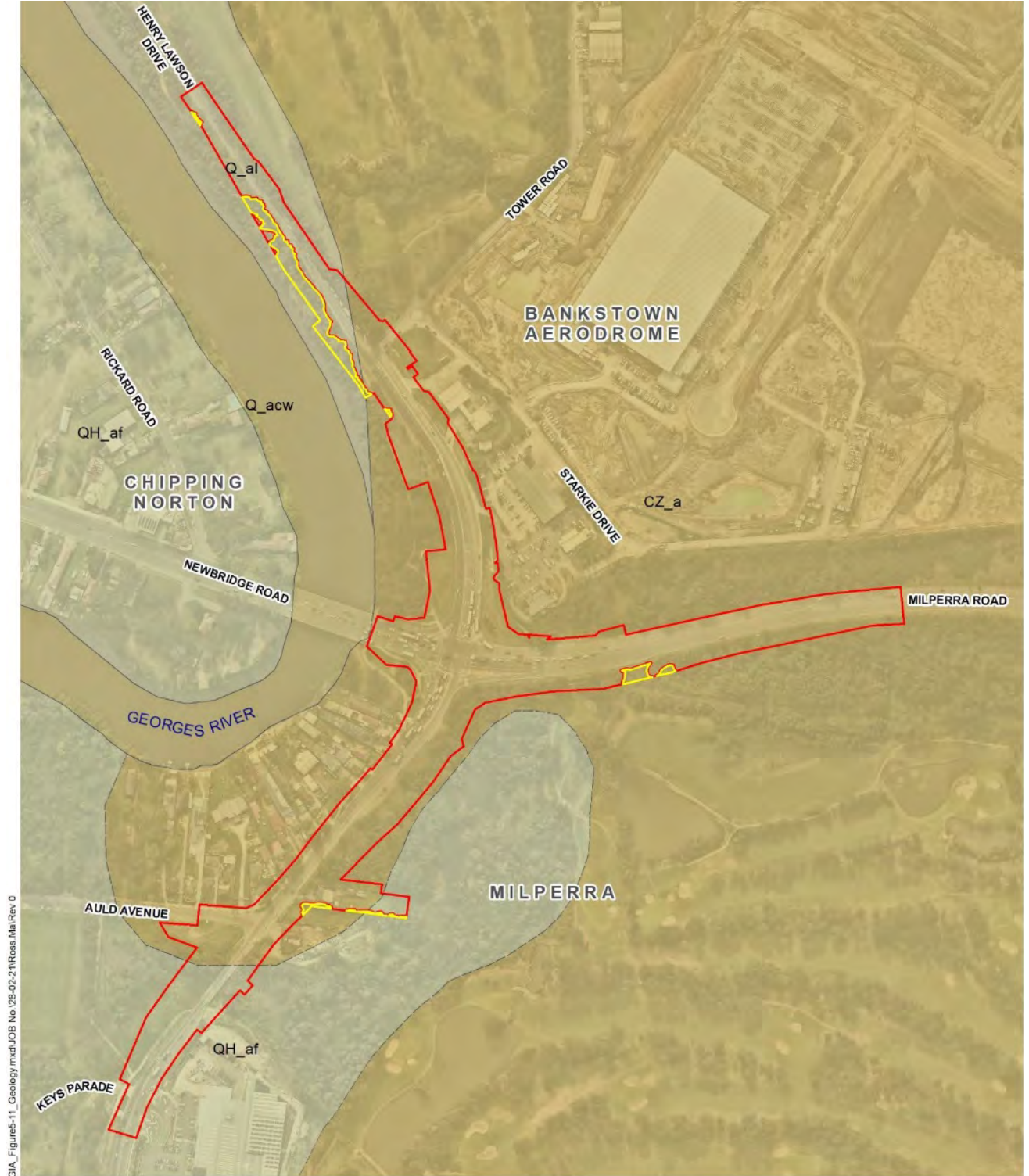
Table 5-2 Geological units

| Period | Name | Area | Description |
|---------------------|--|---|---|
| Quaternary deposits | Alluvial floodplain deposits | REF proposal area EIS proposal area 2 EIS proposal area 3 | Silt, very fine- to medium-grained lithic to quartz-rich sand, clay. |
| | Alluvium | REF proposal area EIS proposal area 3 | Unconsolidated alluvial clay, silt, sand, and gravel deposits. |
| | Alluvial channel deposits - subaqueous | Adjacent to the REF proposal area (Georges River) | Fluvially deposited sand, gravel, silt, clay. |
| | Alluvial levee/overbank deposits | REF proposal area EIS proposal area 1 | Fluvially deposited fine- to medium-grained lithic to quartz-rich sand, silt, clay. |

The overall proposal area is underlain with Holocene aged alluvial sedimentary deposits, largely consisting of a mix of silts, sands and clays from floodplain and swamp environments. Alluvial floodplain deposits of quartz rich sands and clays dominate the southern portion of the proposal alignment.

Unconsolidated alluvial clays, silts, sands and gravels are dominant in the northern portion of the proposal alignment and join with alluvial levee and overbank deposits along the Georges River to the north west of the proposal area. The Georges River itself on the western boundary of the overall proposal area consists of alluvial channel deposits of sand, gravel, silts and clays.

No structural features (dykes or veins) are mapped across the overall proposal area.



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□ EIS proposal area

□ REF proposal area

NSW Seamless Geology

Geological boundaries & misc. boundaries

— Geological boundary, position accurate

- - - Geological boundary, position approximate

Rock Units

□ CZ_a Alluvium

□ QH_af Alluvial floodplain deposits

□ Q_acw Alluvial channel deposits - subaqueous

□ Q_al Alluvial levee/overbank deposits

Source: Aurecon, TfNSW, Spatial Services, DPIE, Nearmap



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0 50 100m

Projection: GDA 1994 MGA Zone 56

Henry Lawson Drive Stage 1A **Groundwater Impact Assessment**

FIGURE 5-11: Geology

5.8 Hydrogeological landscapes

The western portion of the overall proposal area where the roadway is parallel to the Georges River falls within the Parramatta/Georges River hydrogeological landscape (HGL). The northern, eastern and southern portions of the study area further from the river are within the Moorebank hydrogeological landscape. These HGLs are represented in Figure 5-12. Technical reports and details of each hydrogeological landscape are presented in Appendix C.

The Parramatta/Georges River landscape (across the REF proposal area, EIS proposal area 1 and part EIS proposal area 3) are characterised by low lying Quaternary and Tertiary alluvial floodplains of the Georges River and areas of reclaimed land around the river. This landscape is heavily influenced by acid sulfate soils and has generally a higher than average salinity, primarily due to cyclic flows with estuarine and acid sulfate influences. Flow is generally unconfined through the alluvial soils into the Georges River; hence groundwater flow direction is expected to the west. Surface water runoff is also expected in this direction towards the river, due to the flat nature of the proposal area and increasing elevation away from the river.

The Moorebank hydrogeological landscape (across the REF proposal area, EIS proposal area 2 and part EIS proposal area 3) present in the north, east and south of the proposal alignment is characterised by moderate salinity shale layers that cyclically flush salts into the lower lying Parramatta/Georges River hydrogeological landscape. The Moorebank landscape is distinguished by its terminal-like ponding of the river with minimal acid sulfate influences.

The Moorebank hydrogeological landscape differs from other hydrogeological areas within the Sydney region due to its very flat and low-lying alluvial plains and ponding in the river bend areas. Ponding and slow drainage is particularly notable in the Chipping Norton area, to the north west of the proposal alignment. This area is dominated by Tertiary alluvium which is distinguishable from the Parramatta/Georges River HGL by a lower salinity signature and less influence from acid sulfate soils.

5.8.1 Groundwater levels and flow paths

Groundwater levels throughout the overall proposal area are expected to be shallow due to the location on alluvium and the close proximity of the Georges River, between 0 to 8 m below the surface, varying seasonally (higher in winter, lower in summer). A review of groundwater bores in the area reported groundwater levels near the proposal area of between 4.6 to 5.0 m below ground level (m bgl).

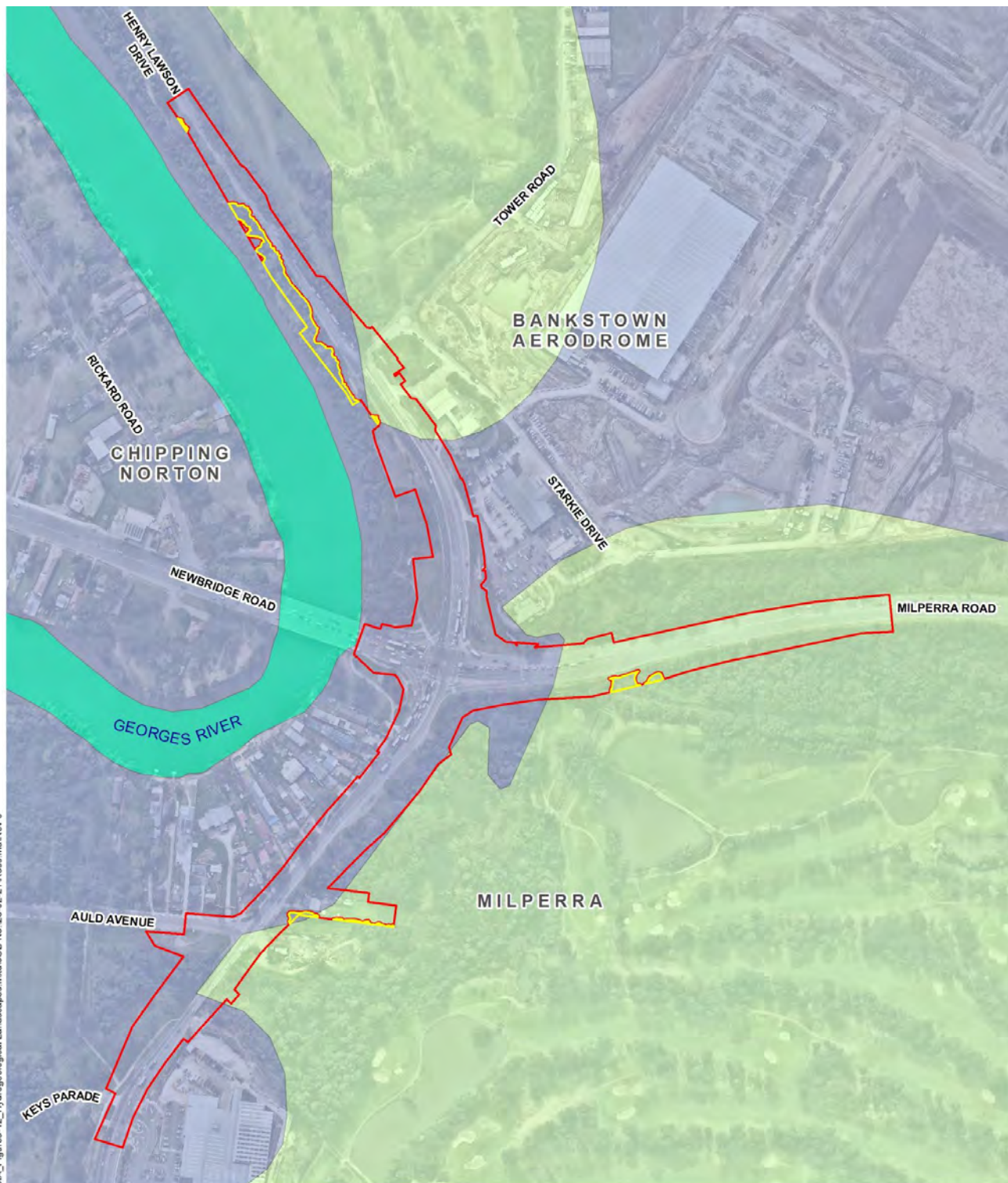
In the Geotechnical Factual Report 2019 for the Henry Lawson Drive Upgrade Stage 1A and Stage 1B Strategic, a series of Test Pits, Pavement Cores and a Single Borehole were excavated. The borehole located approximately 100m south east of the EIS proposal area 3, intersected groundwater at a depth of 2.8 m bgl. The five pavement cores within the overall proposal area drilled to a depth of 2 m bgl did not intercept groundwater, these measurements were taken in February and March when groundwater levels are lower. A summary of registered bores in the area are presented in Table 5-5 give groundwater depths ranging between 3.6 m and 5 m bgl. This is still consistent with shallow groundwater levels between 0 to 8m.

Groundwater flow through the alluvial sediments is anticipated to be towards the Georges River. Elevation data indicates that the Georges River forms a local groundwater discharge point (gaining conditions). This preliminary indication would need to be confirmed through groundwater monitoring and baseflow analysis of the Georges River within and around the proposal.

Three stormwater drains are present beneath Henry Lawson Drive (near to EIS proposal area 1) and Milperra Road (EIS proposal area 2) that were identified during an Aurecon proposal area inspection on 28 September 2020. Stormwater drains were observed to flow into the Georges River. These drains may locally alter groundwater flow paths where they intersect groundwater or act as recharge zones for groundwater as a result of leakage or discharge.

Based on cross sections from the Moorebank HGL report (refer Appendix C), groundwater flow generally occurs horizontally nearer the surface (particularly toward salt sites) and through unconsolidated sediments in both the unsaturated (as interflow) and saturated zone (as baseflow). Flow paths in the Parramatta/Georges River HGL are simpler, with groundwater expected to flow vertically downward through unconsolidated sediments down to the Wianammatta Group below, before flowing laterally within the saturated zone.

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— EIS proposal area

— REF proposal area

Hydrogeological Landscapes

Moorebank

Parramatta and Georges River

Water

Source: Aurecon, TfNSW, Spatial Services, Nearmap



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0 50 100m

Projection: GDA 1994 MGA Zone 56

Henry Lawson Drive Stage 1A **Groundwater Impact Assessment**

FIGURE 5-12: Hydrogeological landscapes

5.8.2 Aquifer chemistry and groundwater quality

Groundwater quality and chemistry for both hydrogeological landscapes are summarised in Table 5-3.

Table 5-3 Aquifer Chemistry and Groundwater Quality for the Parramatta/Georges River and Moorebank HGLs

| Item | Parramatta/Georges River HGL | Moorebank HGL |
|-------------------------|------------------------------|--|
| Groundwater Quality | Brackish to saline | Fresh to marginal (more saline in deeper aquifers in the Wianammatta Group shales) |
| Groundwater Salinity | 1.6 - >4.8 dS/m | <0.8–1.6 dS/m |
| Electrical Conductivity | High | Low |
| Salt Mobility | High | Moderate |

The available information indicates that groundwater within the Moorebank HGL may be fresh to marginal, while groundwaters of the Parramatta/Georges River HGL may be brackish to saline. A review of nearby groundwater bore data and local studies did not yield any further information for actual aquifer chemistry and groundwater quality data, specific to the overall proposal area.

5.8.3 Aquifer properties – hydraulic parameters

A summary of aquifers within both the Moorebank and Parramatta/Georges River HGLs is provided in Table 5-4.

Table 5-4 Summary of HGL aquifer attributes

| Item | Parramatta/Georges River HGL | Moorebank HGL |
|----------------------|---|---|
| Aquifer type | Unconfined in unconsolidated alluvial sediments Vertical and lateral flow components Local perching above clay-rich layers (seasonal) | Unconfined in unconsolidated alluvial sediments Unconfined to semi-confined in fractured rock along structures Local perching above clay-rich layers (seasonal) |
| Conductivity | 10 ⁻² –10 m/day | 10–30 m/day |
| Transmissivity | Moderate to high: 10–100 m ² /day | Moderate: 2–100 m ² /day |
| Specific Yield | 10-20% | 5-15% |
| Hydraulic Gradient | Gentle: <10% | Gentle to moderate: <10-30% |
| Depth to Water Table | Shallow to intermediate (seasonal): 0-8 m | Shallow to intermediate (seasonal): 0–8 m |
| Recharge Estimate | High | Moderate to high |
| Residence Time | Short to medium (months to years) | Short to medium (months to years) |

The available information indicates that aquifers within both the Moorebank HGL and Parramatta/Georges River HGL are generally unconfined to semi-confined with local perching above clay-rich layers. The hydraulic conductivity ranges from 0.01 to 10 m/day in the Parramatta/Georges River HGL, and from 10 to 30 m/day in the Moorebank HGL.

Overall, the available information indicates that groundwater may have a tendency to perch within the unconsolidated sediments, with seasonal variations in groundwater levels, and moderate to high discharge rates within aquifers.

5.8.4 Aquifers and aquifer vulnerability

As noted in Section 5.8, the proposal area is noted to include two different hydrogeological landscapes. The Parramatta/Georges River landscape (western section) is characterised by unconsolidated Quaternary aged sedimentary fine-grained sands, silts and clays.

Aquifers within the landscape are typically unconfined and unconsolidated, with perched water above the clay-rich layers, which are expected to act as an aquitard.

Aquifers are considered to have a high vulnerability due to their unconfined nature and moderate to high permeability.

5.8.5 Registered groundwater bores and groundwater levels

A search of the BOM Groundwater Explorer and NSW Water databases indicate that there are nine bores within 1 km of the Milperra Road and Henry Lawson Drive intersection and one more from the HDL Geotechnical Factual Report 2019. A summary of these bores is provided in Table 5-5 and presented on Figure 5-13. Data from these bores did not contain any information regarding salinity or chemistry.

Table 5-5 Groundwater bores within 1 km of the proposal alignment

| Bore ID | Bore depth (m) | Water depth (m BGL) | Purpose | Status | Latitude | Longitude | Distance from proposal area |
|--------------|----------------|---------------------|--------------|------------|----------|-----------|-----------------------------|
| GW047864.1.1 | 252 | | Other | Functional | -33.9184 | 150.9765 | 200 m south east |
| GW108838.1.1 | 240 | | Monitoring | Functional | -33.9365 | 150.9862 | 200 m south east |
| GW112549.1.1 | 6.5 | 4.6 | Monitoring | Functional | -33.9276 | 150.9806 | 10 m east |
| GW112548.1.1 | 7 | 4.6 | Monitoring | Functional | -33.9274 | 150.9804 | 10 m east |
| GW112547.1.1 | 8 | 4.8 | Monitoring | Functional | -33.9275 | 150.9805 | 10 m east |
| GW106700.1.1 | 16 | | Other | Unknown | -33.9184 | 150.9772 | 20 m east |
| GW110200.1.1 | 8 | 5 | Monitoring | Unknown | -33.9273 | 150.9806 | 10 m east |
| GW023146.1.1 | 5.4 | 3.6 | Water Supply | Unknown | -33.9256 | 150.9764 | 20 m east |
| GW024357.1.1 | 3 | | Irrigation | Unknown | -33.9362 | 150.9742 | 80 m south west |

5.9 Groundwater contamination

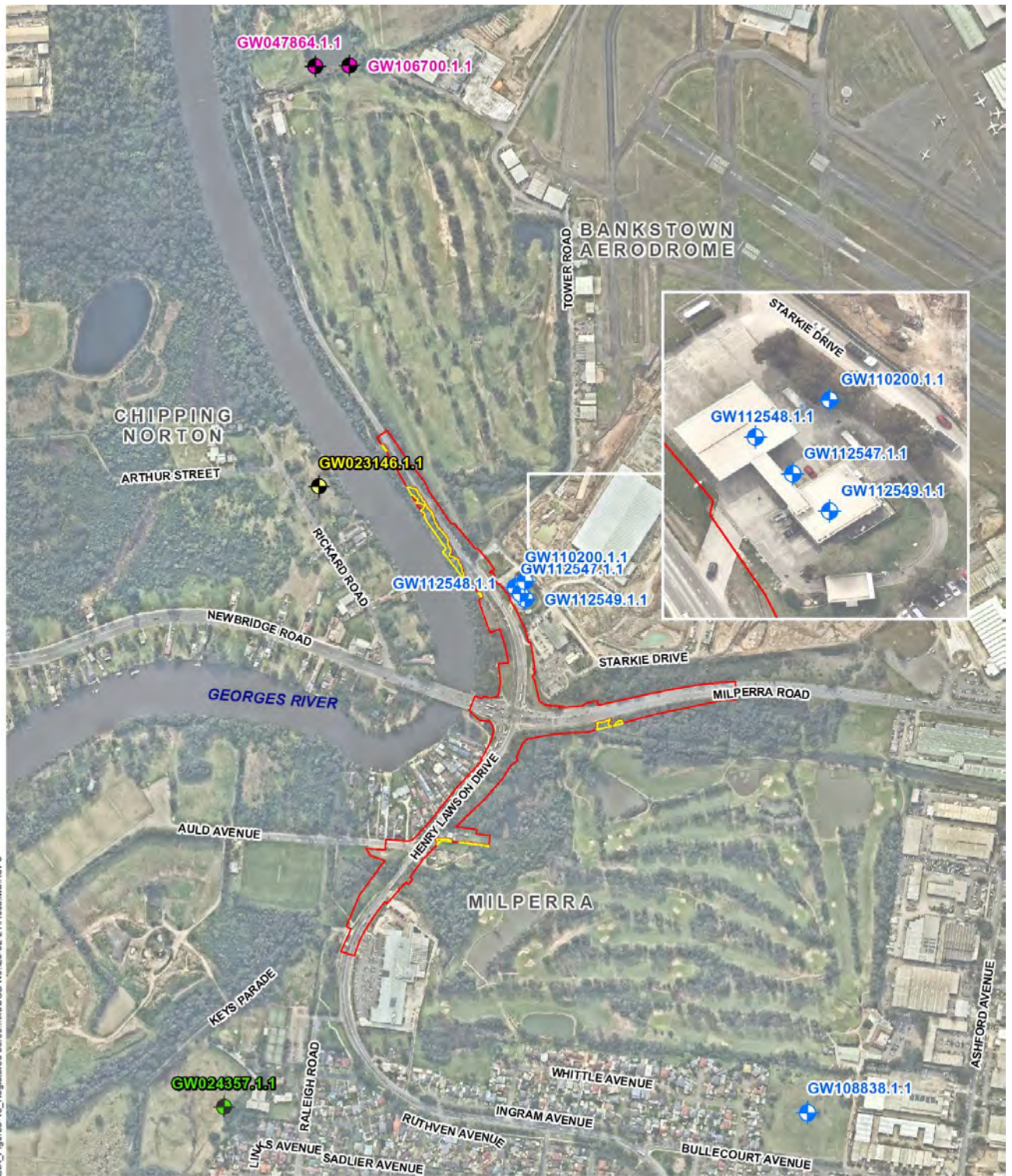
Nearby land use activities and previous investigations undertaken in and around the overall proposal area were reviewed to better assess the site conditions as part of the groundwater assessment. Further information on existing contamination sources within the REF proposal area and the EIS proposal areas are discussed in the PSI.

5.9.1 PFAS

Bankstown Airport which lies 80 m east of the proposal area is currently under investigation by the NSW EPA following the detection for PFAS in groundwater, surface water and soils. The source of PFAS contamination is likely from the historical use of aqueous film forming foam for firefighting purposes. Given the persistence of PFASs in the environment, soils and groundwater within both the REF and EIS proposal areas may be PFAS impacted. Refer to Section 3.3 of the PSI for further investigation.

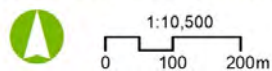
5.9.2 Hydrocarbons, volatile organic compounds, and heavy metals

Surrounding land uses include a number of service stations adjacent to the proposal (7-Eleven, located 10 m east off Henry Lawson Drive, Shell located 200m west of the proposal off Newbridge Road). There is potential for hydrocarbon, volatile organic compound, and heavy metal contamination to be present within groundwater within and around these operational service stations. There are four registered contaminated sites within one kilometre of the overall proposal area, the closest being the 7-Eleven service station mentioned above and the former landfill site (now the Flower Power Garden Centre).



- EIS proposal area
 REF proposal area
- Registered Bores (BoM)**
- ◆ Irrigation
 - ◆ Monitoring bores
 - ◆ Water supply
 - ◆ Other

Source: Aurecon, TfNSW, Spatial Services, Nearmap



Projection: GDA 1994 MGA Zone 56

Henry Lawson Drive Stage 1A Groundwater Impact Assessment

FIGURE 5-13: Registered bores

The former landfill located at 479 Henry Lawson Drive may present a moderate risk given its proximity to the REF proposal area and EIS proposal area 3. Given the former and current site use a wide variety of contaminants and chemicals including but not limited to heavy metals, gas (eg carbon dioxide and methane), petroleum hydrocarbons, polycyclic aromatic hydrocarbons, volatile organic compounds and nutrients may be present. The other two listed sites are not considered to pose a risk to the proposal given their distance (>500 m away) and construction is not likely to interact with the groundwater table near to these locations. Refer to Section 3.1 of the PSI for further information.

5.9.3 Pesticides and herbicides

Two constructed golf courses are present in and adjacent to the REF proposal area (and EIS proposal area 2); one to the north off Tower Road (closest point 5m from the REF proposal area), and the other south east off Milperra Road (closest point 50m from REF proposal area and EIS proposal area 2). There is potential for contamination of groundwater as a result of potential use of pesticides and herbicides in maintenance of the golf course.

6 Potential impacts

6.1 Potential impact ratings

An impact rating is used in this groundwater impact assessment, the level of impact is described as very low, low, medium or high, ratings are made on impact severity and/or probability of occurrence. The definitions are listed below:

- **Very Low/Minimal:** Potential adverse impact could result in a minimal decline in the resource in the study area during the life of the proposal. Probability of event occurring may be not anticipated.
- **Low:** Potential adverse impact could result in a slight decline in the resource/quality of a resource in the study area during the life of the proposal. Probability of event occurring may be unlikely. Research, monitoring, and/or recovery initiatives would not normally be required.
- **Moderate:** Potential adverse impact could result in a decline in the resource resource/quality of a resource to lower-than-baseline/worse-than-baseline but stable levels in the study area after proposal closure and into the foreseeable future. Probability of event occurring may be probable/possible. Regional management actions such as research, monitoring and/or recovery initiatives may be required.
- **High:** Potential adverse impact could threaten sustainability of the resource/quality of a resource and should be considered a management concern. Probability of event occurring may be likely. Avoidance of this impact through mitigation strategies is recommended. Research, monitoring and/or recovery initiatives should be considered.

6.2 Potential impacts during construction

6.2.1 Construction activities for the REF proposal

Construction activities within the REF proposal area are anticipated to have minor excavation activities. Ground clearing and levelling activities will be minimal due to the flat topography of the proposal area and incorporation of existing levelled road shoulders. It is anticipated that only around 184 cubic metres of soil would be excavated as part of the REF proposal.

Some site levelling and cut and fill is to be employed at the Tower Road intersection to level the proposal area in line with the design specifications for the road. Piling works using a bored cast in-situ method to support the upgrade and duplication of the Auld Avenue bridge are anticipated, with an anticipated depth of about 30 m. Groundwater interception during piling work is expected.

Excavation of drainage and underground utility trenches and channels and foundations for overhead infrastructure is also anticipated, however the design of these and the construction methodology has not been undertaken at the time of writing this report. These are largely expected to reach only shallow depths, however with the groundwater table in the area being generally between 2.5 to 5 m below the surface (based on available data), groundwater interception is likely.

6.2.2 Construction activities for the EIS proposal

Construction activities within the EIS proposal areas are anticipated to have moderate excavation activities and earthworks. Ground clearing and levelling activities will be minimal due to the flat topography of the proposal area and incorporation of existing levelled road shoulders. It is anticipated that only around 0.9 cubic metres of soil would be excavated as part of the EIS proposal.

Extension of existing stormwater culverts and installation of stormwater culverts, which requires ground clearing and excavation would be located in EIS proposal areas 1 and 2. Additional fill material is required for fill embankments which are located in in the EIS proposal areas. This includes the installation of hardstand surfaces such as paths and roadways and embankments to support the road formation, which could affect groundwater recharge and flow.

6.2.3 Impact assessment for construction impacts

The impacts assessment is separated into three categories. Impacts on the REF proposal, direct impacts of the EIS proposal area and indirect impacts from the REF proposal on the EIS proposal areas. The impact assessment highlights potential impacts to groundwater resource/quality and groundwater users/receiving environments from construction stage activities (including permanent works, structures, drainage and road infrastructure) in consideration of Local Environment Plans, Water Sharing Plans and relevant legislation.

The assessment for construction activities are presented in Table 6-1, Table 6-2 and Table 6-3.

Table 6-1 REF proposal construction impact assessment

| Impact | Potential impact | Relevance/discussion |
|--|------------------|--|
| Aquifer Interference: Flow obstruction/ interference | Low | No planned works as part of construction of the REF proposal that would result in flow obstruction or interference beyond localised piling at the Auld Avenue bridge. Localised piling only affects a small special extent and flow interference would be on the scale of 10 ⁻¹ m. As such, potential for aquifer interference is considered to be low and potential impacts downstream or on other groundwater users would be negligible. |
| Aquifer Interference: Dewatering | Very low | <p>The WM Act 2000 states that an Aquifer Interference Approval is needed for aquifer interference activities (which would include construction dewatering). Approval is required only for significant active dewatering (>3 ML/day) or where GDEs are potentially impacted. Passive dewatering activities of groundwater ingress into excavations and bored piles by public authorities do not require any approvals or permits under the WM Act 2000.</p> <p>Based on current design information pavement, utility and drainage excavations for the REF proposal are likely to be shallow (<1.5m – 2m) compared to groundwater levels generally being 2.8 – 5 mbgl. Therefore, no dewatering is expected. As such, risk of settlement from over-pumping is expected to be negligible.</p> <p>Bridge piles (Auld Avenue bridge) may reach depths of approximately 30 mbgl but are subject to further analysis during detail design. Groundwater ingress into the bored piles is likely to occur although construction methodologies may be adopted to minimise groundwater ingress. As such, it is considered unlikely that any significant groundwater dewatering will be required as part of construction and thus the potential for aquifer interference is very low and potential impacts on other groundwater users would be negligible.</p> <p>There is potential for groundwater levels to rise in response to higher than average rainfall conditions caused by short-term and long-term climate cycles, leading to potential saturation of planned excavations and dewatering of excavation sites might be necessary, this should be monitored throughout construction.</p> |
| Discharges to groundwater | Very low | <p>The WM Act 2000 states that an Aquifer Interference Approval is needed for aquifer interference activities (which would include controlled discharges to groundwater). No discharges to groundwater are anticipated as a result of construction activities for the REF proposal, as all collected stormwater, surface water runoff and groundwater (from dewatering activities if they should they be required in high rainfall events) is to be managed under the proposal CEMP, rather than discharged to groundwater.</p> <p>No input or inflows to the aquifers onsite is anticipated as a result of construction works therefore potential impact is considered to be very low.</p> |
| Acid sulfate soils | Moderate to high | <p>The REF proposal areas are considered to pose a risk of encountering ASS, varying from low risk to high risk (refer Figure 5-8).</p> <p>If excavation expose ASS which is likely, infiltration and recharge after rain events of exposed ASS can transport acids into the groundwater.</p> <p>Drawdown of aquifers/seasonal variability of groundwater levels have been known to oxidise PASS which creates ASS causing impacts on groundwater quality. This level of aquifer interference is not proposed or required as part of the REF proposal.</p> <p>Without suitable management measures, disturbance of acid sulfate soils is considered to present a moderate to high potential impact to groundwater.</p> |

| Impact | Potential impact | Relevance/discussion |
|-----------------------------|------------------|--|
| Salinity | Very low | Salts within the Parramatta/Georges River HGL are known to be highly mobile and pose a severe potential impact to buildings and structures within the proposal area. There is a high risk of excavated soils being saline, which may cause impacts where spoil material is exposed to surface waters and rain. However, it is noted that in the area, groundwater salinity is already high. Runoff from exposed soils could produce a highly saline waste stream that may have minor impacts should it migrate into the groundwater through recharge. Due to the minor amount of soil to be excavated (148m ³), these impacts are considered very low . |
| Contamination | Moderate | <p>The potential for groundwater contamination mobilisation exists where piling works are proposed. Piling at the Auld Avenue Bridge area has the potential to mobilise and intersect any contamination that may exist in groundwater within the area.</p> <p>Potential contamination sources include gas (eg carbon dioxide and methane), hydrocarbon, volatile organic compound, and heavy metal contamination to be present within groundwater within and around operational service stations as a result of leaks, spills and stormwater leakage to groundwater. There is also potential for PFAS contamination from Bankstown Airport and herbicide/pesticide contamination from golf courses/historical activities including former landfill sites and petrol stations.</p> <p>There are also potential risks to both human health and structures arising from vapour intrusion into excavations from hydrocarbon contaminated soils and groundwater during excavation works.</p> <p>Further risk of contamination to groundwater may occur as a result of on-site leaks, accidental spills of fuels and in appropriate storage of chemicals. Key risks to groundwater quality will include contamination from oils and grease, lead, zinc, copper, cadmium from vehicles, and nitrogen and phosphorous from atmospheric deposition during construction works.</p> <p>The potential impacts from groundwater contamination are considered to be moderate.</p> |
| Impact to groundwater users | Moderate - High | <p>There are nine registered bores within 1 km of the Proposal Area. The majority of these are monitoring bores.</p> <p>The risk of aquifer interference and discharges to groundwater is deemed to be 'Very Low – Low'. As such the water table should not be affected by this Proposal and the risk of changes to water availability to groundwater users is therefore also deemed to be very low – low.</p> <p>The risks of ASS and contamination to groundwater are deemed to be 'Moderate – High'. As such taking a conservative approach, the risk of the quality of water becoming unsuitable for groundwater users is also deemed to be moderate – high.</p> |

Table 6-2 EIS proposal construction impact assessment

| Impact | Potential impact | Relevance/discussion |
|---|------------------|--|
| Groundwater dependent ecosystems and coastal wetlands | Very high | <p>Excavations</p> <p>Shallow excavations within the topsoil and fill materials for embankments and a shared path in EIS proposal area 1; and drainage structures constructed under and from the roadway in EIS proposal area 1 and 2 are not expected to intersect groundwater due to the shallow nature of expected excavations. EIS proposal area 3 will be used as a temporary ancillary site during construction and only minor ground improvements would be undertaken to stabilise surfaces for construction vehicles entering and exiting. Excavations and drainage outlet construction in EIS proposal area 1 would intersect coastal wetlands along the riparian zone of the Georges River. Construction of drainage outlets in EIS proposal area 2 would impact on coastal wetlands along Milperra Drain. The coastal wetlands and associated vegetation communities form aquatic GDEs within the EIS boundaries. Within the EIS boundaries, the potential impacts from excavations on aquatic GDEs are considered to be very high as a result of direct loss of habitat caused by excavation and disturbance.</p> |

| Impact | Potential impact | Relevance/discussion |
|--------------------|------------------|--|
| Acid Sulfate Soils | Moderate to high | <p>The EIS proposal areas are considered to pose a risk of encountering ASS as follows: EIS proposal area 1 is considered high risk; EIS proposal area 2 is considered low risk; and EIS proposal area 3 has both high risk and low risk ratings (refer Figure 5-8).</p> <p>If excavations expose ASS which is likely during excavation, infiltration and recharge after rain events of exposed ASS can transport acids (low pH runoff) into the groundwater and to areas of GDE habitat. Leaching of acid from soils would potentially impact the health of GDEs from low pH water or from some existing soil toxicants becoming mobilised as a result of low pH conditions.</p> <p>Drawdown of aquifers/seasonal variability of groundwater levels have been known to oxidise PASS which creates ASS causing impacts on groundwater quality. This level of aquifer interference is not proposed and not required for the construction of the EIS proposal or the overall proposal.</p> <p>Without suitable management measures, acid sulfate soils are considered to present a moderate to high potential impact to groundwater water and indirectly impact on the health of GDEs.</p> |
| Salinity | Very low | <p>Salts within the Parramatta/Georges River HGL are known to be highly mobile and pose a severe potential impact to buildings and structures within the EIS proposal area. There is a high risk of excavated soils being saline, which may cause impacts where spoil material is exposed to surface waters and rain. However, it is noted that in the EIS proposal areas, groundwater salinity is already high. Runoff from these exposed soils could produce a highly saline waste stream that may have minor impacts should it migrate into the groundwater through recharge or to GDEs. Given the groundwater salinity is high and due to the minor amount of soil to be excavated (0.9 m³), these impacts are considered very low.</p> |
| Contamination | Moderate | <p>The potential for groundwater contamination mobilisation exists where excavation will occur. This is highly likely in EIS proposal areas 1 and 2. Some minor surface stabilisation would occur in EIS proposal area 3.</p> <p>Potential contamination sources include gas (eg carbon dioxide and methane), hydrocarbon, volatile organic compound, and heavy metal contamination to be present within groundwater within and around operational service stations as a result of leaks, spills and stormwater leakage to groundwater. These sources are relevant to EIS proposal area 1. There is also potential for PFAS contamination from Bankstown Airport for EIS proposal areas 1 and 2 that occur nearest to the aerodrome. The potential for leaching of wastes from a former landfill site is most relevant to EIS proposal area 3 which occurs north of the former landfill site. Herbicide/pesticide contamination from golf courses and historical activities are relevant to all EIS proposal areas.</p> <p>If dewatering of excavations is required for the EIS proposal, the removal of groundwater from excavations may pose a potential risk to construction workers and the environment without adequate management. There are also potential risks to both human health and structures arising from vapour intrusion into excavations and groundwater from potential hydrocarbon contaminated soils in EIS proposal area 1.</p> <p>Further risk of contamination to groundwater may occur as a result of on-site leaks, accidental spills of fuels and inappropriate storage of chemicals during construction. Key risks to groundwater quality will include contamination from oils and grease, lead, zinc, copper, cadmium from vehicles, and nitrogen and phosphorous from atmospheric deposition during construction works.</p> <p>The potential impacts from groundwater contamination are considered to be moderate.</p> |

Table 6-3 REF proposal construction impacts on EIS proposal area – indirect impacts

| Impact | Potential impact | Relevance/discussion |
|--|------------------|---|
| Aquifer Interference: Flow obstruction/ interference | Very low | No planned works as part of the REF proposal that would result in flow obstruction or interference beyond localised piling. Due to the distance from piling areas and EIS proposal areas, potential for aquifer interference is considered to be very low and potential impacts on other groundwater users would be negligible |
| Aquifer Interference: Dewatering | Very low | Legislation requirement for dewatering is identified in Table 6-1. Dewatering is not anticipated but if required as part of piling processes or excavation, the distance from piling of the three EIS proposal areas means that the indirect impacts to these areas are very low . |

| Impact | Potential impact | Relevance/discussion |
|---|------------------|--|
| Groundwater dependent ecosystems and coastal wetlands | Low | Excavations Due to the small amount of excavation within the REF, the potential impacts to GDEs and coastal wetlands within the EIS are considered low |
| Groundwater dependent ecosystems and coastal wetlands | Very low | Dewatering Dewatering of the aquifer and lowering of the water table is not proposed as part of the REF proposal and as such, the potential indirect impact on GDEs from dewatering is considered to be very low . |
| | Low | Piling Groundwater interception during piling activities within the REF proposal would have impacts on groundwater resource and quality that could have indirect impacts to GDEs. Possible aquifer interference and possible leakage of pollutants from concrete being poured for bridge piles into groundwater, could subsequently impact groundwater dependent ecosystems and coastal wetlands nearby and within the EIS boundaries. If contaminants are present in soil sediments, piling could cause the mobilisation of these contaminants. Due to the limited extent of piling activities and implementation of appropriate controls, the risk of indirect impacts to groundwater dependent ecosystems and coastal wetlands from piling is considered to be low . |
| Discharges to groundwater | Moderate | Discharges to GDEs and coastal wetlands The REF proposal has the potential to mobilise sediment and leak contaminants into receiving waterways and areas defined as GDEs within the study area. Discharges of sediment or contaminated stormwater/leaks and spills into GDEs has the potential to degrade GDEs through impacts to habitat (burial) and flora/ fauna (toxic effects). The potential indirect impacts from discharges are considered to be moderate . |
| | Very low | The WM Act 2000 states that an Aquifer Interference Approval is needed for aquifer interference activities (which would include controlled discharges to groundwater). No discharges to groundwater are anticipated as a result of construction activities for the REF or EIS proposal, as all collected stormwater, surface water runoff and groundwater (from dewatering activities) is to be managed under the proposal CEMP, rather than discharged to groundwater. The REF proposal would not result in input or inflows to the aquifers that would affect the EIS proposal areas. Therefore, potential indirect impacts are considered to be very low . |
| Impact to groundwater uses | Moderate - High | The risk of aquifer interference and discharges to groundwater is deemed to be 'Very Low – Low'. As such the water table should not be affected by this Proposal and the risk of changes to water availability to groundwater users is therefore also deemed to be very low – low . The risks of ASS and contamination to groundwater are deemed to be 'Moderate – High'. As such taking a conservative approach, the risk of the quality of water becoming unsuitable for groundwater users is also deemed to be moderate – high . |
| Contamination | Moderate | There is potential for hydrocarbon, volatile organic compound, and heavy metal contamination to be present within groundwater within and around operational service stations as a result of leaks, spills and stormwater leakage to groundwater. There is also potential for PFAS contamination from Bankstown Airport and herbicide/pesticide contamination from golf courses/historical activities. The EIS locations are downstream from these locations and any works within the REF could cause the migration of contaminants into the EIS proposal areas. If dewatering is required, the extraction and removal of groundwater during works may pose a potential risk to construction workers and the environment without adequate management. There are also potential risks to both human health and structures arising from vapour intrusion into excavations from hydrocarbon contaminated soils and groundwater during excavation works. If excavation and dewatering occurs in areas of the REF close to the EIS proposal areas, this can have an impact on contamination issues and water levels within the EIS proposals. |

| Impact | Potential impact | Relevance/discussion |
|--------|------------------|---|
| | | <p>Further risk of contamination to groundwater may occur as a result of accidental on-site leaks/spills of fuels/stored chemicals from the REF proposal and migrating downstream to EIS proposal areas. Groundwater flow would migrate these contaminants into the EIS proposal areas and create contamination issues for the coastal wetlands. Key risks to groundwater quality would include contamination from oils and grease, lead, zinc, copper, cadmium from vehicles, and nitrogen and phosphorous from atmospheric deposition during construction works.</p> <p>The potential indirect impacts from groundwater contamination on the EIS proposal areas are considered to be moderate.</p> |

6.3 Potential impacts during operation

Operation of Henry Lawson Drive will comprise a key connection for traffic moving between the Hume Highway, Milperra Road /Newbridge Road and the M5 Motorway. It will also be used for local travel trips between residences and services.

The impacts assessment is separated into three categories. Impacts on the REF proposal, direct impacts of the EIS proposal area and indirect impacts from the REF proposal on the EIS proposal areas. The assessment for construction activities are presented in Table 6-4, Table 6-5 and Table 6-6.

Table 6-4 REF proposal operational impact assessment

| Impact | Potential impact | Relevance/discussion |
|------------------------|------------------|---|
| Aquifer interference | Very low | <p>The presence of impermeable surfaces and high permeability drainage lines from the REF proposal may reduce local recharge to the underlying aquifer and result in preferential groundwater flows along filled drainage lines. Surface water runoff, stormwater and other associated drainage channels are not expected to interact with groundwater or aquifers across the proposal alignment during operation.</p> <p>Due to the increase in the impermeable pavement for Henry Lawson Drive and Milperra Road, there is likely to be a minor reduction in the overall recharge rate to the underlying unconfined aquifers, as a result of the proposal being upgrades to existing road infrastructure rather than new road infrastructure. The overall reduction is unlikely to produce an effect that would constitute aquifer interference, with the aquifer interference framework, therefore the potential impacts are considered to be very low.</p> <p>The potential impact relative to aquifer interference has been qualitatively assessed as very low based on available information.</p> |
| Groundwater discharges | Very low | <p>Extraction of water is not a requirement for the continued operation of the REF proposal, the risk to groundwater through over extraction as a part of the operation of this proposal is negligible.</p> <p>There is potential for groundwater levels to rise in response to higher than average rainfall conditions caused by short-term and long-term climate cycles, leading to potential saturation of stormwater networks. Stormwater infrastructure which transport stormwater to Georges River may have an element of groundwater recharge. This is the case for the proposed stormwater treatment infrastructure, including the bio-retention basins, open grassed swales and other treatment methods. These impacts are considered very low.</p> |
| Groundwater quality | Low | <p>Stormwater leakage containing concentrations of contaminants as a result of the operation of the REF proposal has the potential to impact groundwater quality, by increasing concentrations of nutrients, heavy metals, and hydrocarbons. Stormwater treatment infrastructure including basins/swales will assist in reducing impacts on groundwater quality as an amount of stormwater will become groundwater recharge as its transported to the Georges River.</p> <p>The potential impact on groundwater quality has been qualitatively assessed as low based on available information.</p> |

| Impact | Potential impact | Relevance/discussion |
|----------------------------|------------------|---|
| Impact to groundwater uses | Moderate - High | <p>The risk of aquifer interference and discharges to groundwater is deemed to be 'Very Low – Low'. As such the water table should not be affected by this Proposal and the risk of changes to water availability to groundwater users is therefore also deemed to be very low – low.</p> <p>The risks of ASS and contamination to groundwater are deemed to be 'Moderate – High'. As such taking a conservative approach, the risk of the quality of water becoming unsuitable for groundwater users is also deemed to be moderate – high.</p> |
| Bio-retention Basin | Low - Moderate | <p>The two Bio-retention basins are proposed to reduce the amount of pollutants from the road runoff to the surface water and groundwater environments and thus in terms of groundwater quality, the basins will have a positive impact, therefore, in terms of quality it is deemed to be very low</p> <p>In terms of water table interaction, bio-retention basins may cause local mounding of the groundwater table, as a result this impact is deemed to be low to moderate.</p> |

Table 6-5 EIS proposal operational impact assessment

| Impact | Potential impact | Relevance/discussion |
|---|------------------|---|
| Aquifer interference | Very low | <p>Due to the nature of key features for the EIS proposal, a significant change of impermeable surfaces in the three EIS proposal areas is not anticipated. The key features mainly consist of mostly embankment with a small amount of road or shared path and EIS proposal area 3 becoming stabilised land once the road is operation. The minor increase in impermeable surfaces would only result in a very minor reduction in the overall recharge rate to the underlying unconfined aquifers. This would be unlikely to produce an effect that would constitute aquifer interference, with the aquifer interference framework, therefore the potential impacts are considered to be very low.</p> <p>The potential impact relative to aquifer interference has been qualitatively assessed as very low based on available information,</p> |
| Groundwater dependent ecosystems and coastal wetlands | Low-moderate | <p>GDEs including the mapped coastal wetlands are not anticipated to be adversely affected long term by the operation of the EIS proposal with the potential alteration of recharge rate and change of land use.</p> <p>Discharge and leakage of stormwater from the surrounding road corridor has the potential to contain concentrations of suspended solids and potential contaminants and have the potential to impact all EIS proposal areas. These pollutants have the potential to impact the health of GDEs and coastal wetlands through sedimentation and toxicological effects. This includes indirect leakage of stormwater into groundwater. The potential impacts from discharges are considered to be low-moderate. Stormwater treatment infrastructure, including vegetated swales located within the EIS proposal areas, will assist in reducing impacts on groundwater quality. The impact on GDEs and coastal wetlands will subsequently also be reduced as the treatment process will result in a percentage of the treated stormwater becoming groundwater recharge.</p> <p>The potential impact on GDEs within the EIS proposal areas has been qualitatively assessed as "low-moderate" based on available design information.</p> |
| Groundwater users | Negligible | <p>Extraction of water is not a requirement for the maintenance of the EIS proposal areas during operation of the road. The operational risk to groundwater is therefore negligible.</p> |
| Groundwater quality | Low | <p>Discharge and leakage of stormwater from the road corridor during operation has the potential to contain concentrations of suspended solids and potential contaminants. This is relevant to EIS proposal area 1 and to EIS proposal area 2 that includes transverse drainage discharging to Milperra Drain and nearby coastal wetlands. These pollutants may include nutrients, heavy metals, and hydrocarbons, some of which would recharge to groundwater.</p> <p>Stormwater treatment infrastructure including vegetated swales located within the EIS proposal areas 1 and 3 would assist in reducing impacts on groundwater quality. This is achieved by some of the stormwater being treated through the swales recharging the groundwater resource.</p> <p>The potential impact on groundwater quality has been qualitatively assessed as low based on available information.</p> |

Table 6-6 REF proposal operational impacts on EIS proposal area – indirect impacts

| Impact | Potential impact | Relevance/discussion |
|---|------------------|--|
| Groundwater dependent ecosystems and coastal wetlands | Low-moderate | <p>GDEs including the mapped coastal wetlands are not anticipated to be adversely affected long term with the alteration of recharge rate and ground coverage as a result of the widening of Henry Lawson Drive.</p> <p>The stormwater infrastructure is located through the REF proposal and flows through the EIS proposal areas at some points. Stormwater discharge and leakage of contaminated stormwater (from roadways) within the REF proposal has the ability to become groundwater recharge and impact the coastal wetlands within the EIS proposal areas.</p> <p>The potential indirect impact on groundwater dependent ecosystems and coastal wetlands has been qualitatively assessed as “low-moderate” based on available design information.</p> |
| Impact to groundwater uses | Moderate - High | <p>The risk of aquifer interference and discharges to groundwater is deemed to be ‘Very Low – Low’. As such the water table should not be affected by this Proposal and the risk of changes to water availability to groundwater users is therefore also deemed to be very low – low.</p> <p>The risks of ASS and contamination to groundwater are deemed to be ‘Moderate – High’. As such taking a conservative approach, the risk of the quality of water becoming unsuitable for groundwater users is also deemed to be moderate – high.</p> |

6.4 Potential cumulative impacts

Cumulative impacts have the potential to arise from the interaction of individual aspects of the site and the effects of the proposal with other projects in the local area. Potential cumulative impacts from projects located in the vicinity are presented in Table 6-7. Potential cumulative impacts may include reduced recharge as a result of increased area of impervious surfaces. Increased groundwater and soil salinity may also be a result of stormwater to groundwater interactions. The Bankstown Airport projects are a potential source of any impacts and due to the invasiveness of this proposal, potential cumulative impacts are considered minimal.

Table 6-7 Projects in the area

| Time frame | Project | Potential cumulative impacts |
|-----------------|---------------------------------|---|
| Existing | Flower Power Complex | <p>This is an existing complex, potential Impacts to groundwater quality as a result of high concentrations of fertilisers used and stored within the Flower Power Complex. However, as construction is complete and only operational impacts exist which is considered minimal it is expected that these materials are stored within the complex and do not have a pathway to groundwater sources.</p> |
| In Construction | Bankstown Airport Redevelopment | <p>It is unknown if the Bankstown Airport Redevelopment projects require dewatering. If so, this will have a potential impact on the groundwater resource of the area.</p> <p>Risk levels are mapped for ASS in this area. It is anticipated that any excavations from Bankstown Airport are likely to intercept ASS or PASS. Infiltration through PASS or ASS will potentially leach acids into the groundwater resource which is shared by the REF and EIS proposals. If these projects are constructed simultaneously, construction activities at Bankstown Airport Redevelopment should be considered when impacts need to be managed as it is located upstream of the REF and EIS proposal area 1.</p> <p>There is potential for hydrocarbon, volatile organic compound, and heavy metal contamination to be present within groundwater within and around operational service stations as a result of leaks, spills and stormwater leakage to groundwater. There is also potential for PFAS contamination from Bankstown Airport Redevelopment for projects at this site may cause PFAS contamination transport to the groundwater resource.</p> |

| Time frame | Project | Potential cumulative impacts |
|-------------|---|--|
| | Milperra Drain Widening | <p>Milperra Drain widening is located just east of the REF proposal running between EIS proposal area 2 and 3. Cumulative impacts to groundwater quality, acid sulfate soils and aquifer interference may occur due to proposed dewatering.</p> <p>Earthworks (19 000m³ of proposed excavations) or dewatering, which could alter the level and flow of groundwater and expose potential or actual acid sulfate soils or disturb contaminated materials in some parts of the project area, which could result in the mobilisation of acidic runoff and/or contaminants into surface water and/or groundwater.</p> <p>Accidental spill or leak of fuel, oil, greases or other chemicals from the use and/or storage of vehicles, plant and/or machinery on site. These could pollute surface water and/or groundwater.</p> |
| Near Future | Rabaul Rd/ HLD upgrade by Transport in Georges Hall | <p>Only excavations to 2.5m below ground level are being completed for this project, it is not anticipated that there are substantial impacts to the aquifer or groundwater quality.</p> <p>It is anticipated that any excavations from the upgrade project will possibly intercept ASS or PASS. Infiltration through PASS or ASS will potentially leach acids into the groundwater resource which is shared by the REF and EIS proposals. However, these are to be managed by following <i>Guidelines for the Management of Acid Sulphate Materials 2005</i> (RMS, 2005) and the CEMP of this project.</p> |
| | Riverlands Subdivision by Mirvac | <p>Works require construction and upgrade of Keys Parade which is located at the southern point of the REF proposal area. Potential impacts are considered minimal as the result of a small road construction. Due to location and assumed groundwater flow, cumulative potential impacts are unlikely.</p> |
| | Tower Road upgrade by Bankstown Airport Ltd | <p>It is not anticipated that there are substantial impacts to the aquifer or groundwater quality as a result of the Tower Road and intersection project.</p> <p>It is anticipated that any excavations from the upgrade project will possibly intercept ASS or PASS. Infiltration through PASS or ASS will potentially leach acids into the groundwater resource which is shared by the REF and EIS proposals. However, these are to be managed by following <i>Guidelines for the Management of Acid Sulphate Materials 2005</i> (RMS, 2005) and the CEMP of this project.</p> |
| | Murray Jones Drive/ Milperra Road intersection upgrade by Bankstown Airport Ltd | <p>It is not anticipated that there are substantial impacts to the aquifer or groundwater quality as a result of Murray Jones Drive/Milperra Road intersection project.</p> <p>It is anticipated that any excavations from the upgrade project will possibly intercept ASS or PASS. Infiltration through PASS or ASS will potentially leach acids into the groundwater resource which is shared by the REF and EIS proposals. However, these are to be managed by following <i>Guidelines for the Management of Acid Sulphate Materials 2005</i> (RMS, 2005) and the CEMP of this project.</p> |

7 Management measures

7.1 Management of potential impacts during construction

7.1.1 Management measures

A number of management measures are recommended to mitigate risks to and from groundwater across the proposal alignment during the construction phase. These are outlined in Table 7-1.

Table 7-1 Proposed groundwater management measures for construction

| Risk | Trigger | Relevance | Management measures |
|--|--|-------------|---|
| Aquifer Interference: Flow obstruction/ interference | Piling works at the Auld Avenue bridge duplication | REF | Piling works are understood to be limited in extent and unlikely to result in development of significant groundwater flow barriers. As such, no management measures are required for aquifer interference. |
| | Aquifer drawdown | REF | Although aquifer drawdown is not proposed, if groundwater dewatering must occur to aid constructability, further information on groundwater levels and groundwater quality is to be obtained during detailed design, to estimate dewatering quantities and the zone of influence. If above 3ML/day, further approvals under the Water Act 2000 would be required. |
| Disturbance of groundwater dependent ecosystems and coastal wetlands | Groundwater ingress into excavations | EIS | Excavations are likely to have direct impacts on potential GDEs and coastal wetlands within the EIS extents. Direct disturbance of GDEs should be minimised where possible. A CEMP should be created to manage ingress to groundwater into excavated areas. Where disturbance cannot be avoided, appropriate mitigation measures should be adopted to prevent impacts outside of the required areas of disturbance. This may include use of physical barriers, boundary demarcation and signage to prevent intrusion of contractors and equipment into sensitive areas, and ongoing monitoring to ensure disturbance footprints do not extend outside of set boundaries. |
| | Groundwater dewatering during excavation | EIS and REF | In the event that groundwater aquifer dewatering must occur to lower the groundwater table and reduce or prevent groundwater ingress into excavation, then potential impacts on GDEs must be quantitatively assessed prior to dewatering along with appropriate management measures and documented in a site dewatering management plan. Quantitative assessment must include assessment of the magnitude and duration of drawdown and whether impacts are likely to adversely affect the habitat conditions and ecological communities within the GDE. This assessment must also include reference to the NSW Aquifer Interference Policy Minimal Impact Conditions to determine need for Aquifer interference approval. Relevant approvals and permits must be obtained prior to groundwater/ aquifer dewatering. |
| | Piling works at the Auld Avenue bridge duplication | REF | Piling is considered to present a minimal risk to groundwater dependent ecosystems and coastal wetlands within the REF extents based on the proposed methodology. Despite the low risk, piling activities should be closely monitored to ensure that contamination through leaks, spills or ambient groundwater does not accumulate within pile borings resulting in point source pollution with the potential to impact GDEs. Monitoring may include regular inspections of pile borings to monitor for any light non-aqueous phase liquids (LNAPL), oils, staining, or odours. |

| Risk | Trigger | Relevance | Management measures |
|------------------------------------|---|-------------|---|
| | Shallow excavations within the topsoil and fill materials for embankments | REF and EIS | Excavations are likely to have direct impacts on potential GDEs and coastal wetlands within the EIS extents. Direct disturbance of GDEs should be minimised where possible. A CEMP should be created to manage direct impacts to GDEs. A Construction Soil and Water Management Plan, Construction Flora and Fauna Management Plan and a Clearing and Grubbing Plan will include mitigation measures and procedures to identify further opportunities to minimise direct impacts to coastal wetlands and GDEs. |
| Mobilisation of acid sulfate soils | Excavations and stockpiling | EIS and REF | An Acid Sulfate Soil Management Plan (ASSMP) should be prepared and implemented to manage PASS or ASS exposed from excavations and changes to groundwater levels. Refer to the PSI for further discussion. |
| Groundwater contamination | Piling and excavations | REF and EIS | A site contamination management plan (CMP) should be prepared and implemented in the event that contaminated groundwaters are encountered during construction activities, this should be completed before construction occurs. During construction any intercepted groundwater should be managed under the proposal CEMP to mitigate risks associated with the potential mobilisation or release of contamination to the groundwater, improper storage and disposal of intercepted groundwaters. If major spills and leaks occurs, remediation might be necessary to reduce impact to nearby coastal wetlands and GDEs. Excavations should also be monitored for volatile gases that may be present as a result of hydrocarbon contamination, which may pose a risk to human health and built environment. |
| Impact to groundwater users | Aquifer interference and contamination | EIS and REF | There are only two registered bores (used for water supply and irrigation) in proximity to the Proposal area. The extraction of groundwater for water supply or lowering of the water table is not proposed, therefore, potential impacts to surrounding groundwater users are considered minimal. Measures associated with management of drawdown and safeguarding against water quality deterioration due to contamination will reduce risk to groundwater users. |

7.1.2 Groundwater monitoring

It is recommended that a baseline groundwater monitoring program is implemented during detailed design across the overall proposal area. This baseline assessment will be used to further identify and quantify groundwater-surface water interactions, groundwater level variations in areas where excavations are proposed and bridge piling, understanding the existing groundwater quality in these areas, potential risks and impacts associated with groundwater levels and groundwater quality within and around the REF and EIS proposal area.

An agreement about the specific design of the monitoring program (eg number of wells, locations, parameters, duration, frequency) will be made during detailed design phase and a Sampling Analysis and Quality Plan will be completed.

Groundwater monitoring wells will be installed by an appropriately experienced hydrogeologist or environmental scientist to ensure that the installation is fit-for-purpose in monitoring both groundwater levels and groundwater quality.

7.2 Management of potential impacts during operation

7.2.1 Management measures

The surface water management measures (as identified in the Water Quality Strategy (Lyall and Associates, 2021b), will provide a beneficial result to groundwater recharge and quality. These stormwater treatment infrastructure management measures include bio-retention basins and grassed swales which would capture stormwater contaminants leading to no deterioration in groundwater quality conditions from the proposed upgrade. The inclusion of the aforementioned stormwater quality measures would provide a net reduction in the average annual weight of gross pollutants, TSS and TP when compared to present day conditions, but there would still be an increase in the average annual weight of TN. Space and topography constraints limit the ability to implement additional area bio-retention swales or basins at the drainage outlets.

No other ongoing groundwater management measures are recommended as the residual risks to groundwater during the operation phase following stormwater treatment are considered negligible – very low. However, review during the detailed design and the assessment based on outcomes of the DSI and groundwater monitoring program and updated design will provide a basis for the requirement of any post construction monitoring for any residual impacts and management measures.

7.2.2 Monitoring procedures

No ongoing groundwater monitoring is recommended as risks to groundwater should be mitigated through adequate design and suitable construction methodologies and management (refer Section 7.2.1).

A review during the detailed design and the assessment based on outcomes of the DSI and groundwater monitoring program and updated design will provide a basis for the requirement of any post construction monitoring for any residual impacts and management measures.

8 Conclusion

This report has been prepared to support the REF and EIS for the proposal. This report has been prepared in accordance with the Secretary's Environmental Assessment Requirements (SEARs) for the EIS proposal, in particular it highlights the potential impacts on the quality and quantity of the groundwater resources that are intercepted by the EIS and the REF proposal areas.

The following sections provide conclusions of the assessment for the REF and the EIS proposal areas, based on the desktop information reviewed, available previous reports and information obtained.

8.1 REF proposal conclusions

- The REF proposal lies in a flat floodplain area for the nearby Georges River and is underlain with poorly drained and low permeability soils;
- Generally, groundwater flow is assumed to flow westerly, towards Georges River with shallow groundwater depths between 2.8 m bgl and 5 m bgl. Seasonal variation to groundwater levels are expected, higher levels in winter and lower levels in summer
- The aquifer below the REF proposal is assumed to be unconfined and unconsolidated alluvial aquifer
- There is one mapped terrestrial GDE located within the REF proposal area, it is located just east of the intersection between Henry Lawson Drive and Milperra Road
- Land salinity for the REF proposal is moderate to high and with a possibility that groundwater is also at risk of high salinity levels
- The overall proposal is in an area of very high probability for acid sulphate soils in the south west, west and north west portion of the REF proposal area between 2 to >4 m. These acid sulphate soils, should they be encountered by shallow excavation activities, will require careful management to ensure no ongoing environmental harm or migration of ASS is caused, particularly to the nearby Georges River and coastal wetlands.
- A summary of the REF proposal construction phase moderate to high risk impacts include:
 - Exposure of ASS and potential of transfer into groundwater
 - Exposure of contamination and transfer into groundwater or exposure of contaminated groundwater. This could also be an indirect impact, with activities for the REF proposal area potentially affecting the EIS proposal area
 - An indirect impact to the EIS proposal areas through discharge to groundwater which could affect GDEs and the coastal wetlands
 - Impact on surrounding groundwater users are considered minimal as only two identified registered bores used for water supply or irrigation within a 1 km radius
- REF proposal construction phase **moderate to high** risk impacts were considered to include exposure of ASS and potential of transfer into groundwater, exposure of contamination and transfer into groundwater or exposure of contaminated groundwater, indirect impact to the EIS proposal areas through discharge to groundwater which could affect GDEs and the coastal wetlands.

8.2 EIS proposal conclusions

- Generally, groundwater flow is assumed to flow westerly, towards Georges River with shallow groundwater depths between 2.8m bgl and 5m bgl. Exact groundwater depths are unknown for the EIS proposal areas. Seasonal variation to groundwater levels are expected, higher levels in winter and lower levels in summer.
- The aquifer below the EIS proposal is assumed to be unconfined and unconsolidated alluvial aquifer.
- Each of the EIS proposal areas intersect a coastal wetland.

- Land salinity for the EIS proposal areas are moderate to high and with a possibility that groundwater is also at risk of high salinity levels. EIS proposal area 1 is high risk and EIS proposal areas 2 and 3 are moderate risk.
- The EIS proposal areas 1 and 3 are deemed to have a very high probability for acid sulphate soils between 2 to >4 m, with EIS proposal area 2 having a low probability to encounter acid sulphate soils. These acid sulphate soils, should they be encountered by shallow excavation activities, will require careful management to ensure no ongoing environmental harm or migration of ASS is caused, particularly to the nearby Georges River and coastal wetlands;
- A summary of the EIS proposal construction phase moderate to high risk impacts include:
 - Impacts to GDEs including coastal wetlands that could affect the groundwater resource
 - Exposure of ASS and potential of transfer into groundwater
 - Exposure of contamination and transfer into groundwater or exposure of contaminated groundwater.
 - Impact on surrounding groundwater users are considered minimal as only two identified registered bores used for water supply or irrigation within a 1km radius.
- EIS proposal construction phase **moderate to high** risk impacts were considered to include GDEs including coastal wetlands that could affect the groundwater resource, exposure of ASS and potential of transfer into groundwater, exposure of contamination and transfer into groundwater or exposure of contaminated groundwater.

8.3 Recommendations


- A baseline groundwater monitoring program of the REF and EIS proposal areas should be undertaken during detailed design as described in Section 7.1.2 with reference to necessary guidelines for groundwater quality to fully address the SEARs for the EIS, outlined in Section 1.3.3. This baseline monitoring will guide understanding of groundwater depths in proposed piling and excavation areas.
- A Construction and Environmental Management Plan (CEMP) should be prepared prior to construction commencing.
- If soils between 2 and 4 m are disturbed (within the REF proposal and all EIS proposal areas), an Acid Sulfate Soils Management Plan (ASSMP) should be included in the CEMP.
- No management measures are proposed as part of the operational phase of the proposal. However, it is noted that surface water management measures (as identified in the Water Quality Strategy (Lyalls and Associates, 2021b), could provide a beneficial result in groundwater recharge and quality.

9 References

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Appendix A

Site Inspection Photo Log

| | | |
|---|--|-----------------------------|
|  | Photographic Log | |
| Client Name Transport for NSW (TfNSW) | Site Location Henry Lawson Drive | Project ID 510102 |


| | | |
|--|---------------------------|---|
| Photo No. 1 | Date 28/10/2020 |  |
| Description There was a large drainage line running north to south along Henry Lawson Drive. | | |

| | | |
|--|---------------------------|--|
| Photo No. 2 | Date 28/10/2020 |  |
| Description Surface conditions near the southern boundary of the study area. Vegetated land (grass covering) with patches of bare earth and some angular to sub angular rocks and gravels. | | |

| | | | |
|---|--|--|-----------------------------|
|  | | Photographic Log | |
| Client Name Transport for NSW (TfNSW) | | Site Location Henry Lawson Drive | Project ID 510102 |


| | | |
|---|--------------------|---|
| Photo No. 3 | Date 28/10/2020 |  |
| Description There was a corridor of bare earth traversing along the large drainage line to the south. | | |

| | | |
|---|---------------------------|--|
| Photo No. 4 | Date 28/10/2020 |  |
| Description The large drainage line diverted near Raleigh Road towards Milperra Golf Driving Range. | | |

| | | |
|---|--|-----------------------------|
|  | Photographic Log | |
| Client Name Transport for NSW (TfNSW) | Site Location Henry Lawson Drive | Project ID 510102 |


| | | |
|--|--------------------|---|
| Photo No. 5 | Date 28/10/2020 |  |
| Description The site is highly urbanised with numerous artificial drains and gutters along Henry Lawson Drive. Some of these drains lead into the large drainage ditch to the south. | | |

| | | |
|---|---------------------------|--|
| Photo No. 6 | Date 28/10/2020 |  |
| Description There was an entry and exit gate adjacent to Henry Lawson Drive, which lead into a large area potentially used for parking, storage and/or maintenance. Surface conditions consisted of cleared non vegetated land with angular to sub angular rocks and gravels. | | |

| | | |
|---|--|-----------------------------|
|  | Photographic Log | |
| Client Name Transport for NSW (TfNSW) | Site Location Henry Lawson Drive | Project ID 510102 |


| | | |
|---|---------------------------|---|
| Photo No. 7 | Date 28/10/2020 |  |
| Description An unknown creek was flowing south west to north east along Henry Lawson Drive. | | |

| | | |
|--|---------------------------|--|
| Photo No. 8 | Date 28/10/2020 |  |
| Description There was an area near the southern boundary of the site which showed signs of uncontrolled fill and previous development. Large amounts of angular to sub angular rocks and gravels were present on the surface adjacent to Henry Lawson Drive. | | |

| | | |
|---|--|-----------------------------|
|  | Photographic Log | |
| Client Name Transport for NSW (TfNSW) | Site Location Henry Lawson Drive | Project ID 510102 |


| | | |
|--|--------------------|---|
| Photo No. 9 | Date 28/10/2020 |  |
| Description Patches and diverts of bare earth were present along Henry Lawson Drive | | |


| | | |
|--|---------------------------|--|
| Photo No. 10 | Date 28/10/2020 |  |
| Description Majority of the site is highly urbanised and developed with an artificial rain gutter and numerous drains running along both sides of Henry Lawson Drive in the south. | | |

| | | |
|---|--|-----------------------------|
|  | Photographic Log | |
| Client Name Transport for NSW (TfNSW) | Site Location Henry Lawson Drive | Project ID 510102 |


| | | |
|--|---------------------------|---|
| Photo No. 11 | Date 28/10/2020 |  |
| Description <p>There was an area near the intersection of Henry Lawson Drive and Milperra Road, which was used for stopping and car wreckage. There would be potential for wrecked cars to leak fuel, lubricant and coolant into the surrounding environment</p> | | |

| | | |
|---|---------------------------|--|
| Photo No. 12 | Date 28/10/2020 |  |
| Description <p>There was a large mound running along Milperra Road, which elevated the bridge from the surrounding topography and vegetation.</p> | | |


| | | |
|---|--|-----------------------------|
|  | Photographic Log | |
| Client Name Transport for NSW (TfNSW) | Site Location Henry Lawson Drive | Project ID 510102 |


| | | |
|---|--------------------|---|
| Photo No. 13 | Date 28/10/2020 |  |
| Description There was a large area of bare earth adjacent to the bridge and Milperra Road. | | |

| | | |
|--|---------------------------|--|
| Photo No. 14 | Date 28/10/2020 |  |
| Description Surface conditions north of Milperra Road, coverage consisted of vegetated land (grass covering) with patches of bare earth and angular to sub angular rocks and gravels | | |

| | | |
|---|--|-----------------------------|
|  | Photographic Log | |
| Client Name Transport for NSW (TfNSW) | Site Location Henry Lawson Drive | Project ID 510102 |


| | | |
|--|---------------------------|---|
| Photo No. 15 | Date 28/10/2020 |  |
| Description There was a fenced gate running along Georges River to prevent public access | | |

| | | |
|---|---------------------------|--|
| Photo No. 16 | Date 28/10/2020 |  |
| Description There was a large area used for stopping, parking and car wreckage near the northern boundary of the site, adjacent to the BP Truckstop. Surface conditions consisted of non-vegetated land with angular to sub angular rocks and gravels. There was also general rubbish and car wreckage. | | |

| | | |
|---|--|-----------------------------|
|  | Photographic Log | |
| Client Name Transport for NSW (TfNSW) | Site Location Henry Lawson Drive | Project ID 510102 |


| | | |
|---|--------------------|---|
| Photo No. 17 | Date 28/10/2020 |  |
| Description Car wreckage was observed in the large stopping/parking bay adjacent to Henry Lawson Drive. The material consisted of a rusty exhaust pipe, metal poles, a tyre and car seat. | | |

| | | |
|--|---------------------------|--|
| Photo No. 18 | Date 28/10/2020 |  |
| Description An old building with rusty infrastructure was present in the north, adjacent to Georges River. Potential Hazardous Building Material (HBM) due to the age of the building. | | |

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|  | Photographic Log | |
| Client Name Transport for NSW (TfNSW) | Site Location Henry Lawson Drive | Project ID 510102 |


| | | |
|--|---------------------------|---|
| Photo No. 19 | Date 28/10/2020 |  |
| Description <p>There was a moderate mound running along Henry Lawson Drive in the north. This helped elevate the road from the surrounding topography and vegetation. Due to this mound, there is a slight to moderate gradient falling from Henry Lawson Drive towards Georges River.</p> | | |

| | | |
|--|---------------------------|--|
| Photo No. 20 | Date 14/09/2020 |  |
| Description Georges River flows along majority of the north east and eastern boundary of the study area. | | |

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|---|--|-----------------------------|
|  | Photographic Log | |
| Client Name Transport for NSW (TfNSW) | Site Location Henry Lawson Drive | Project ID 510102 |


| | | |
|--|--------------------|---|
| Photo No. 21 | Date 28/10/2020 |  |
| Description There was a large artificial culvert and drainage line running east to west from Georges River Golf Course, under Henry Lawson Drive and into Georges River. | | |

| | | |
|--|--------------------|--|
| Photo No. 22 | Date 28/10/2020 |  |
| Description In the north, there was a significant amount of general rubbish and some car wreckage adjacent to Henry Lawson Drive. | | |

| | | |
|---|--|-----------------------------|
|  | Photographic Log | |
| Client Name Transport for NSW (TfNSW) | Site Location Henry Lawson Drive | Project ID 510102 |


| | | |
|--|--------------------|---|
| Photo No. 23 | Date 28/10/2020 |  |
| Description Surface conditions near the far northern boundary of the site. Coverage consisted of vegetated land (grass covering) with patches of bare earth and general rubbish. There were some rocks and gravels observed on the surface | | |

| | | |
|--|---------------------------|--|
| Photo No. 24 | Date 28/10/2020 |  |
| Description There was a slight to moderate gradient falling from Henry Lawson Drive towards a drainage line along the Georges River Golf Course. | | |

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|---|--|-----------------------------|
|  | Photographic Log | |
| Client Name Transport for NSW (TfNSW) | Site Location Henry Lawson Drive | Project ID 510102 |


| | | |
|---|--------------------|---|
| Photo No. 25 | Date 28/10/2020 |  |
| Description <p>There was a lot of broken glass adjacent to Henry Lawson Drive near the northern boundary of the site. This could potentially be from vehicle accidents and wreckage, which could cause contamination from leaking of car fluids (fuel, lubricant and coolant).</p> | | |

| | | |
|--|--------------------|--|
| Photo No. 26 | Date 28/10/2020 |  |
| Description Significant amounts of general rubbish were observed along Henry Lawson Drive, adjacent to the Georges River Golf Course. | | |

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|  | Photographic Log | |
| Client Name Transport for NSW (TfNSW) | Site Location Henry Lawson Drive | Project ID 510102 |


| | | |
|---|---------------------------|---|
| Photo No. 27 | Date 28/10/2020 |  |
| Description There was an artificial drainage line running north west to south east along Henry Lawson Drive, which diverted from the Georges River Golf Course. | | |

| | | |
|--|---------------------------|--|
| Photo No. 28 | Date 28/10/2020 |  |
| Description Majority of the site is highly urbanised and developed with an artificial rain gutter and numerous drains running along both sides of Henry Lawson Drive to the north. | | |

| | | |
|---|--|-----------------------------|
|  | Photographic Log | |
| Client Name Transport for NSW (TfNSW) | Site Location Henry Lawson Drive | Project ID 510102 |

| | | |
|--|--------------------|---|
| Photo No. 29 | Date 28/10/2020 |  |
| Description There was an area adjacent to the BP Truckstop, which was used by vehicles for stopping, parking and/or maintenance. Tracks of bare earth from heavy vehicles | | |


| | | |
|--|---------------------------|--|
| Photo No. 30 | Date 28/10/2020 |  |
| Description There was a large mound present at the intersection of Henry Lawson Drive and Milperra Road. This mound was used to elevate the adjacent business park from the surrounding infrastructure, topography and vegetation. | | |

| | | |
|---|--|-----------------------------|
|  | Photographic Log | |
| Client Name Transport for NSW (TfNSW) | Site Location Henry Lawson Drive | Project ID 510102 |

| | | |
|--|--------------------|---|
| Photo No. 31 | Date 28/10/2020 |  |
| Description Small to moderate patches of sand were observed along the base of the mound. | | |

| | |
|---|---------------------------|
| Photo No. 32 | Date 28/10/2020 |
| Description There were two large artificial drains with accompanying infrastructure adjacent to the mound and business park, located at the intersection of Henry Lawson Drive and Milperra Road. | |




| | | |
|---|--|-----------------------------|
|  | Photographic Log | |
| Client Name Transport for NSW (TfNSW) | Site Location Henry Lawson Drive | Project ID 510102 |

| | |
|---|---------------------------|
| Photo No. 33 | Date 28/10/2020 |
| Description A small drainage ditch was traversing along the intersection of Henry Lawson Drive and Milperra Road. | |


A photograph showing a grassy area in the foreground, likely a median or roadside. In the background, there is a road intersection with traffic lights and several vehicles, including cars and trucks. Trees and bushes are visible behind the road. The scene is captured during the day under clear skies.


| | | |
|--|---------------------------|--|
| Photo No. 34 | Date 28/10/2020 |  |
| Description Asphalt was present on the ground surface adjacent to the large mound, business park and Milperra Road | | |

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|---|--|-----------------------------|
|  | Photographic Log | |
| Client Name Transport for NSW (TfNSW) | Site Location Henry Lawson Drive | Project ID 510102 |


| | | |
|--|---------------------------|---|
| Photo No. 35 | Date 28/10/2020 |  |
| Description Retaining walls were used to elevate the large mound and business park | | |

| | | |
|--|---------------------------|--|
| Photo No. 36 | Date 28/10/2020 |  |
| Description There was a cleared area adjacent to Milperra Road, which was used for parking, stopping and car wreckage. Surface conditions consisted of non-vegetated land with angular to sub angular rocks and gravels. | | |

| | | |
|---|--|-----------------------------|
|  | Photographic Log | |
| Client Name Transport for NSW (TfNSW) | Site Location Henry Lawson Drive | Project ID 510102 |


| | | |
|--|---------------------------|---|
| Photo No. 37 | Date 28/10/2020 |  |
| Description A large artificial culvert and drainage line was present in the eastern boundary of the site, which was flowing from the Bankstown Aerodrome towards Milperra Road and Bankstown Golf Club. As majority of the site is highly urbanised and developed, there was also an artificial rain gutter and numerous drains running along both sides of Milperra Road. | | |

| | | |
|---|--------------------|--|
| Photo No. 38 | Date 28/10/2020 |  |
| Description Multiple cleared non-vegetated areas were present along Henry Lawson Drive, which were used for stopping, parking and car wreckage. There was a large patch of dumped asphalt and potential chemical staining observed from leaks and wreckage. | | |

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|---|--|-----------------------------|
|  | Photographic Log | |
| Client Name Transport for NSW (TfNSW) | Site Location Henry Lawson Drive | Project ID 510102 |

| | | |
|--|---------------------------|---|
| Photo No. 39 | Date 28/10/2020 |  |
| Description Potential chemical staining from vehicles and wreckage adjacent to Henry Lawson Drive. | | |

| | | |
|--|---------------------------|--|
| Photo No. 40 | Date 28/10/2020 |  |
| Description <p>There were signs of uncontrolled fill near the south western boundary of the site. A small patch of dumped asphalt and a stockpile of material with angular to subangular rocks and gravels were present. There are also obvious patches of chemical staining adjacent to the stockpile and asphalt, which could contaminate the surrounding environment.</p> | | |

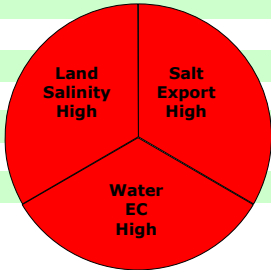
| | | |
|---|--|-----------------------------|
|  | Photographic Log | |
| Client Name Transport for NSW (TfNSW) | Site Location Henry Lawson Drive | Project ID 510102 |

| | | |
|---|---------------------------|---|
| Photo No. 41 | Date 28/10/2020 |  |
| Description Surface conditions in the south western corner of the site. Coverage consisted of vegetated land (grass and leaf covering) with patches of bare earth and rock and gravels. | | |

Appendix B

Hydrogeological Landscape Reports

4. Parramatta/Georges River Hydrogeological Landscape

| | | |
|------------------|--|---|
| LOCALITIES | HOME BUSH BAY, ROSEHILL, CAMELIA, CLYDE, PANANIA |  |
| TYPE AREA | ROSEHILL | |
| GRID REFERENCE | 318000 mE 6255000 mN (Z 56) | |
| GEOLOGY SHEET | SYDNEY 1:100 000; PENRITH 1:100 000 | |
| CONFIDENCE LEVEL | LOW | |

OVERVIEW

The Parramatta/Georges River Hydrogeological Landscape (HGL) is characterised by the low lying Quaternary and Tertiary Alluvial floodplains of the Parramatta and Georges Rivers and features flat extensive floodplains and alluvial plains with some ponding. The HGL is located in the central part of the Western Sydney region along the Parramatta River near the confluence with Duck River; at Homebush Bay; and on the low lying, inundated floodplains of the Georges River near Chipping Norton. These include areas of disturbed and/or reclaimed land close to the rivers. They are commonly waterlogged and contain ponded water and back swamps, and are areas with potential for acid sulfate soils. They occur in an area of moderate to high rainfall (900–1100 mm).

This HGL is distinguished from other areas within the Sydney Metropolitan CMA by its very flat and low lying alluvial plain with ponding, on the borders of the Parramatta and Georges Rivers. The Parramatta/Georges River HGL is distinct from the Moorebank HGL because it is heavily influenced by acid sulfate soils which produces a different salinity signature. This HGL has been defined on the distribution of potential acid sulfate soils.

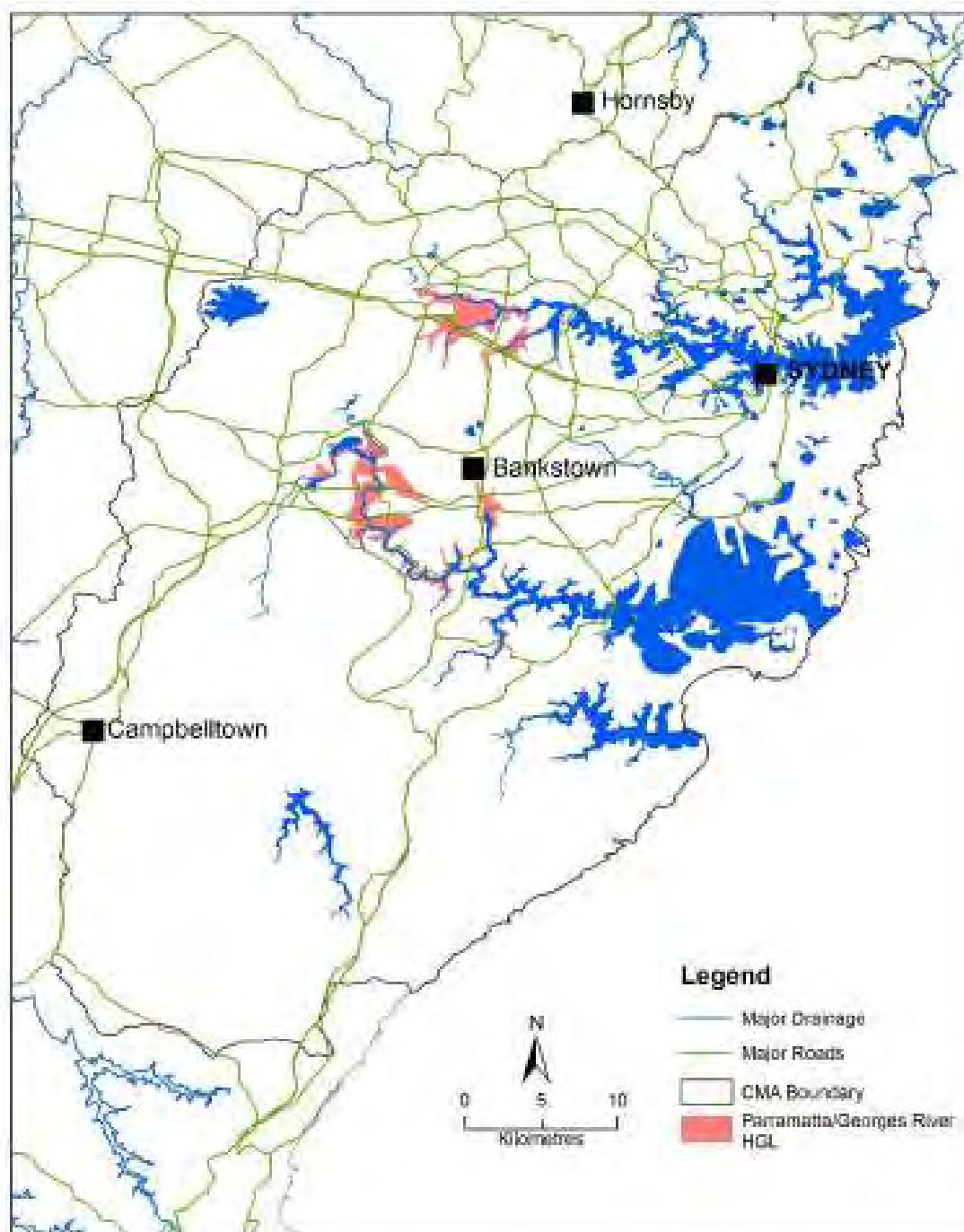
This HGL comprises unconsolidated sedimentary fine-grained sands, silts and clays from the Quaternary period. These have been derived from (and overlie) the surrounding Wianamatta Group rocks and Hawkesbury Sandstone. These older rocks are not exposed in this HGL. Local relief is typically <10 m with slopes <3%. Regolith cover on this HGL is generally very deep (>2m).

Soils are: Yellow Podzolic Soils and Yellow Solodic Soils on older alluvial terraces, and deep Solodic Soils and Yellow Solonetzic Soils on current floodplains (Birrong Soil Landscape – level to gently undulating alluvial floodplain); Brown and Yellow Sodosols (Soloths) and Brown and Yellow Kurosols (Yellow and Brown Podzolic Soils) occur on dissected, gently undulating low rises (Berkshire Park Soil Landscape); Plastic clays occur in drainage lines, non-calcareous brown soils, red earths and Red Podzolic Soils occur on terrace surfaces with earthy sands on terrace edges (Richmond Soil Landscape – Quaternary terraces).

Water infiltrates down through alluvial materials and predominantly flows into the Parramatta or Georges River. Regional and local systems drain the area.

The salt sites occur on the flat-lying land. Salinity is primarily driven by shallow cyclic flows, estuarine and acid sulfate influences.

Land use on this HGL is predominantly recreational land as the area is prone to flooding and waterlogging. Landscape limitations and hazards include flooding, stream bank erosion and associated mass movement, waterlogging, foundation hazard and acidic topsoils. There is no unique vegetation signature in this landscape; and *Riparian Woodland* and *Alluvial Forest* are the most common vegetation communities that remain.



Parramatta/Georges River HGL Distribution Map

SALINITY

| | |
|----------------------|---|
| OCCURRENCE (LAND) | Land salinity is high. This is because of the tidal influence on extensive floodplains and alluvial plains with some ponding along the Parramatta and Georges Rivers, and the periodic wetting and drying of the alluvial floodplain sediments which allows for cycling of the salts. |
| EXPORT (LOAD) | Salt export is high. Waterlogging and the constant flux of water draining through the HGL carry dissolved salts from the sediments. The impact of sulfate soils adds to salt load. |
| WATER | Water EC is high. High salinity levels occur in tributaries to the major |

(EC)

water courses.

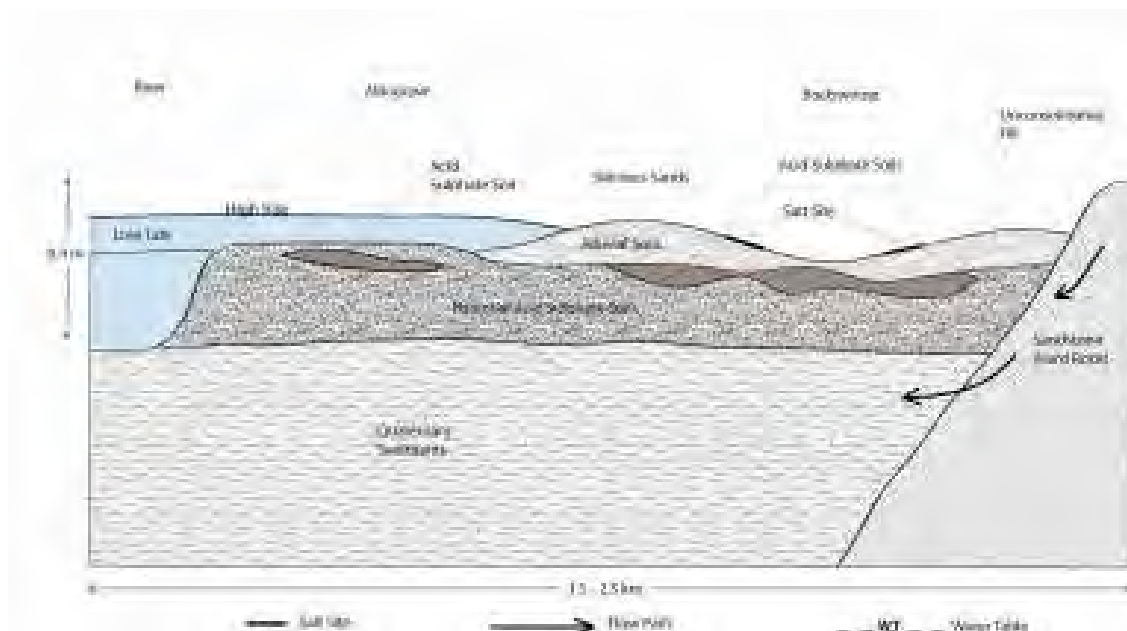
SALT MOBILITY

| | AVAILABILITY | | |
|------------|--------------|----------|---------------------------------|
| SALT STORE | LOW | MODERATE | HIGH |
| HIGH | | | Parramatta/Georges River |
| MODERATE | | | |
| LOW | | | |

HAZARD

| HAZARD ASSESSMENT | Limited potential impact | Significant potential impact | Severe potential impact |
|-----------------------------------|--------------------------|------------------------------|---------------------------------|
| High likelihood of occurrence | | | Parramatta/Georges River |
| Moderate likelihood of occurrence | | | |
| Low likelihood of occurrence | | | |

LANDSCAPE ATTRIBUTES



Conceptual Parramatta/Georges River Hydrogeological Landscape cross-section showing the distribution of regolith, landforms, salt sites and flow paths.

LITHOLOGY

This HGL comprises unconsolidated sedimentary materials from

| | |
|---|---|
| <p>(<i>Sherwin & Holmes 1986; Jones & Clarke 1991; Geoscience Australia 2009</i>)</p> | <p>the Quaternary and Neogene periods. The key lithologies are:</p> <ul style="list-style-type: none"> • Recent alluvium – fine-grained sand, gravel, silt and clay • Sand plains – sand, with lesser gravel and clay • Minor exposures of Triassic Wianamatta Group consolidated sediments and Hawkesbury Sandstone are also present. |
| <p>ANNUAL RAINFALL</p> | <p>900–1100 mm</p> |
| <p>REGOLITH-LANDFORMS</p> | <p>This HGL is characterised by unconsolidated alluvium deposits forming level to gently undulating alluvial floodplains (<5m) and gently undulating low rises (1–20m) such as along the Georges River around Chipping Norton and along the Parramatta River near Homebush. Minor levee banks, dissected floodplains and flat topped terraces also occur within the landscape.</p> <p>Regolith materials commonly include fine-grained sand, reddish brown silt and clay. As the Parramatta and Georges Rivers are large the regolith of the landscape is deep (>2m).</p> |



Typical Parramatta/Georges River HGL – very level floodplain within 400m of river; street lined with paperbark trees, typical of floodplain area. Photo looking south along Durham Street, Rosehill (Photo: DECCW/Marion Winkler).



Typical Parramatta/Georges River HGL – flat floodplain area with gentle inclination towards the river channel of Parramatta River (behind photographer). Photo looking west along Grand Avenue, Rosehill (Photo: DECCW/Marion Winkler).



Typical Parramatta/Georges River HGL – contained drainage channel with levee banks showing some salinity effects on lower slope near to drainage line; wetlands of mangroves typical in estuarine channels and Casuarina spp. in the riparian zone. Photo taken along Haslams Creek (The Wetlands Corridor) off Hill Rd, Homebush Bay. (Photo: DECCW/Marion Winkler).



Typical Parramatta/Georges River HGL – flat alluvial floodplain along Georges River. Photo showing Heron Park beside Riverside Road, Chipping Norton (Photo: DECCW/Marion Winkler).



Parramatta/Georges River HGL – evidence of salinity in structure of Telstra Stadium, around the runway entrance to the stadium, Sydney Olympic Park. Salt crystals forming after evaporation of saline rising damp in brick work (Photo: DECCW/Charmaine Beckett).

| | |
|-----------------------------|---|
| SOIL LANDSCAPES | <p>This HGL includes parts of the Berkshire Park, Richmond and Birrong Soil Landscapes with very minor expressions of various alluvial soil types and soil of disturbed terrain.</p> <p>The Berkshire Park Soil Landscape forms the dissected, gently undulating low rises on Tertiary alluvium of the HGL and typically contains Brown and Yellow Sodosols (Soloths), Brown and Yellow Kurosols (Yellow and Brown Podzolic Soils). The topsoils of the terraces are comprised of brown sandy loams and dark brown loamy sands. Ferromanganiferous nodules are common. Brown clayey sands, yellowish brown sandy clays and yellowish brown nodular clay, with abundant iron and manganese nodules form the subsoil of the terraces.</p> <p>The Richmond Soil Landscape forms the terraces of the Georges River. They typically show plastic clays in drainage lines, non-calcic brown soils, red earths and Red Podzolic Soils on terrace surfaces and earthy sands on terrace edges.</p> <p>The level to gently undulating alluvial floodplains of Birrong Soil Landscape form Yellow Podzolic Soils and Yellow Solodic Soils on older alluvial terraces, and deep Solodic Soils and Yellow Solonetzic Soils on current floodplains.</p> |
| RURAL LAND CAPABILITY | Typically Class IV and V land occurs within the HGL. |
| LAND USE | <p>The land within the HGL is used for parkland (Bicentennial Park, Sydney Olympic Park), golf courses, residential and industrial development and recreational space. Areas of reclaimed land provide habitat to significant threatened and endangered fauna and flora, including Green and Golden Bell Frog (<i>Litoria aurea</i>) and migratory birds protected under CAMBA and JAMBA treaties. Nature Reserves and “wetlands of ecological significance” include Newington Nature Reserve, The Wetlands Corridor (Haslams Creek) and Badu Mangroves near Liberty Grove.</p> |
| KEY LAND DEGRADATION ISSUES | <p>Limitations:</p> <ul style="list-style-type: none"> • Flood hazard • Acid sulfate soils • High soil erosion hazard on floodplain and terrace edges • Gully, sheet and rill erosion on dissected areas • Saline subsoil • Impermeable subsoil • Seasonal waterlogging • Very low fertility |
| VEGETATION | <p>Parramatta/Georges River HGL is predominantly cleared of vegetation apart from areas that may have been replanted with non-endemic species or are have been invaded by weeds.</p> <p>Mangrove communities are common in the less disturbed section of the riparian zones and flood plains. <i>Riparian Woodland</i> and <i>Alluvial Forest</i> are the most common vegetation communities that remain.</p> <p>Common dominant tree species across vegetation communities are <i>Eucalyptus amplifolia</i> (cabbage gum), <i>E. tereticornis</i>, <i>E. botryoides</i>,</p> |

| | |
|--|---|
| | <p><i>E. elata</i> (river peppermint), <i>Angophora subvelutina</i> (broad-leaf apple), <i>A. floribunda</i> (rough-barked apple) and <i>Casuarina glauca</i> (river oak) close to channels.</p> <p>Signature: not unique</p> |
|--|---|

VEGETATION ASSEMBLAGES

Parramatta/Georges River HGL is highly cleared. Some of the HGL is now supporting non-endemic native vegetation or weed species, with estuarine influences sections supporting mangrove swamps, salt marsh and “wetlands of ecological significance” listed on the Register of the National Estate (Badu Mangroves, Homebush Bay).

Remnants of floodplain communities are evident in street trees of *Casuarina glauca* and various *Melaleuca sp.* and *Callistemon sp.*

The remaining native vegetation community of *Alluvial Woodland* contains *Eucalyptus amplifolia*, *E. tereticornis* and *Casuarina glauca* as dominant species; *Acacia parramattensis* subsp. *parramattensis*, *Casuarina glauca*, and sometimes *Angophora floribunda* and *Melaleuca linariifolia* in the understorey; and a shrub stratum is invariably dominated by *Bursaria spinosa*.

Riparian Forest occurs particularly beside the Georges River channel, dominated by *Eucalyptus botryoides*, *E. elata*, *Angophora subvelutina* and *A. floribunda* with a small tree stratum of *Acacia binervia*, *A. floribunda* and *A. mearnsii*.

Endangered ecological communities in Parramatta/Georges River HGL

| FORMATION (Keith 2004) | STATE CLASS (Keith 2004) | LOCAL CLASS (NPWS 2002) | ENDANGERED ECOLOGICAL COMMUNITY |
|---------------------------|--------------------------------|----------------------------------|--|
| Forested Wetlands | Coastal Floodplains Wetlands | <i>Alluvial Woodland</i> | <i>Alluvial Woodland</i> and <i>Riparian Forest</i> fall within <i>River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions</i> endangered ecological community listing (NSW Scientific Committee 2004) |
| | | <i>Riparian Forest</i> | |

HYDROGEOLOGY

Groundwater flow in this HGL is unconfined through unconsolidated alluvial sediments. Localised perching of water tables occur above clay lenses during wetter periods. Hydraulic conductivity and transmissivity are moderate to high.

Groundwater systems are local with short flow lengths. These systems are generally aligned with current stream channels and drainage depressions. Water quality within these systems is brackish to saline. Water table depths are shallow to intermediate.

Short to medium residence times are typical. These landscapes have a fast response time to changes in land management.

| | |
|--------------|--|
| AQUIFER TYPE | <p>Unconfined in unconsolidated alluvial sediments</p> <p>Vertical and lateral flow components</p> <p>Local perching above clay-rich layers (seasonal)</p> |
| HYDRAULIC | Moderate to high |

| | |
|--------------------------|---|
| CONDUCTIVITY | Range: 10^{-2} → 10 m/day |
| AQUIFER TRANSMISSIVITY | Moderate to high Range: 10 → 100 m ² /day |
| SPECIFIC YIELD | Moderate to high Range: 10–20% |
| HYDRAULIC GRADIENT | Gentle Range: <10% |
| GROUNDWATER SALINITY | Brackish to saline Range: 1.6 - >4.8dS/m |
| DEPTH TO WATER TABLE | Shallow to intermediate (seasonal) Range: 0–8 m |
| TYPICAL CATCHMENT SIZE | Small (<100 ha) |
| SCALE (FLOW LENGTH) | Local Flow length: <5 km (short) |
| RECHARGE ESTIMATE | High |
| RESIDENCE TIME | Short to medium (months to years) |
| RESPONSIVENESS TO CHANGE | Fast (months) |

MANAGEMENT OPTIONS

The overarching salinity management strategies have specific biophysical outcomes. These outcomes are achieved by implementing a series of targeted land management actions taking into account the opportunities and constraints of the particular HGL. The actions recognise the need for diffuse and specific activities within the landscape that are required to impact on salinity issues.

Salinity processes are driven by the interactions between water use characteristics of vegetation, physical soil properties and hydrogeological processes within the HGL.

Actions that impact on the way water is used by vegetation or stored in the soil profile will have impacts on recharge. The influence of both continual and episodic recharge and the impacts of extreme weather events need to be considered in deciding on the appropriate management actions. Short and long-term climate cycles also need to be considered as they will have some bearing on salinity processes, particularly salt load and land salinity.

Where in some rural cases a land use change has occurred and the landscape has been altered (e.g. clearing of vegetation), a balance could occur. Where a balance does not occur it can result in the expression of salinity at various points in the landscape. In urban situations, where the landscape is altered further in shape (such as road and building construction including cut and fill practices) and water movement is impeded and/or water use is increased, salinity may emerge.

Emerging saline effects within the Sydney Metropolitan catchment have occurred in areas underlain by Wianamatta shales. Possible causes of urban salinity in Sydney are shown in the cross-sectional diagram for this HGL. The increased occurrence of salinity is related to:

- A decrease in deep-rooted vegetation
- Over-irrigation of crops, improved pastures and private gardens and lawns

- Alteration of natural drainage patterns by the construction of houses, roads, railways, channels etc.
- Creation of wet zones of waterlogged soil by impeded drainage
- Leakage of standing water bodies, pools, lakes and service pipes
- Exposure of susceptible soils
- Irrigation of sports grounds, golf courses, parks and gardens.

Where salinity is likely to occur in areas of urban development, the following overarching principles should apply:

- Land managers should clearly demonstrate what measures will be employed to ensure the salinity hazard does not increase (both on site and on adjoining land) as a result of a development.
- Identify and manage sensitive soils (e.g. sodic soils, reactive soils, type of salts, salt loads).
- New houses, buildings or infrastructure (including roads, pathways and retaining walls) in current or potentially salt affected areas may need to be built to withstand the effects of salinity (including the establishment of good drainage prior to construction).
- Employ deficit irrigation principles to prevent over-irrigation of sports grounds, golf courses, parks, private gardens and lawns; and limit the application of extra salt through water recycling programs or irrigation of saline groundwater.
- Implement a monitoring program (where deemed necessary) including a clear identification of responsibilities.

Landscape Function – Parramatta/Georges River HGL

The following list details the functions this landscape provides within a catchment scale salinity context:

- **H. The landscape contains high hazard for generating sodic and saline sediment.**
- **D. The landscape generates salt loads which enter the streams and are redistributed in the catchment.**
- **F. The landscape generates high salinity concentration water.**
- **I. The landscape contains high hazard for acid sulfate processes.**

Landscape Management Objectives – Parramatta/Georges River HGL

The following list details the appropriate strategies pertinent to this landscape:

- **Stop discrete landscape recharge:** There are discrete elements of this landscape where specific recharge occurs
- **Manage and avoid acid sulfate hazards:** There are techniques and processes used to manage acid sulfate conditions.

Urban Management Strategy Objectives – Parramatta/Georges River HGL

The following list (in priority order) details the appropriate urban strategies pertinent to this landscape:

- **Urban Investigations (UI):** The landscape contains significant salinity, and geological situations that predispose salinity development. Assessment of the location, intensity and scale of salinity is needed. There are areas of sensitive soils that need to be identified.

Investigations in new subdivision or re-development of areas are required for management of salinity consequences.

- **Urban Planning (UP):** Development must not increase the salinity hazard of the natural and built environment. Layout and design should consider locations of roads, infrastructure and greenspace as well as building allotments, and water sensitive urban design.
- **Urban Management (UM):** The input of water into the landscape (lawns, gardens, sporting fields) including the management of recycled water requires careful management.
- **Urban Construction (UC):** Construction on saline land will require salt resistant/ resilient materials. On some Management Areas the typical slope gradient of this HGL requires consideration of depth of cut and location of roads; and infrastructure, including underground utilities.
- **Riparian Management (RM):** Vegetation management in riparian areas will assist in minimising salt export to streams.
- **Urban Vegetation (UV):** Maintain and enhance vegetation (including remnant vegetation) for the management of recharge, and as a buffer to excess water input. Waterwise gardening should be encouraged in residential areas.

Specific Land Management Opportunities

A range of specific opportunities exist for this HGL:

- Identification of potential acid sulfate soils allows for appropriate management/engineering design to be recommended, e.g.
 - Protect foundations, bridge pylons, pipes and other sub-surface infrastructure with appropriate protective measures such as acid-proofing linings
 - Remediation - apply large quantities of lime
 - Various engineering techniques can be used including groundwater pumping and sub-surface drainage systems

Specific Land Management Constraints

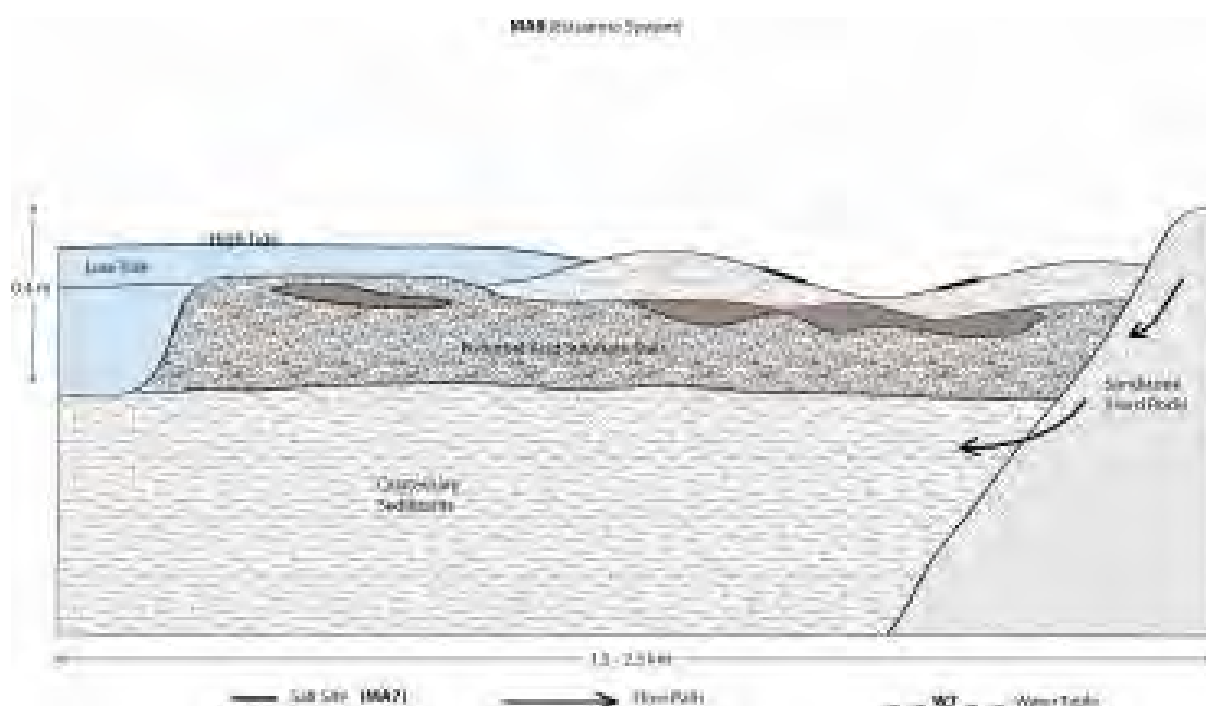
Constraints for land management in this HGL include:

- Potential acid sulfate soils - avoid disturbance of substrate
- Potential acid sulfate soils - avoid drainage of soils and backswamp areas
- There are landscape elements where salinity may be an issue. These are usually on the outer edges of the HGL and are adjacent to change in substrate (sandstone contact) or backswamps.

Specific Targeted Actions for Acid Sulfate Areas

- Minimise water runoff – minimise paved or otherwise sealed areas and maximise vegetation cover in order to promote infiltration of water into the ground and evaporation/transpiration
- Minimise alteration of natural drainage patterns – avoid disturbance to surface drainage lines and groundwater aquifers as far as possible
- Stormwater control – ensure runoff from development is safely directed in a stable drainage system
- Avoid rising regional groundwater levels – avoid exposed ground surfaces and maintain adequate vegetation cover, particularly in high recharge zones
- Avoid deep ripping

- Prevent high seepage from dams
- Carefully manage water application in irrigation projects
- Various engineering techniques can be used including groundwater pumping and sub-surface drainage systems
- Minimise the time of exposure of the soil to air, preferably re-burying it below a permanent watertable on the same day
- Protect foundations, bridge pylons, pipes and other sub-surface infrastructure with appropriate protective measures such as acid-proofing linings
- Apply large quantities of lime
- Where the soils are to be used for landfill purposes, ensure they are only used in the lower layers
- For landscaping purposes, the treatment of these soils with lime and their covering with an appropriate thickness of good topsoil may be necessary to allow ground cover to establishment
- All drainage waters from these soils should be contained and neutralised prior to discharge
- Ensure these soils are not exposed to air by drainage activities. Wide, shallow drains are preferred to deep, narrow drains.



Parramatta/Georges River HGL Management cross-section (Refer to following table for explanation of codes)

Management Actions - Urban

| MANAGEMENT AREA (MA) | ACTION (URBAN) |
|--|--|
| MA9 (ALLUVIAL FLOODPLAIN/ ESTUARINE) | <p>Urban Investigations</p> <p>Investigate concentration and composition of salts in the soil profile, groundwater and surface waters during initial site assessment to determine salinity hazard (U1)</p> <p>Use geophysical techniques to define geological contact (EM survey) (U12)</p> <p>In addition to these actions, the following are recommended for acid sulfate</p> |

| MANAGEMENT AREA (MA) | ACTION (URBAN) |
|----------------------|---|
| | <p>conditions:</p> <ul style="list-style-type: none"> Identify precise nature and distribution (i.e. area and depth) of soils prior to development through appropriate testing <p>Urban Planning</p> <p>Prior to commencement of earthworks sodic/saline soils should be identified. (UP1)</p> <p>Minimise use of infiltration and detention of stormwater in hazard areas, consider lining of detention systems to prevent infiltration (i.e. reconsider WSUD implications in relation to salinity management) (UP2)</p> <p>Identification of discharge sites should influence the size of the area to be developed (UP3)</p> <p>In addition to these actions, the following are recommended for acid sulfate conditions:</p> <ul style="list-style-type: none"> Minimise water runoff – minimise paved or otherwise sealed areas and maximise vegetation cover in order to promote infiltration of water into the ground and evaporation/transpiration Minimise alteration of natural drainage patterns – avoid disturbance to surface drainage lines and groundwater aquifers as far as possible Stormwater control – ensure runoff from development is safely directed in a stable drainage system Where the soils are to be used for landfill purposes, ensure they are only used in the lower layers For landscaping purposes, the treatment of these soils with lime and their covering with an appropriate thickness of good topsoil may be necessary to allow ground cover to establishment All drainage waters from these soils should be contained and neutralised prior to discharge. <p>Urban Management</p> <p>Minimise leakage of standing water bodies, pools, lakes and service pipes (UM1)</p> <p>Employ deficit irrigation principles to prevent over-irrigation of sports grounds, golf courses, parks, private gardens and lawns (UM2)</p> <p>In addition to these actions, the following are recommended for acid sulfate conditions:</p> <ul style="list-style-type: none"> Carefully manage water application in irrigation projects Aim to ensure runoff from development is safely directed in a stable drainage system – can employ various engineering techniques <p>Urban Construction</p> <p>Minimise depth of cut and exposure of susceptible soils during development. Ensure fill material interface is not saline (UC1)</p> <p>Deep drainage should be minimised by maximising surface water runoff and drainage (UC2)</p> |

| MANAGEMENT AREA (MA) | ACTION (URBAN) |
|----------------------|---|
| | <p>Ensure road construction is suitable for conditions (UC5)</p> <p>New houses, buildings or infrastructure (including roads, pathways and retaining walls) in current or potentially salt affected areas may need to be built to withstand the effects of salinity utilising industry accepted standards. In badly affected areas, consideration should be given to rehabilitating salt affected land, building above ground or consideration of open space options (UC6)</p> <p>Consider the use of salt protected materials for services, (e.g. salt resistant drainage pipes, casing of underground services) (UC7)</p> <p>In addition to these actions, the following are recommended for acid sulfate conditions:</p> <ul style="list-style-type: none"> • Minimise the time of exposure of the soil to air, preferably re-burying it below a permanent watertable on the same day • Avoid deep ripping • Aim to ensure runoff from development is safely directed in a stable drainage system – can employ various engineering techniques • Apply large quantities of lime • Protect foundations, bridge pylons, pipes and other sub-surface infrastructure with appropriate protective measures such as acid-proofing linings • All drainage waters from these soils should be contained and neutralised prior to discharge • Ensure these soils are not exposed to air by drainage activities. Wide, shallow drains are preferred to deep, narrow drains. <p>Riparian Management</p> <p>Retain or re-establish areas of effectively vegetated riparian buffer zones to manage discharge areas (preferably salt tolerant indigenous vegetation) (RM1)</p> <p>Maintain/re-establish effective vegetated riparian buffer zones (RM2)</p> <p>Urban Vegetation</p> <p>Promote the retention and establishment of deep-rooted vegetation that maximises water use in new urban development areas (UV2)</p> <p>Establish new vegetation using salt tolerant species (UV4)</p> |

High Hazard Land Use

| AT RISK MANAGEMENT AREAS | ACTION |
|--------------------------|--|
| MA9 | <p>Avoid exposure of soils during development when establishing infrastructure and dwellings</p> <p>Avoid disturbing potential acid sulfate soils</p> <p>Avoid draining acid sulfate soils</p> <p>Careful consideration should be given to the siting of new roads and infrastructure.</p> |

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7. Moorebank Hydrogeological Landscape

| | | |
|------------------|---|---|
| LOCALITIES | MOOREBANK, CHIPPING NORTON, GEORGES HALL, LANSDOWNE, FAIRFIELD EAST |  |
| TYPE AREA | MOOREBANK | |
| GRID REFERENCE | 297700 mE 6270000 mN (Z 56) | |
| GEOLOGY SHEET | PENRITH 1:100 000 | |
| CONFIDENCE LEVEL | MEDIUM | |

OVERVIEW

The Moorebank Hydrogeological Landscape (HGL) is characteristic of areas of Neogene (Pliocene) alluvial deposits contained within the floodplain of the Georges River, particularly around Chipping Norton Lake in the suburbs of Chipping Norton, Moorebank, Lansdowne, Georges Hall and Fairfield East. Landscape features typically include broad, flat alluvial plains, splays and levees which are intersected by present day drainage channels and narrow drainage lines.

This HGL is distinguished from other areas within the Sydney Metropolitan CMA by its very flat, broad and low lying alluvial plain and slowed flow/ponding within the bend in the Georges River around the Chipping Norton Lake area. The bend in the river has allowed Tertiary Alluvium to form the very flat lying landscape. The Moorebank HGL is distinct from the Parramatta/Georges River HGL because of this terminal-like ponding of the river, and that it is not heavily influenced by acid sulfate soils which produce a different salinity signature.

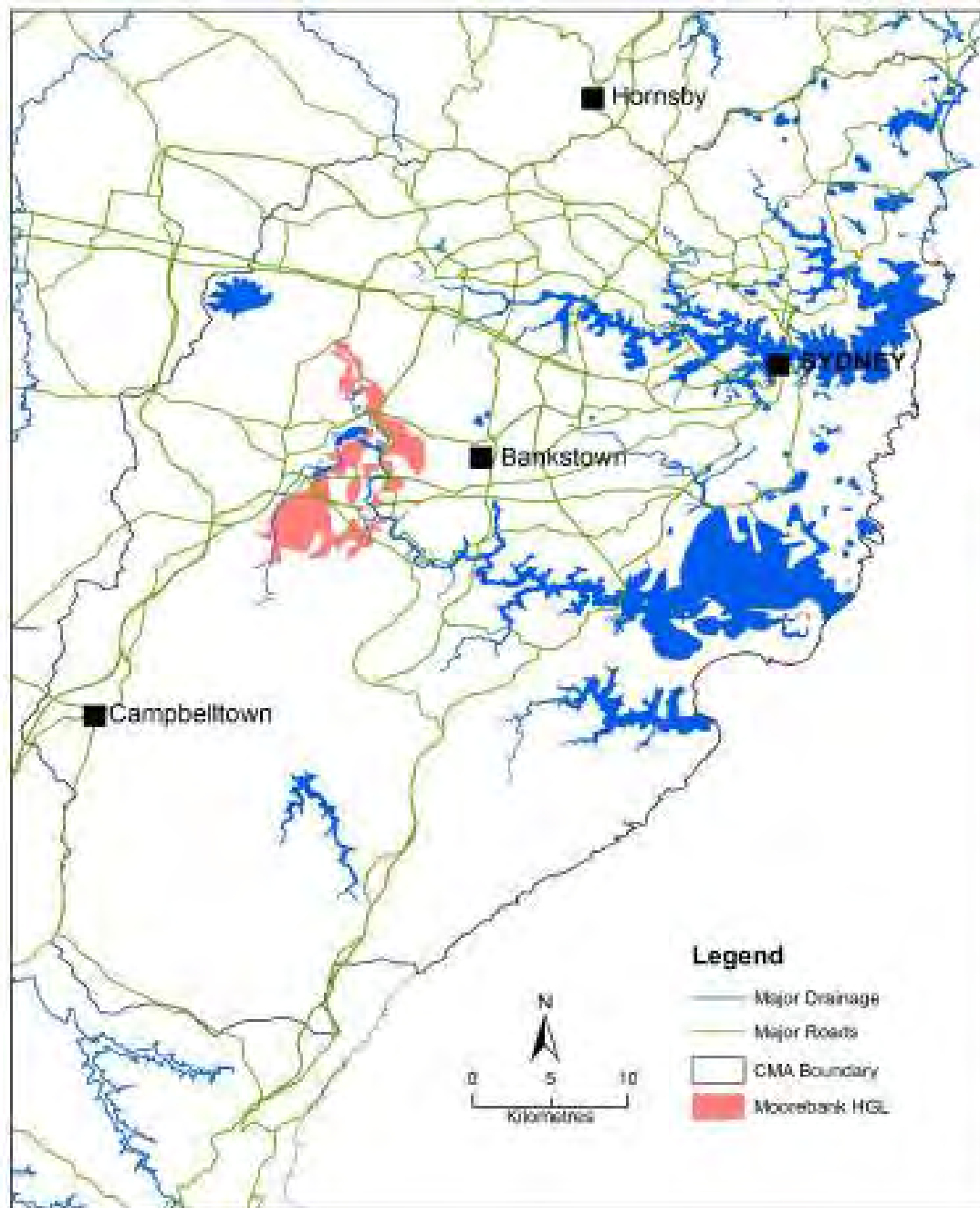
This HGL comprises Neogene Alluvium (clayey quartzose sand and clay under the Georges River as part of the old fluvial environment) with small areas of Hawkesbury Sandstone (medium to very coarse-grained sandstone, minor laminated mudstone and siltstone lenses), and Wianamatta Group Shales and Sandstone (Ashfield Shale which is dark-grey to black claystone-siltstone and fine sandstone-siltstone laminite, and some Bringelly shale which is shale, carbonaceous claystone, claystone, laminite, fine to medium-grained lithic sandstone, rare coal and tuff).

The landscape consists of alluvial plains and drainage lines. Local relief is typically 0–20 m with slopes <10%.

Soils are mainly Brown and Yellow Sodosols (Soloths) and Brown and Yellow Kurosols (Yellow and Brown Podzolic Soils) of the Berkshire Park Soil Landscape on the gently undulating low rises, plains and alluvial terraces, and red earths and Red Podzolic Soils of Richmond Soil Landscape on terrace surfaces with earthy sands on terrace edges. Plastic clays of the Richmond Soil Landscape typically occur in the drainage lines. Substantial areas of Moorebank HGL contain soil of disturbed terrain.

Regional and local groundwater systems flow deeply through the recent alluvium, Neogene alluvium and Triassic sediments. Channels containing surface flow fluctuate with runoff events and are not necessarily fed by groundwater systems, hence are subject to surface intermittent flow and water ponding.

Salt sites within this HGL are on edges of drainage lines. There is a high potential for shallow cyclic or transient salinity in this landscape.



Moorebank HGL Distribution Map

SALINITY

| | |
|------------------------------|--|
| OCCURRENCE (LAND) | Land salinity is moderate. The presence of salty shale layers from the Wianamatta Group sediments contribute to the storage (minor) and subsequent cycling of salts on the low lying alluvial plains. Land salinity is particularly exposed during low flow and drier periods. |
| EXPORT (LOAD) | Salt export is low. The quantity of salts stored generally across the alluvium is low, but the margins of ponds are often saline. The resultant output is low, due to vertical drainage of water in ponds to deeper groundwater. |
| WATER (EC) | Water EC is low. Water quality was measured as being fresh to marginal with EC _w readings of 0.5 – 1.3 dS. |

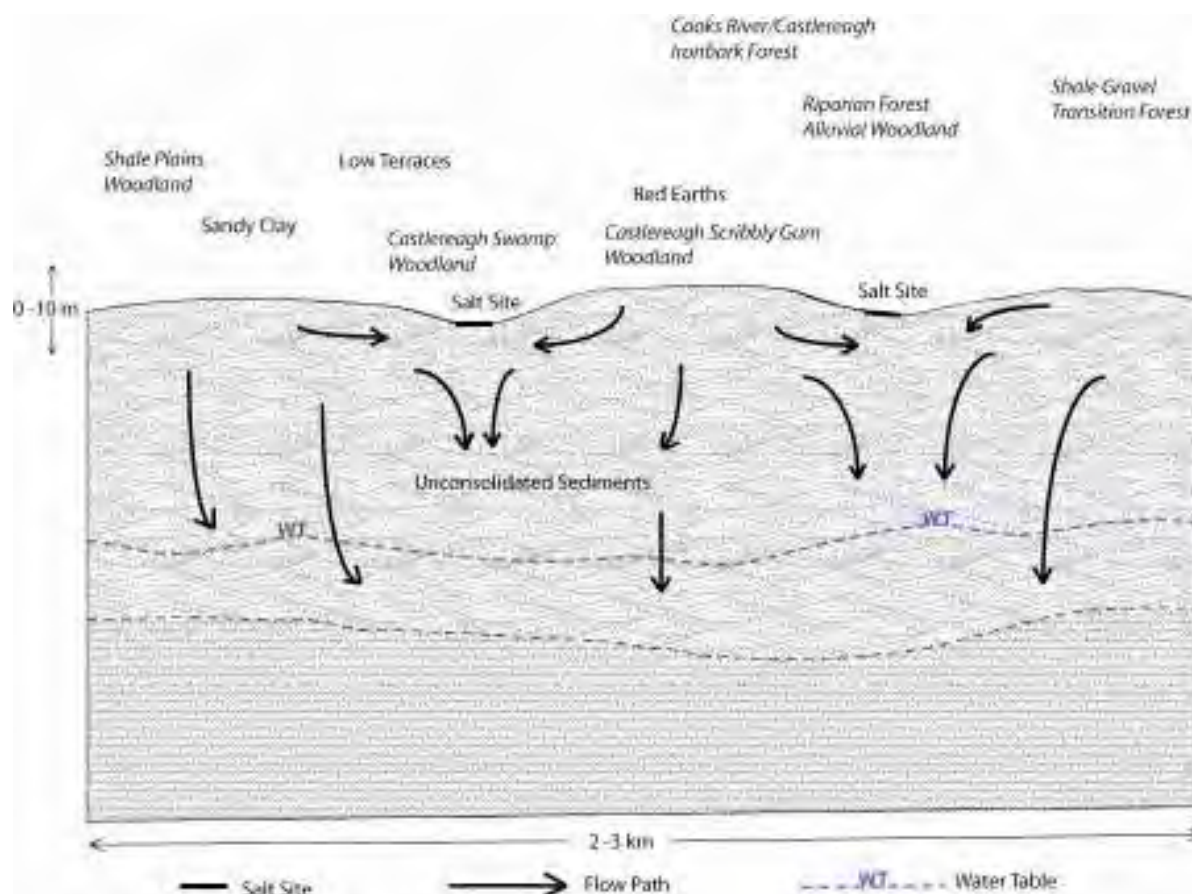
SALT MOBILITY

| | AVAILABILITY | | |
|------------|--------------|------------------|------|
| SALT STORE | LOW | MODERATE | HIGH |
| HIGH | | | |
| MODERATE | | | |
| LOW | | Moorebank | |

HAZARD

| HAZARD ASSESSMENT | Limited potential impact | Significant potential impact | Severe potential impact |
|-----------------------------------|--------------------------|------------------------------|-------------------------|
| High likelihood of occurrence | | | |
| Moderate likelihood of occurrence | | | |
| Low likelihood of occurrence | Moorebank | | |

LANDSCAPE ATTRIBUTES



Conceptual Moorebank HGL cross-section showing the distribution of regolith, landforms, salt sites and flow paths.

| | |
|--|---|
| LITHOLOGY <i>(Jones & Clark 1991; Geoscience Australia 2009)</i> | <p>This HGL comprises unconsolidated sedimentary materials from the Quaternary, Neogene and Triassic periods. The key lithologies are:</p> <ul style="list-style-type: none"> • Recent alluvium – fine-grained sand, gravel, silt and clay. • Neogene alluvium – clayey quartzose sand, and clay • Bringelly Shale (Wianamatta Group) – shale, carbonaceous claystone, laminite, lithic sandstone, rare coal • Ashfield Shale (Wianamatta Group) – black to light grey shale and laminite <p>The Minchinbury Sandstone of the Wianamatta Group and Hawkesbury Sandstone are very minor constituents of this HGL.</p> |
| ANNUAL RAINFALL | 850–930 mm |
| REGOLITH-LANDFORMS | <p>This HGL is highly weathered and is characterised by unconsolidated alluvial sediments forming level to very gently undulating plains (<9 m), gently undulating low rises and alluvial terraces. The plains of the landscape are intersected by present day drainage channels and narrow drainage lines.</p> <p>Regolith materials include clayey quartzose sand and clay, dark-grey to black claystone-siltstone and fine sandstone-siltstone laminite, shale, carbonaceous claystone, claystone, laminite, fine to medium-grained lithic sandstone, rare coal and tuff, and medium-grained sand, silt and some patches of iron oxide cemented aggregates.</p> |



Typical Moorebank HGL – flat lying alluvial area near to Anzac Creek, looking north-west from Heathcote Road, Moorebank. (Photo: DECCW/Marion Winkler).



Typical Moorebank HGL – flat lying alluvial area near to Anzac Creek, looking south-east along Heathcote Road, Moorebank. (Photo: DECCW/Marion Winkler).



Typical Moorebank HGL – flat lying alluvial area used for recreation and open space. (Photo: DECCW/Marion Winkler).

SOIL LANDSCAPES

This HGL includes parts of the Berkshire Park and Richmond Soil Landscapes with very minor expressions of Freemans Reach Soil Landscape and soil of disturbed terrain.

The Berkshire Park Soil Landscape forms the dissected, gently undulating low rises on Tertiary alluvium of the HGL and typically contains Brown and Yellow Sodosols (Soloths), Brown and Yellow

| | |
|-----------------------------|---|
| | <p>Kurosols (Yellow and Brown Podzolic Soils). The topsoils of the terraces are comprised of brown sandy loams and dark brown loamy sands. Ferromanganiferous nodules are common. Brown clayey sands, yellowish brown sandy clays and yellowish brown nodular clay, with abundant iron and manganese nodules form the subsoil of the terraces.</p> <p>The Richmond Soil Landscape forms the terraces of the Georges River. They typically show plastic clays in drainage lines, non-calcic brown soils, red earths and Red Podzolic Soils on terrace surfaces and earthy sands on terrace edges.</p> <p>Freemans Reach Soil Landscape is a minor component of the HGL and occurs on the flood plain of Quaternary Alluvium. It is formed of Stratic Rudosols (Alluvial Soils).</p> |
| RURAL LAND CAPABILITY | The rural land capability for this HGL is predominantly Class I, V and VII. |
| LAND USE | Bankstown Airport, Liverpool and Moorebank industrial areas, Moorebank brickworks, part of New Brighton Golf Course, Bankstown Golf Course, Riverwood Golf Course, Crest of Bankstown Reserve and playing fields, Dunc Gray Velodrome, Lansdowne Reserve (Mirambeena Regional Park and Lansdowne Park), Rowley Park and Strong Park. |
| KEY LAND DEGRADATION ISSUES | <p>Limitations:</p> <ul style="list-style-type: none"> • Waterlogging • Localised flood hazard • Gully, sheet and rill erosion hazard • Very high wind erosion hazard if Berkshire Park soil landscape is cleared |
| VEGETATION | <p>Moorebank HGL is partially cleared of native vegetation. The vegetation is typical of flat lying, swampy land. About half of the remaining native vegetation retains >10% canopy cover (NPWS 2002).</p> <p>Communities include partially cleared <i>Castlereagh Scribbly Gum Woodland</i>, <i>Castlereagh Swamp Woodland</i>, <i>Cooks River/Castlereagh Ironbark Forest</i> and <i>Shale Gravel Transition Forest</i>. <i>Riparian Forest</i> and <i>Alluvial Woodland</i> occur on the current day drainage lines.</p> <p>Common dominant tree species include <i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i> (Parramatta red gum), <i>Angophora bakeri</i> (narrow-leaved apple) and <i>E. sclerophylla</i> (hard-leaved scribbly gum), <i>Melaleuca decora</i>, <i>E. fibrosa</i> (red ironbark), <i>A. subvelutina</i> (broad-leaved apple) and <i>Melaleuca linariifolia</i> (flax-leaved paperbark), <i>E. moluccana</i> (grey box) and <i>E. tereticornis</i> (forest red gum).</p> <p>Signature: not unique</p> <p>Vegetation assemblages are similar to those in low lying areas, with similar soil landscapes, on the Londonderry HGL in Western Sydney (HNCMA).</p> |

VEGETATION ASSEMBLAGES

Moorebank HGL is reasonably cleared however the remaining native vegetation represents a number of endangered Cumberland Plain Woodland communities. *Castlereagh Scribbly Gum Woodland* occurs on higher ground and *Castlereagh Swamp Woodland* in poorly drained depressions, *Cooks River/Castlereagh Ironbark Forest* occurs on clayey soils and *Shale Gravel Transition Forest* on the shallower soils over shale at the edges of the HGL unit. *Shale Plains Woodland* is also present.

Castlereagh Scribbly Gum Woodland (NSW NPWS 2002) is dominated by *Eucalyptus parramattensis* subsp. *parramattensis*, *Angophora bakeri* and *E. sclerophylla*. A small tree stratum of *Melaleuca decora* is sometimes present and a shrub stratum consisting of sclerophyllous species such as *Banksia spinulosa* subsp. *spinulosa*, *M. nodosa*, *Hakea sericea* and *H. dactyloides* (multi-stemmed form).

Castlereagh Swamp Woodland is dominated by medium to dense stands of *Melaleuca decora*. *Eucalyptus fibrosa*, *Angophora subvelutina* and *Melaleuca linariifolia* are present less frequently in both the tree and small tree strata. *Eucalyptus parramattensis* subsp. *parramattensis* is frequently present, but is usually represented by only a few individuals. The Ground stratum is often dense and diverse.

Cooks River/Castlereagh Ironbark Forest is dominated by *Eucalyptus fibrosa* and *Melaleuca decora*, with *E. longifolia* occurring at lower frequency. A relatively dense shrub stratum is typical, and dominated by *M. nodosa* and *Lissanthe strigosa*, and to a lesser extent *M. decora*. Shrub species include *Acacia pubescens*, *Dillwynia tenuifolia*, *Daviesia ulicifolia*, *Pultenea villosa* and *Grevillea juniperina*. The ground stratum is relatively sparse compared to adjoining communities on tertiary alluvium or shale soils.

Shale/Gravel Transition Forest is usually dominated by *Eucalyptus fibrosa* with *E. moluccana* and *E. tereticornis* occurring less frequently, but sometimes dominating in the absence of *E. fibrosa*. *Melaleuca decora* is frequently present in a small tree stratum. A sparse shrub stratum is usually present and typically includes species such as *Bursaria spinosa*, *Daviesia ulicifolia* and *Lissanthe strigosa*.

Shale Plains Woodland is dominated by *Eucalyptus moluccana* and *E. tereticornis* with *E. crebra*, *E. eugenioides* and *Corymbia maculata* occurring less frequently. Other tree and shrub species include *Exocarpus cupressiformis*, *Acacia parramattensis* subsp. *parramattensis*, *Acacia decurrens* and *Bursaria spinosa*.

Riparian Forest and *Alluvial Woodland* have been observed on the current day drainage lines of the HGL.

Endangered ecological communities in Moorebank HGL

| FORMATION (Keith 2004) | STATE CLASS (Keith 2004) | LOCAL CLASS (NPWS 2002) | ENDANGERED ECOLOGICAL COMMUNITY |
|--------------------------------|------------------------------------|--|--|
| Grassy Woodlands | Coastal Valley Grassy Woodlands | <i>Shale Plains Woodland</i> | <i>Shale Plains Woodland</i> fits within <i>Cumberland Plain Woodland</i> endangered ecological community listing (NSW Scientific Committee 1997) |
| Dry Sclerophyll Forests | Cumberland Dry Sclerophyll Forests | <i>Cooks River/Castlereagh Ironbark Forest</i> | <i>Cooks River/Castlereagh Ironbark Forest</i> is listed as <i>Cooks River/Castlereagh ironbark forest in the Sydney Basin Bioregion</i> endangered ecological community listing (NSW Scientific Committee 2001) |
| | | <i>Shale/Gravel Transition Forest</i> | <i>Shale/Gravel Transition Forest</i> is listed as <i>Shale gravel transition forest</i> endangered ecological community (NSW Scientific Committee 2002) |

| | | | |
|--------------------------|---|---|--|
| | Hinterland Sand Flats Dry Sclerophyll Forests | <i>Castlereagh Swamp Woodland</i> <i>Castlereagh Scribbly Gum Woodland</i> | <i>Castlereagh Swamp Woodland</i> is listed as <i>Castlereagh swamp woodland community</i> endangered ecological community (NSW Scientific Committee 1999) <div>n/a</div> |
| Forested Wetlands | Coastal Floodplain Wetlands | <i>Alluvial Woodland</i> | <i>Alluvial Woodland</i> falls within the endangered ecological community listing for <i>River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions</i> (NSW Scientific Committee 2004) |
| | | <i>Riparian Forest</i> | |

HYDROGEOLOGY

Groundwater flow in this HGL is unconfined through unconsolidated alluvial sediments. Localised perching of water tables occur above clay lenses during wetter periods. Unconfined to semi-confined flow also occurs along structures (bedding, joints, faults) in the fractured bedrock. Hydraulic conductivity is moderate to high and transmissivity is moderate.

Groundwater systems are local with short flow lengths. These systems are generally aligned with current stream channels and drainage depressions. Water quality within these systems is fresh to marginal. Water table depths are shallow to intermediate.

Short to medium residence times are typical. These landscapes have a fast to medium response time to changes in land management.

| | |
|-------------------------------|---|
| AQUIFER TYPE | Unconfined in unconsolidated alluvial sediments Unconfined to semi-confined in fractured rock along structures Local perching above clay-rich layers (seasonal) |
| HYDRAULIC CONDUCTIVITY | Moderate to high Range: 10–>30 m/day |
| AQUIFER TRANSMISSIVITY | Moderate Range: 2–100 m ² /day |
| SPECIFIC YIELD | Moderate Range: 5–15% |
| HYDRAULIC GRADIENT | Gentle to moderate Range: <10–30% |
| GROUNDWATER SALINITY | Fresh to marginal (more saline in deeper aquifers in the Wianamatta Group shales) Range: <0.8–1.6 dS/m |
| DEPTH TO WATER TABLE | Shallow to intermediate (seasonal) Range: 0–8 m |
| TYPICAL CATCHMENT | Small (<100 ha) |

| | |
|--------------------------|-----------------------------------|
| SIZE | |
| SCALE | Local |
| (FLOW LENGTH) | Flow length: <5 km (short) |
| RECHARGE ESTIMATE | Moderate to high |
| RESIDENCE TIME | Short to medium (months to years) |
| RESPONSIVENESS TO CHANGE | Fast to medium (months to years) |

MANAGEMENT OPTIONS

The overarching salinity management strategies have specific biophysical outcomes. These outcomes are achieved by implementing a series of targeted land management actions taking into account the opportunities and constraints of the particular HGL. The actions recognise the need for diffuse and specific activities within the landscape that are required to impact on salinity issues.

Salinity processes are driven by the interactions between water use characteristics of vegetation, physical soil properties and hydrogeological processes within the HGL.

Actions that impact on the way water is used by vegetation or stored in the soil profile will have impacts on recharge. The influence of both continual and episodic recharge and the impacts of extreme weather events need to be considered in deciding on the appropriate management actions. Short and long-term climate cycles also need to be considered as they will have some bearing on salinity processes, particularly salt load and land salinity.

Where in some rural cases a land use change has occurred and the landscape has been altered (e.g. clearing of vegetation), a balance could occur. Where a balance does not occur it can result in the expression of salinity at various points in the landscape. In urban situations, where the landscape is altered further in shape (such as road and building construction including cut and fill practices) and water movement is impeded and/or water use is increased, salinity may emerge.

Emerging saline effects within the Sydney Metropolitan catchment have occurred in areas underlain by Wianamatta shales. Possible causes of urban salinity in Sydney are shown in the cross-sectional diagram for this HGL. The increased occurrence of salinity is related to:

- A decrease in deep-rooted vegetation
- Over-irrigation of crops, improved pastures and private gardens and lawns
- Alteration of natural drainage patterns by the construction of houses, roads, railways, channels etc.
- Creation of wet zones of waterlogged soil by impeded drainage
- Leakage of standing water bodies, pools, lakes and service pipes
- Exposure of susceptible soils
- Irrigation of sports grounds, golf courses, parks and gardens.

Where salinity is likely to occur in areas of urban development, the following overarching principles should apply:

- Land managers should clearly demonstrate what measures will be employed to ensure the salinity hazard does not increase (both on site and on adjoining land) as a result of a development.
- Identify and manage sensitive soils (e.g. sodic soils, reactive soils, type of salts, salt loads).

- New houses, buildings or infrastructure (including roads, pathways and retaining walls) in current or potentially salt affected areas may need to be built to withstand the effects of salinity (including the establishment of good drainage prior to construction).
- Employ deficit irrigation principles to prevent over-irrigation of sports grounds, golf courses, parks, private gardens and lawns; and limit the application of extra salt through water recycling programs or irrigation of saline groundwater.
- Implement a monitoring program (where deemed necessary) including a clear identification of responsibilities.

Landscape Function – Moorebank HGL

The following list details the functions this landscape provides within a catchment scale salinity context:

- **C. The landscape provides important base flow to local streams**
- **E. The landscape receives and stores salt load through irrigation or surface flow.**

Landscape Management Objectives – Moorebank HGL

The following list details the appropriate strategies pertinent to this landscape:

- **Discharge rehabilitation:** The saline sites are large in size. Discharge management will reduce salt discharge to streams when vegetation is matched to salt sites.

Urban Management Strategy Objectives – Moorebank HGL

The following list (in priority order) details the appropriate urban strategies pertinent to this landscape:

- **Urban Management (UM):** The input of water into the landscape (lawns, gardens, sporting fields) including the management of recycled water requires careful management.
- **Riparian Management (RM):** Vegetation management in riparian areas will assist in minimising salt export to streams.
- **Urban Vegetation (UV):** Maintain and enhance vegetation (including remnant vegetation) for the management of recharge, and as a buffer to excess water input. Waterwise gardening should be encouraged in residential areas.
- **Urban Planning (UP):** Development must not increase the salinity hazard of the natural and built environment. Layout and design should consider locations of roads, infrastructure and greenspace as well as building allotments, and water sensitive urban design.
- **Urban Investigations (UI):** The landscape contains significant salinity, and geological situations that predispose salinity development. Assessment of the location, intensity and scale of salinity is needed. There are areas of sensitive soils that need to be identified. Investigations in new subdivision or re-development of areas are required for management of salinity consequences.
- **Urban Construction (UC):** Construction on saline land will require salt resistant/ resilient materials. On some management areas the typical slope gradient of this HGL requires consideration of depth of cut and location of roads; and infrastructure, including underground utilities.

Specific Land Management Opportunities

A range of specific opportunities exist for this HGL:

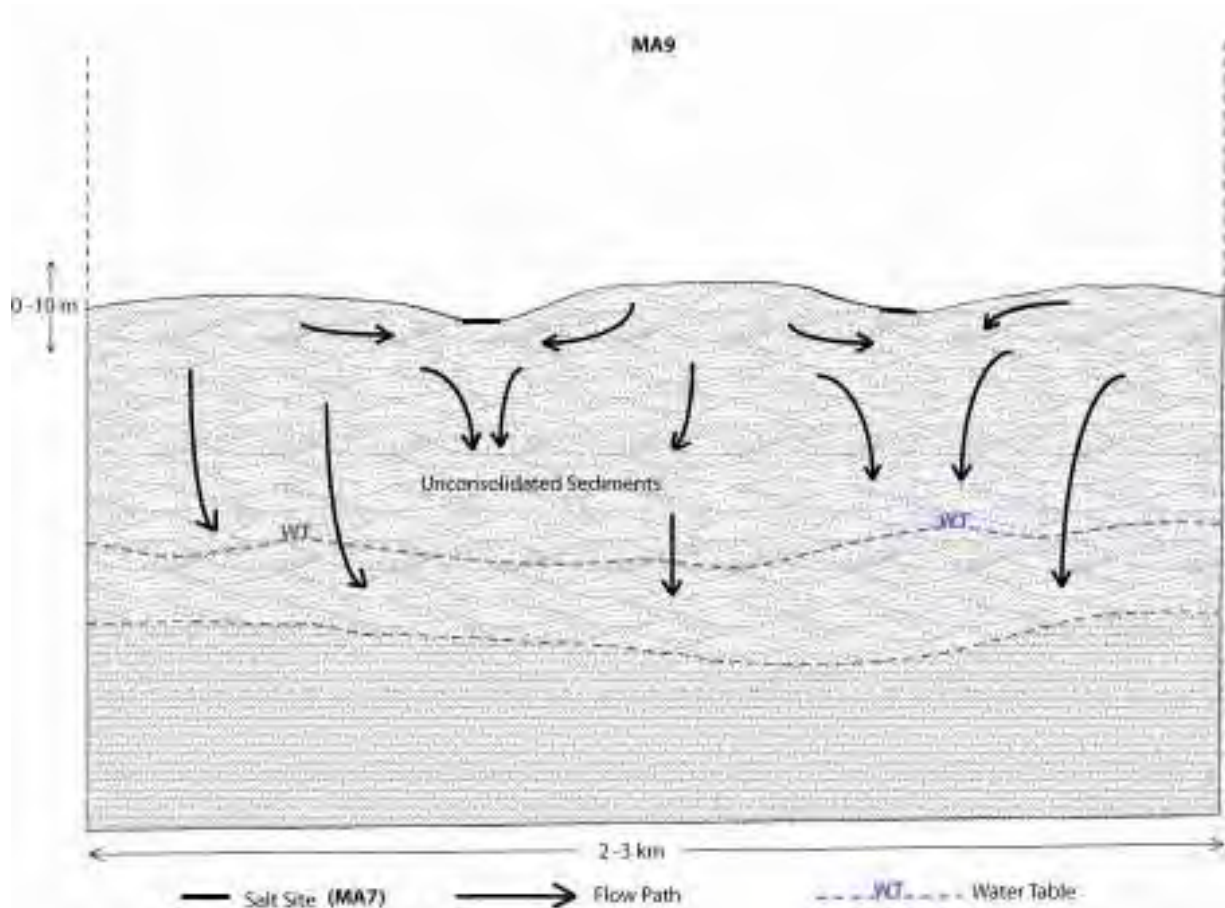
- Free draining soils reduces salinity risk
- Remnant vegetation - landscapes are highly vegetated which aid in reducing recharge in the upper landscape and buffering minor salt store.

Specific Land Management Constraints

Constraints for land management in this HGL include:

- Waterlogging – low lying areas are susceptible to waterlogging
- Lower slope – water from surrounding land drains to this area
- There are landscape elements where salinity may be an issue. These are usually on the outer edges of the HGL and are adjacent to change in substrate (sandstone contact) or near backswamps.

Specific Targeted Actions



Moorebank HGL management cross-section (Refer to following table for explanation of codes)

Management Actions - Urban

| MANAGEMENT AREA (MA) | ACTION (URBAN) |
|--|---|
| MA9 (ALLUVIAL FLOODPLAIN) | <p>Urban Management</p> <p>Minimise leakage of standing water bodies, pools, lakes and service pipes. (UM1)</p> <p>Employ deficit irrigation principles to prevent over-irrigation of sports grounds, golf courses, parks, private gardens and lawns. (UM2)</p> <p>Riparian Management</p> <p>Retain or re-establish areas of effectively vegetated riparian buffer zones to manage discharge areas (preferably salt tolerant indigenous vegetation). (RM1)</p> <p>Maintain/re-establish effective vegetated riparian buffer zones. (RM2)</p> <p>Urban Vegetation</p> <p>Retain or establish areas of deep-rooted salt tolerant indigenous vegetation to manage recharge or discharge sites. (UV1)</p> <p>Promote the retention and establishment of deep-rooted vegetation that maximises water use in new urban development areas. (UV2)</p> <p>Develop native landscaping and “waterwise” gardens to reduce over-irrigation and water usage. (UV3)</p> <p>Establish new vegetation using salt tolerant species. (UV4)</p> <p>Urban Planning</p> <p>Prior to commencement of earthworks sodic/saline soils should be identified. (UP1)</p> <p>Implementation of WSUD techniques considers the potential impact on the local salinity hazard. Revise principles of WSUD where salinity effects are an issue. (UP5)</p> <p>Urban Investigations</p> <p>Investigate concentration and composition of salts in the soil profile, groundwater and surface waters during initial site assessment to determine salinity hazard. (UI1)</p> <p>Urban Construction</p> <p>Minimise depth of cut and exposure of susceptible soils during development. Ensure fill material interface is not saline. (UC1)</p> <p>Minimise the alteration of natural drainage patterns through construction of houses, roads, railways, channels etc. (UC8)</p> |

High Hazard Land Use

| AT RISK MANAGEMENT AREAS | ACTION |
|--------------------------|---|
| MA9 | <p>Careful consideration should be given to the siting of new roads and infrastructure.</p> <p>Avoid obstructing drainage lines which impedes the flow of water.</p> <p>Avoid over watering via irrigation of sports grounds, golf courses, parks, private gardens and lawns.</p> |

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NSW Scientific Committee (2004) *River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community listing*. New South Wales Department of Environment, Climate Change and Water. [Cited 4 August 2009.] Available from URL: <http://www.environment.nsw.gov.au/determinations/RiverflatEucalyptForestEndSpListing.htm>

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Appendix C

Dial Before You Dig Plans

Caller Details

Contact: Mr Raghav Rana
Company: Aurecon
Address: 552 Boronia Road
Wantirna VIC 3152

Caller Id: 2235321
Mobile: Not Supplied
Email: raghav.rana@aurecongroup.com
Phone: 0401448946
Fax: Not Supplied

Dig Site and Enquiry Details

WARNING: The map below only displays the location of the proposed dig site and does not display any asset owners' pipe or cables. The area highlighted has been used only to identify the participating asset owners, who will send information to you directly.



User Reference: 510003
Working on Behalf of: Other
Enquiry Date: 24/09/2020
Start Date: 25/09/2020
End Date: 30/09/2020

Address:
Henry Lawson Drive
Milperra NSW 2214

Job Purpose:

Design

Location of Workplace:

Road Reserve

Onsite Activity:

Planning & Design

Location in Road:

CarriageWay, Footpath, Nature Strip

- Check the location of the dig site is correct. If not submit a new enquiry.
- If the scope of works change, or plan validity dates expire, resubmit your enquiry.
- Do NOT dig without plans. Safe excavation is your responsibility. If you do not understand the plans or how to proceed safely, please contact the relevant asset owners.

Notes/Description of Works:

Road upgrade

Your Responsibilities and Duty of Care

- The lodgement of an enquiry does not authorise the project to commence. You must obtain all necessary information from any and all likely impacted asset owners prior to excavation.
- If plans are not received within 2 working days, contact the asset owners directly & quote their Sequence No.
- ALWAYS perform an onsite inspection for the presence of assets. Should you require an onsite location, contact the asset owners directly. Please remember, plans do not detail the exact location of assets.
- Pothole to establish the exact location of all underground assets using a hand shovel, before using heavy machinery.
- Ensure you adhere to any State legislative requirements regarding Duty of Care and safe digging requirements.
- If you damage an underground asset you MUST advise the asset owner immediately.
- By using this service, you agree to Privacy Policy and the terms and disclaimers set out at www.1100.com.au
- For more information on safe excavation practices, visit www.1100.com.au

Asset Owner Details

The assets owners listed below have been requested to contact you with information about their asset locations within 2 working days. Additional time should be allowed for information issued by post. It is **your responsibility** to identify the presence of any underground assets in and around your proposed dig site. Please be aware, that not all asset owners are registered with the Dial Before You Dig service, so it is **your responsibility** to identify and contact any asset owners not listed here directly.

** Asset owners highlighted by asterisks ** require that you visit their offices to collect plans.

Asset owners highlighted with a hash require that you call them to discuss your enquiry or to obtain plans.

| Seq. No. | Authority Name | Phone | Status |
|-----------|--|------------|----------|
| 102165063 | Ausgrid | 0249510899 | NOTIFIED |
| 102165068 | BP Australia Pty Ltd, Remediation Management NSW | 0392683025 | NOTIFIED |
| 102165062 | Endeavour Energy | 0298534161 | NOTIFIED |
| 102165066 | Jemena Gas West | 1300880906 | NOTIFIED |
| 102165058 | Liverpool City Council | 1300362170 | NOTIFIED |
| 102165069 | NBN Co, NswAct | 1800626329 | NOTIFIED |
| 102165060 | Nextgen, NCC - NSW | 1800032532 | NOTIFIED |
| 102165065 | Optus and/or Uecomm, Nsw | 1800505777 | NOTIFIED |
| 102165059 | Roads and Maritime Services | 0288370285 | NOTIFIED |
| 102165067 | Sydney Water | 132092 | NOTIFIED |
| 102165064 | Telstra NSW, Central | 1800653935 | NOTIFIED |
| 102165061 | TPG Telecom (NSW) | 1800786306 | NOTIFIED |

END OF UTILITIES LIST

Response Cover Letter

Liverpool City Council

Locked Bag 7064

Liverpool BC NSW 1871

www.liverpool.nsw.gov.au



Date: 24/09/2020

To:

Mr Raghav Rana

Aurecon

552 Boronia Road

Wantirna VIC 3152

According to our records your enquiry with the following details impacts our infrastructure. Please review other documents included with this response for additional details:

Sequence No: 102165058

Job No: 20310876

Location: Henry Lawson Drive
Milperra NSW 2214

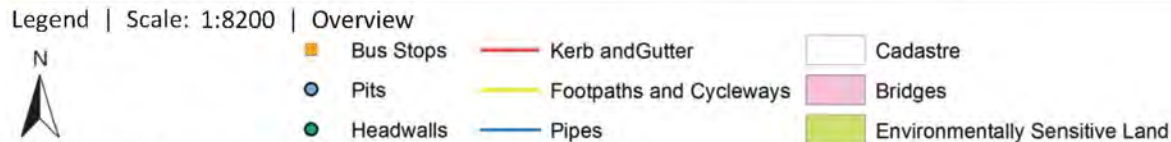
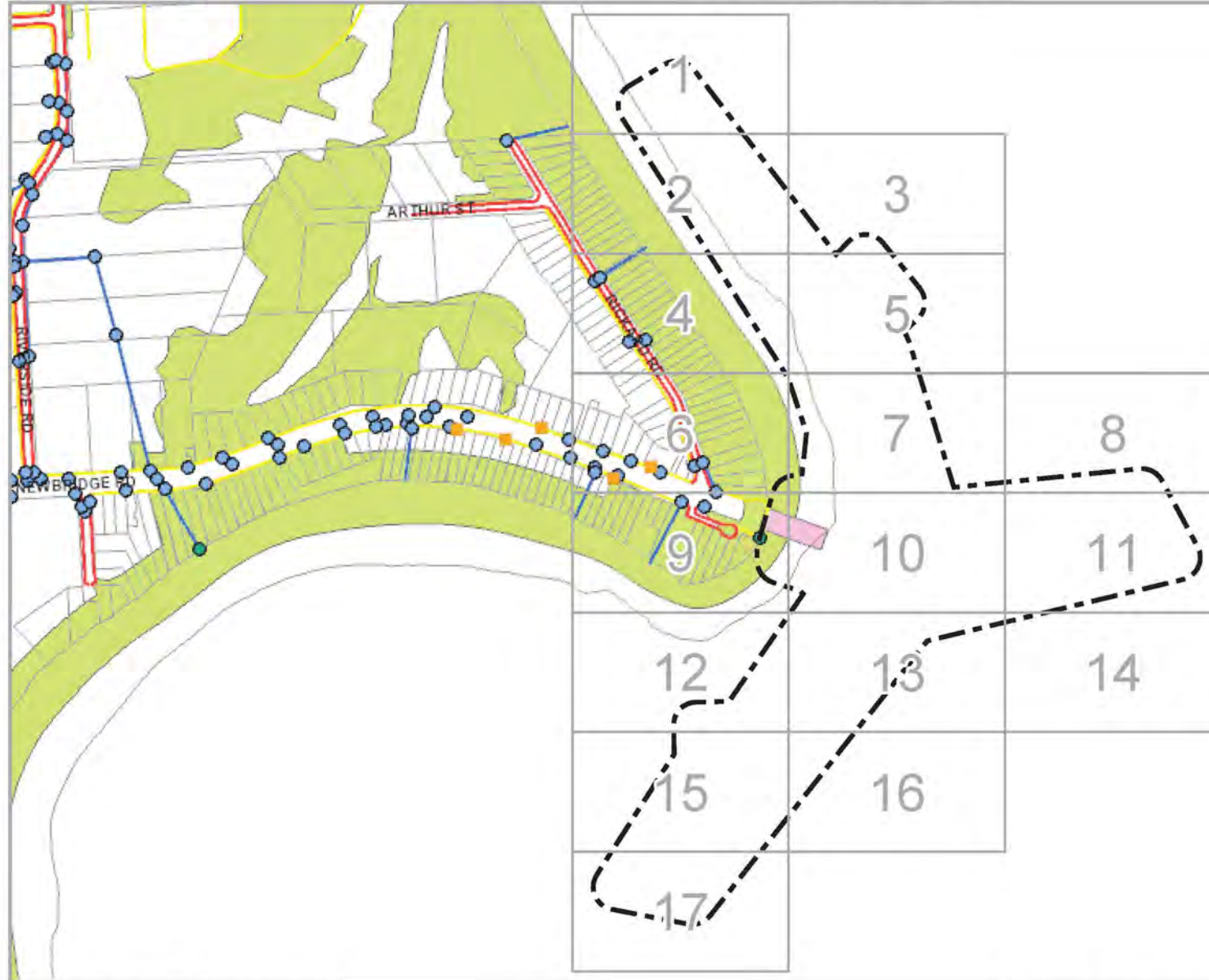
If you require further information, please contact the Liverpool City Council's Customer Centre on 1300 362 170 or lcc@liverpool.nsw.gov.au

Important Notice: This enquiry response, including any associated documentation, has been assessed and compiled from the information detailed within the DBYD enquiry outlined above. Please ensure that the DBYD enquiry details and this response accurately reflect your proposed works.

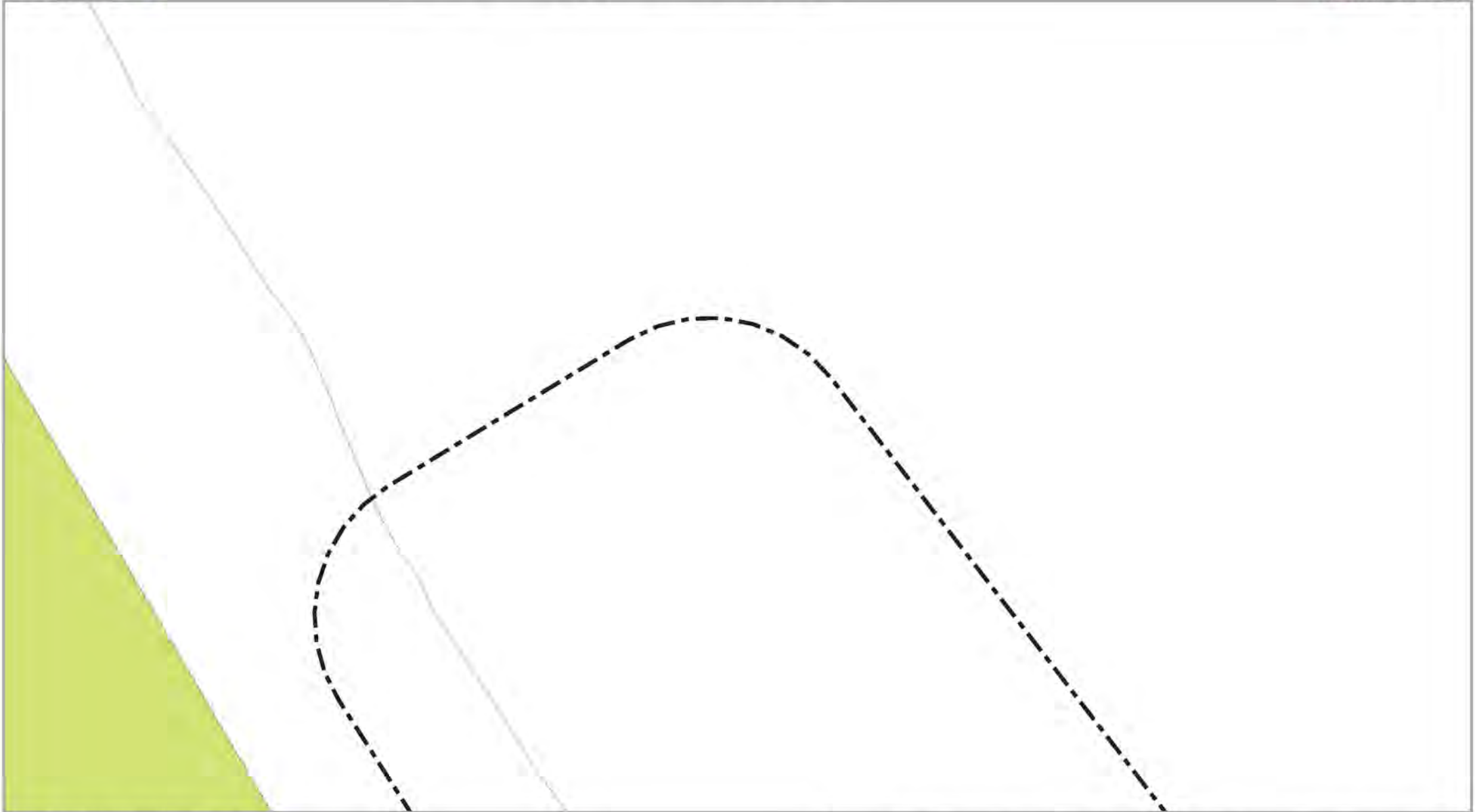
This response is intended for use only by the addressee. If you have received the enquiry response in error, please let us know by telephone and delete all copies; you are advised that copying, distributing, disclosing or otherwise acting in reliance on the response is expressly prohibited.












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Legend | Scale: 1:1000 | Tile No: 1

- | | | |
|---|---|--|
|  Bus Stops |  Kerb and Gutter |  Cadastre |
|  Pits |  Footpaths and Cycleways |  Bridges |
|  Headwalls |  Pipes |  Environmentally Sensitive Land |

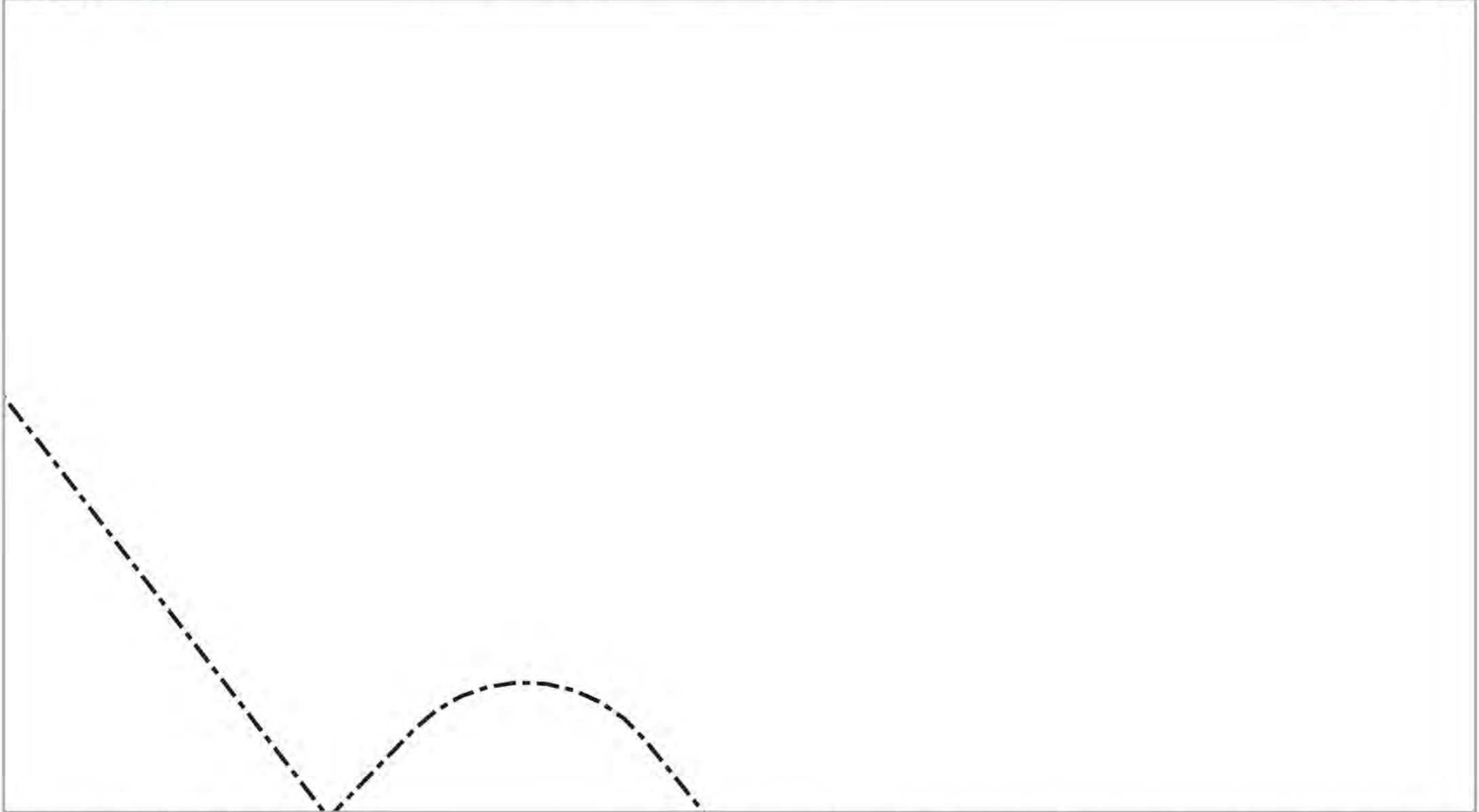
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Legend | Scale: 1:1000 | Tile No: 2

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|---|---|--|
|  Bus Stops |  Kerb and Gutter |  Cadastre |
|  Pits |  Footpaths and Cycleways |  Bridges |
|  Headwalls |  Pipes |  Environmentally Sensitive Land |

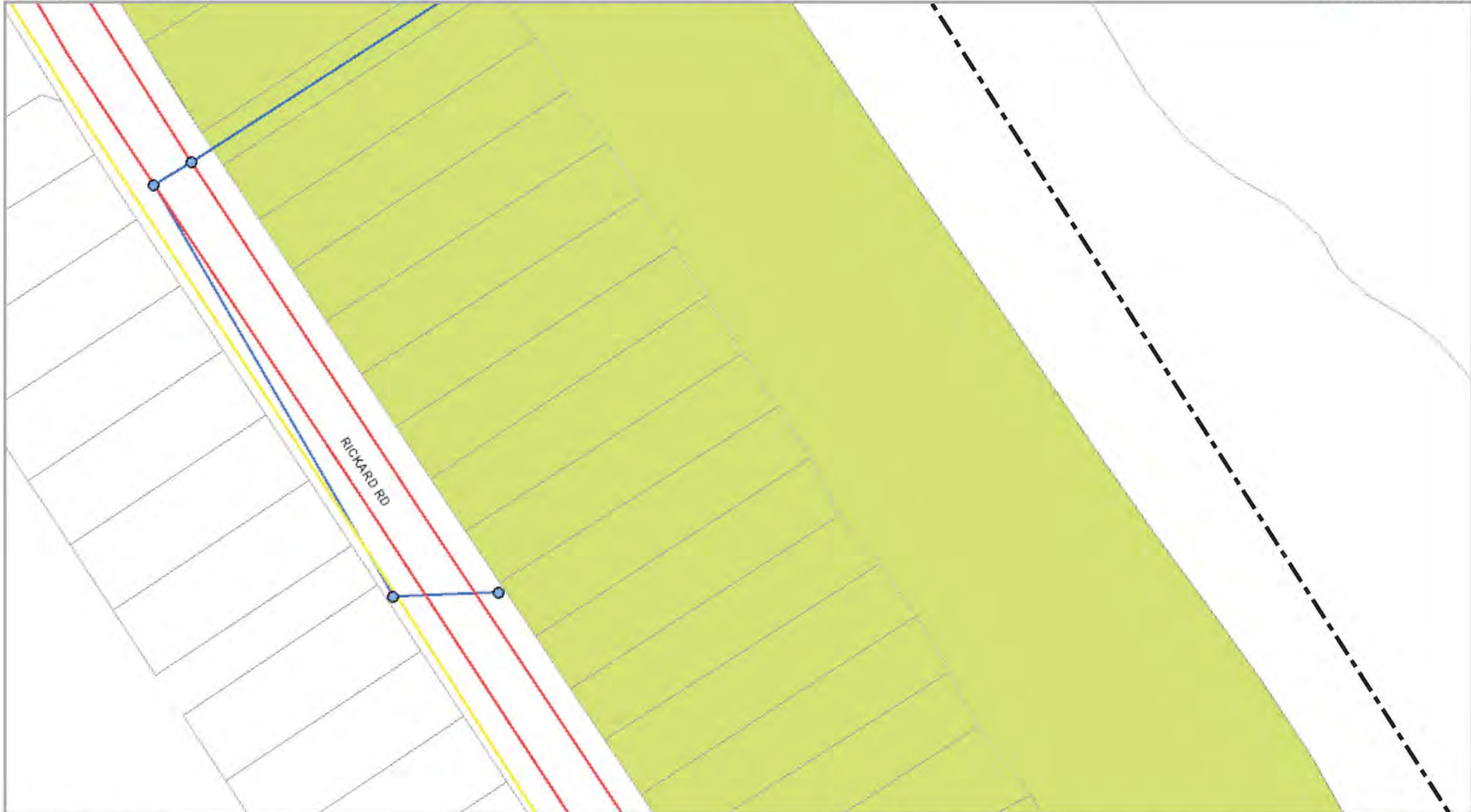
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Legend | Scale: 1:1000 | Tile No: 3

- | | | |
|---|---|--|
|  Bus Stops |  Kerb and Gutter |  Cadastre |
|  Pits |  Footpaths and Cycleways |  Bridges |
|  Headwalls |  Pipes |  Environmentally Sensitive Land |

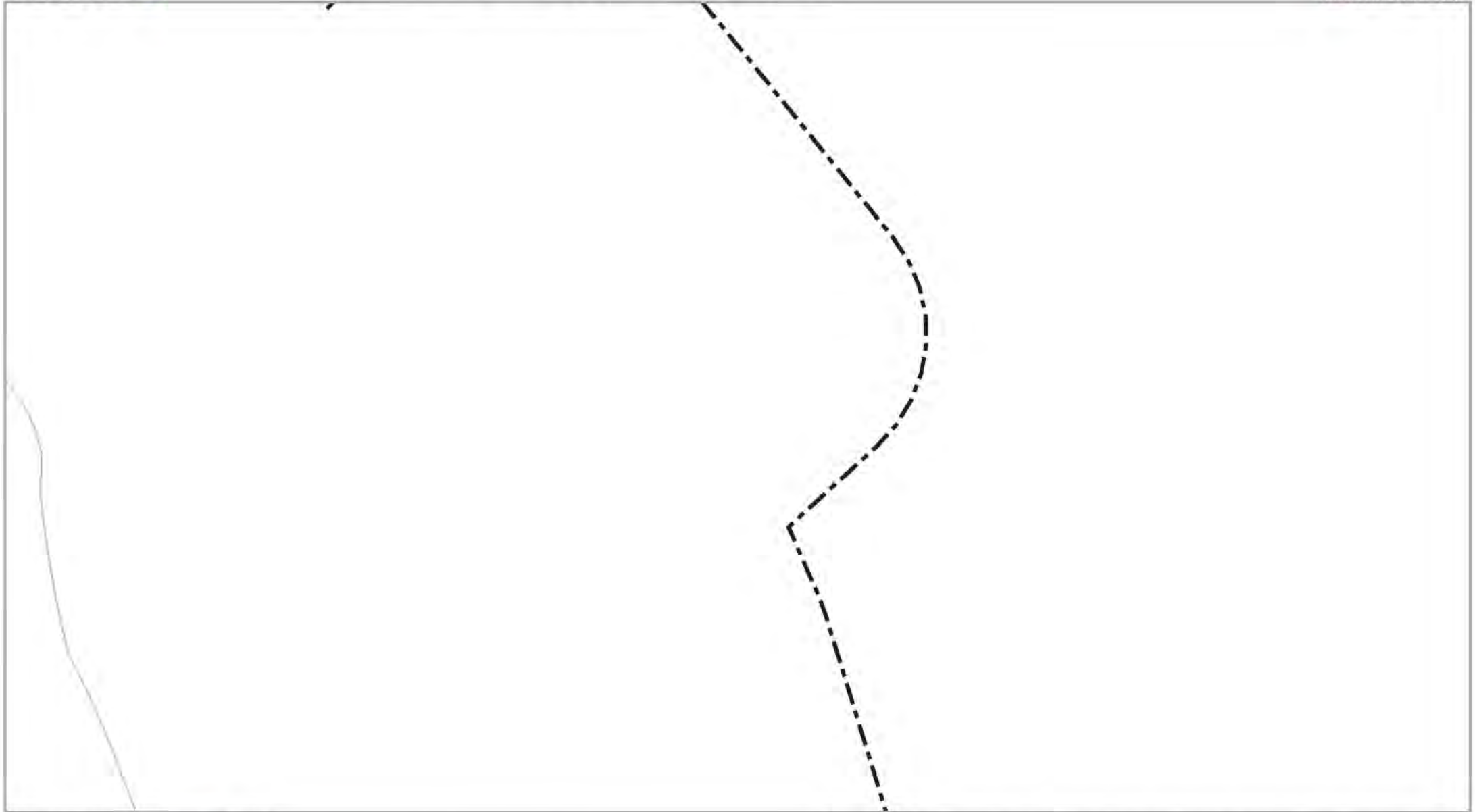
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Legend | Scale: 1:1000 | Tile No: 4










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|-----------|-------------------------|--------------------------------|
| Bus Stops | Kerb and Gutter | Cadastre |
| Pits | Footpaths and Cycleways | Bridges |
| Headwalls | Pipes | Environmentally Sensitive Land |

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Legend | Scale: 1:1000 | Tile No: 5












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|---|---|--|
|  Bus Stops |  Kerb and Gutter |  Cadastre |
|  Pits |  Footpaths and Cycleways |  Bridges |
|  Headwalls |  Pipes |  Environmentally Sensitive Land |

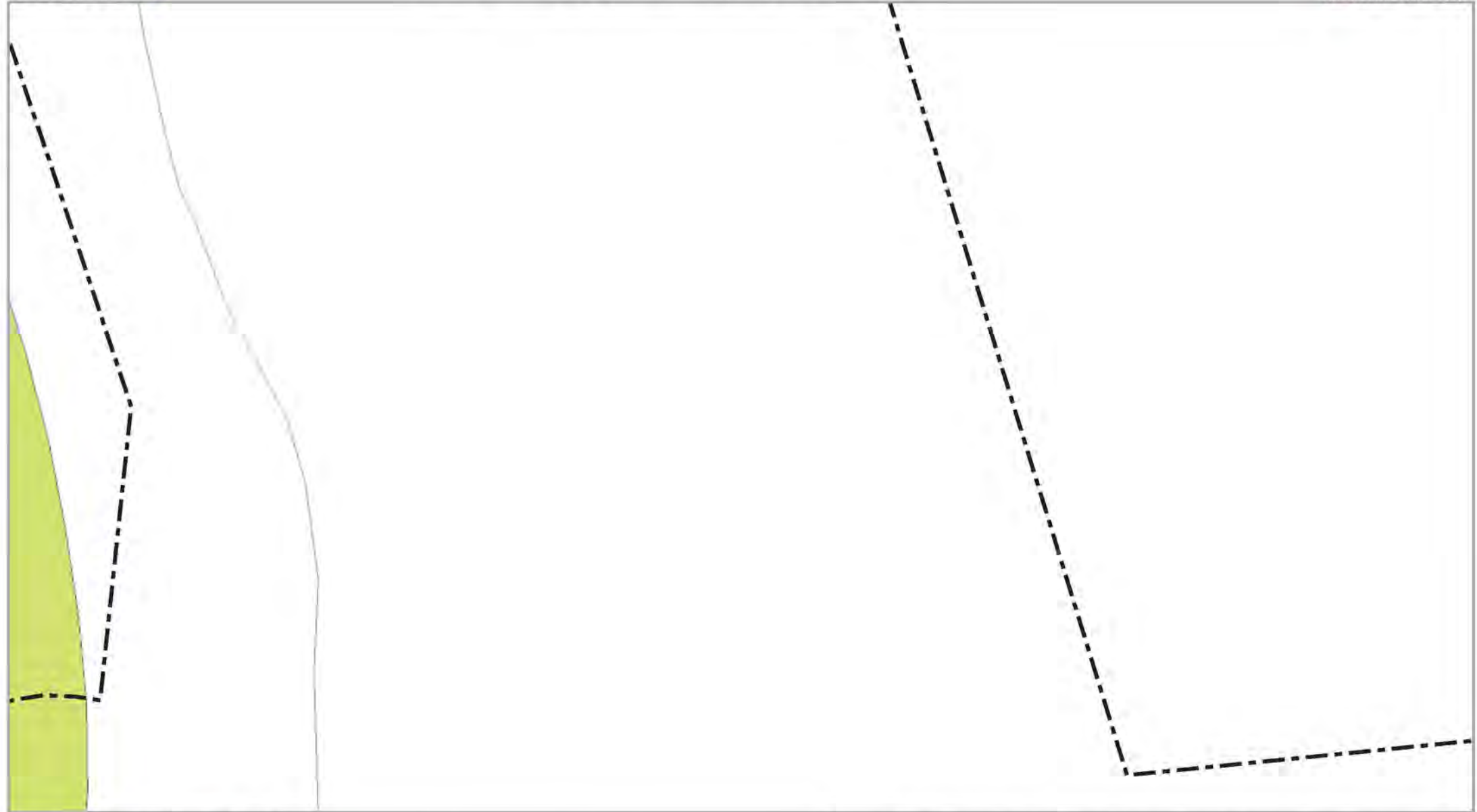
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Legend | Scale: 1:1000 | Tile No: 6

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|---|---|--|
|  Bus Stops |  Kerb and Gutter |  Cadastre |
|  Pits |  Footpaths and Cycleways |  Bridges |
|  Headwalls |  Pipes |  Environmentally Sensitive Land |

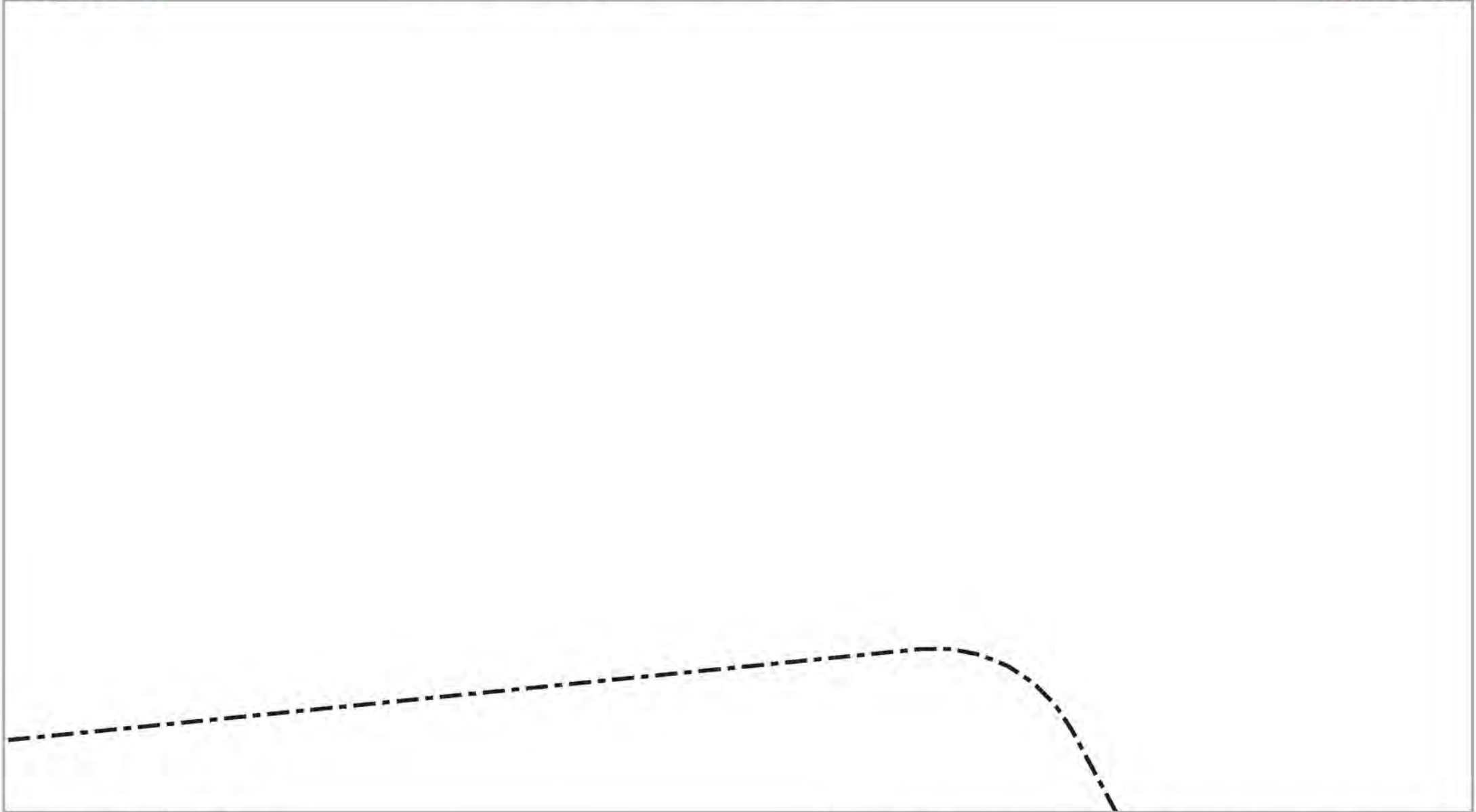
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Legend | Scale: 1:1000 | Tile No: 7

- | | | |
|---|---|--|
|  Bus Stops |  Kerb and Gutter |  Cadastre |
|  Pits |  Footpaths and Cycleways |  Bridges |
|  Headwalls |  Pipes |  Environmentally Sensitive Land |

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Legend | Scale: 1:1000 | Tile No: 8

- | | | |
|---|---|--|
|  Bus Stops |  Kerb and Gutter |  Cadastre |
|  Pits |  Footpaths and Cycleways |  Bridges |
|  Headwalls |  Pipes |  Environmentally Sensitive Land |

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Legend | Scale: 1:1000 | Tile No: 9

- | | | |
|-----------|-------------------------|--------------------------------|
| Bus Stops | Kerb and Gutter | Cadastre |
| Pits | Footpaths and Cycleways | Bridges |
| Headwalls | Pipes | Environmentally Sensitive Land |

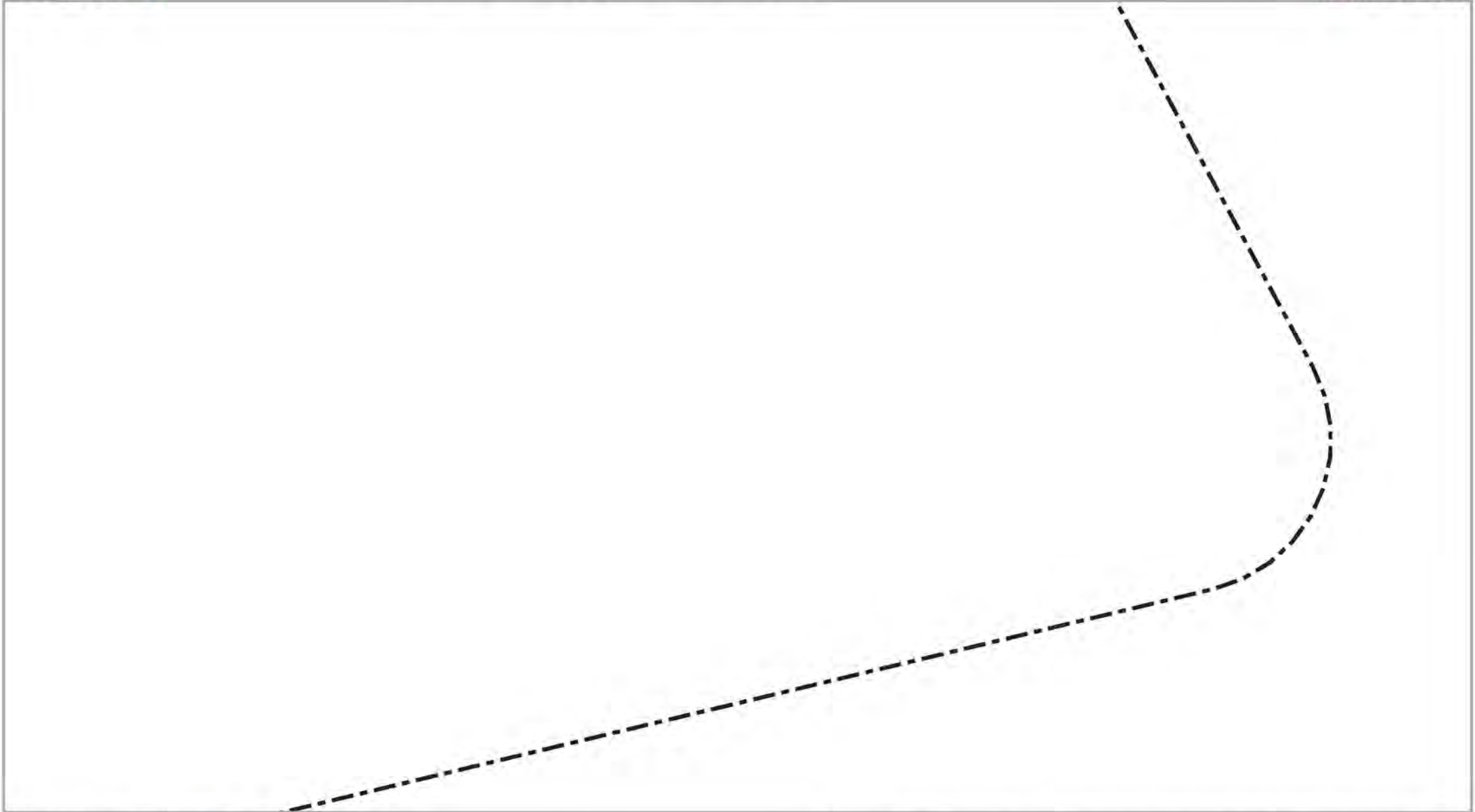
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Legend | Scale: 1:1000 | Tile No: 10

- | | | |
|---|---|--|
|  Bus Stops |  Kerb and Gutter |  Cadastral |
|  Pits |  Footpaths and Cycleways |  Bridges |
|  Headwalls |  Pipes |  Environmentally Sensitive Land |

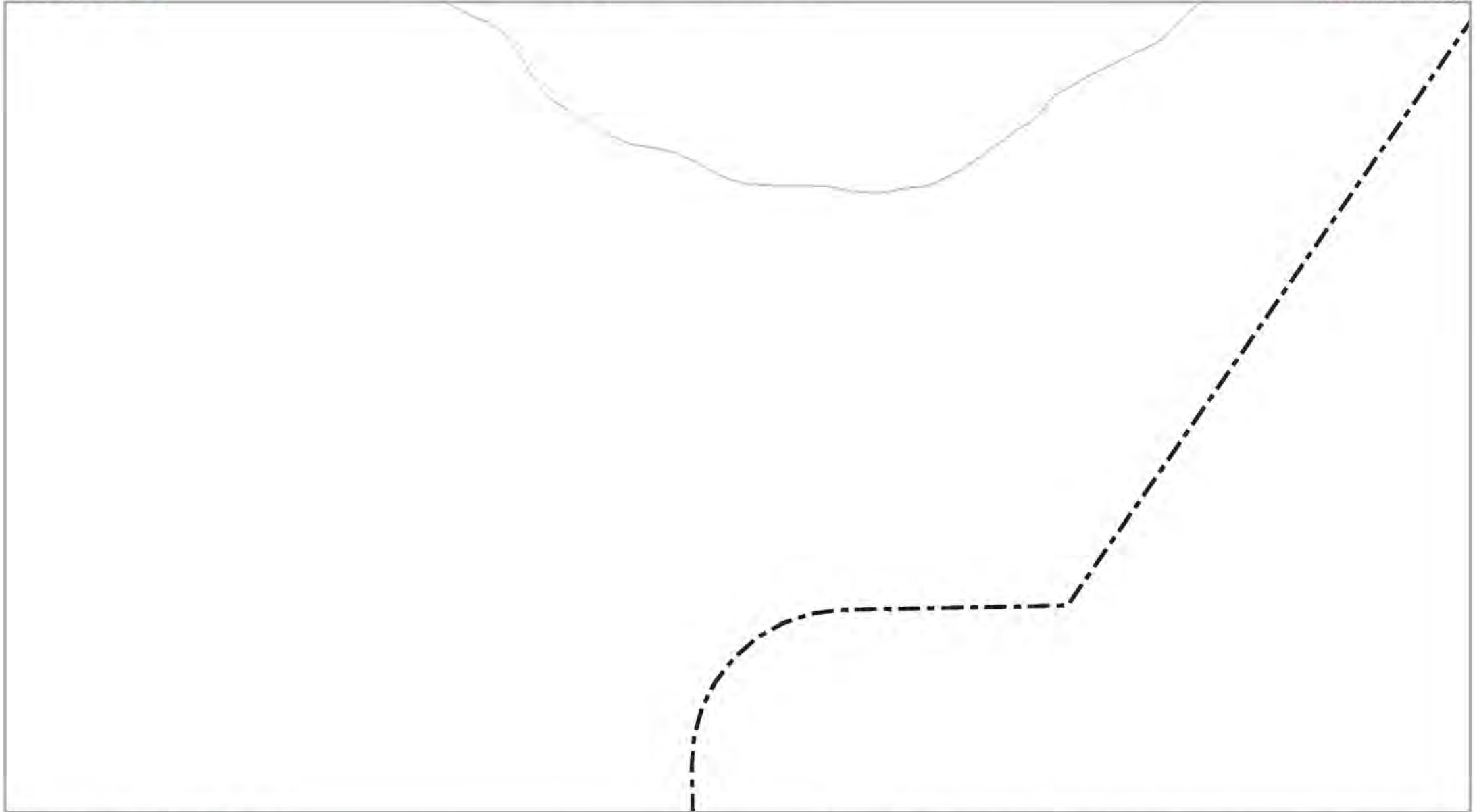
DISCLAIMER: While reasonable measures have been taken to ensure the accuracy of the information contained in this plan response, neither Liverpool City Council or PelicanCorp shall have any liability whatsoever in relation to any loss, damage, cost or expense arising from the use of this plan response or the information contained in it or the completeness or accuracy of such information. Use of such information is subject to and constitutes acceptance of these terms.












Legend | Scale: 1:1000 | Tile No: 11

- | | | |
|---|---|--|
|  Bus Stops |  Kerb and Gutter |  Cadastre |
|  Pits |  Footpaths and Cycleways |  Bridges |
|  Headwalls |  Pipes |  Environmentally Sensitive Land |

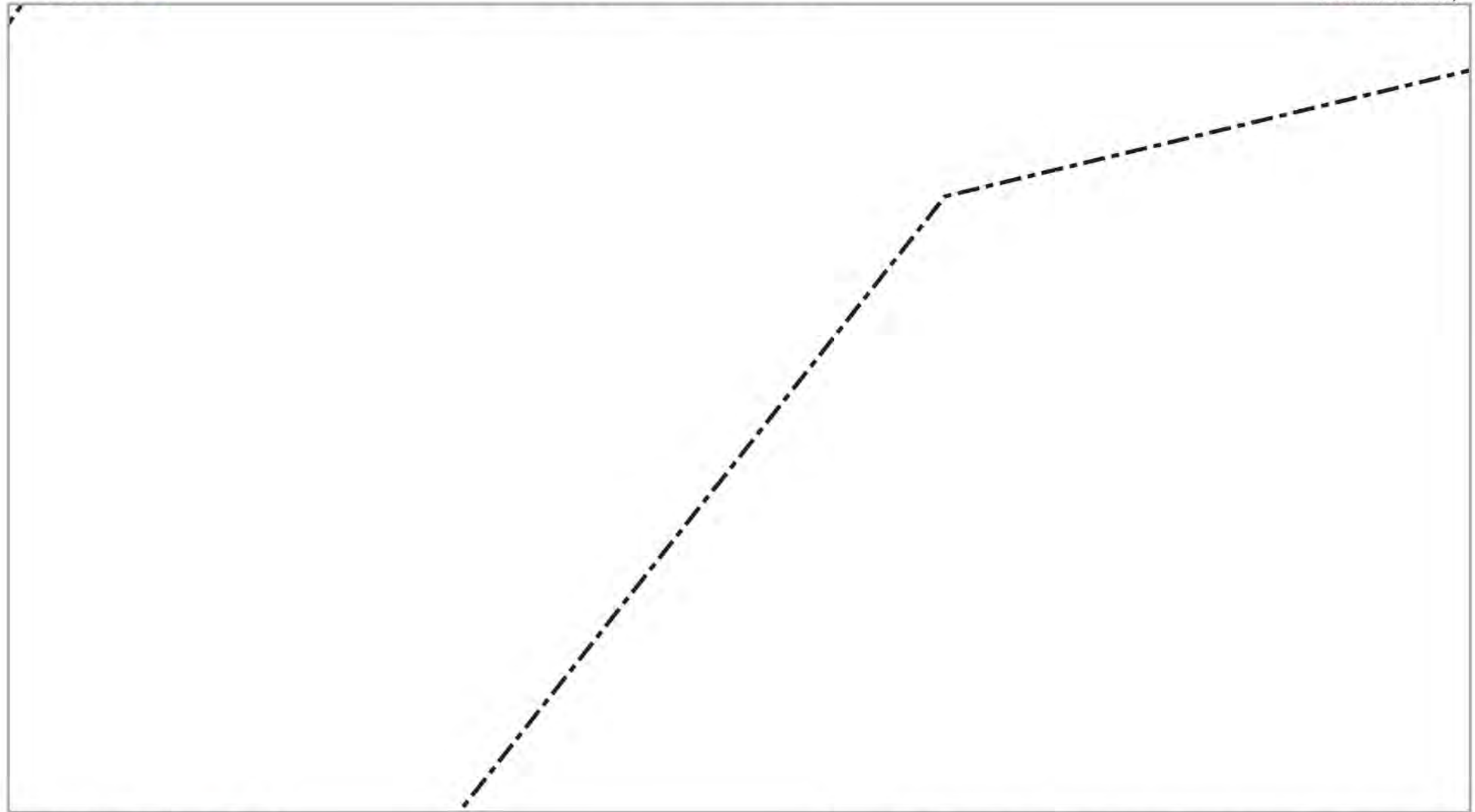
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Legend | Scale: 1:1000 | Tile No: 12

- | | | |
|---|---|--|
|  Bus Stops |  Kerb and Gutter |  Cadastre |
|  Pits |  Footpaths and Cycleways |  Bridges |
|  Headwalls |  Pipes |  Environmentally Sensitive Land |

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Legend | Scale: 1:1000 | Tile No: 13










- | | | |
|---|---|--|
|  Bus Stops |  Kerb and Gutter |  Cadastre |
|  Pits |  Footpaths and Cycleways |  Bridges |
|  Headwalls |  Pipes |  Environmentally Sensitive Land |

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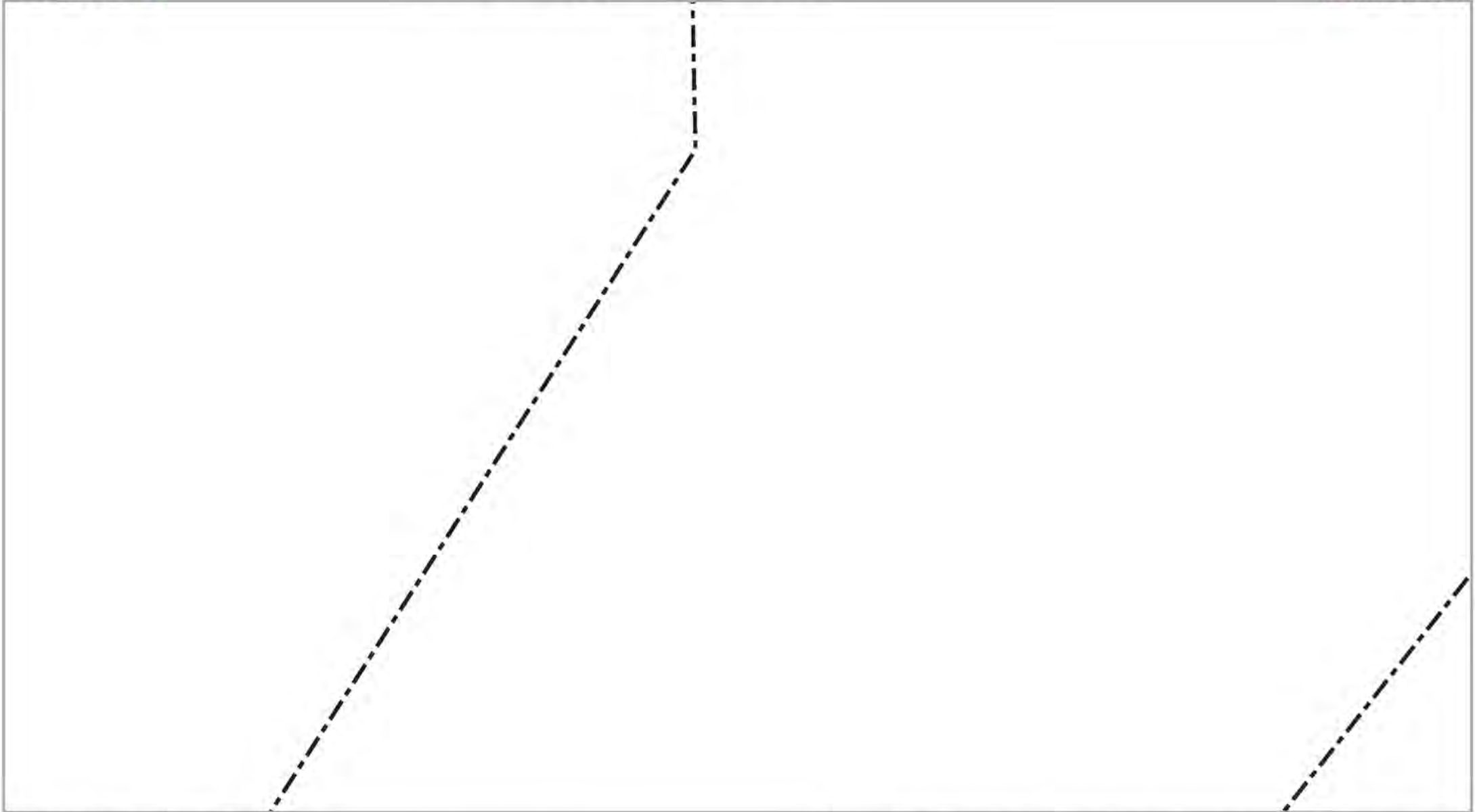


Legend | Scale: 1:1000 | Tile No: 14












- | | | |
|---|---|--|
|  Bus Stops |  Kerb and Gutter |  Cadastre |
|  Pits |  Footpaths and Cycleways |  Bridges |
|  Headwalls |  Pipes |  Environmentally Sensitive Land |

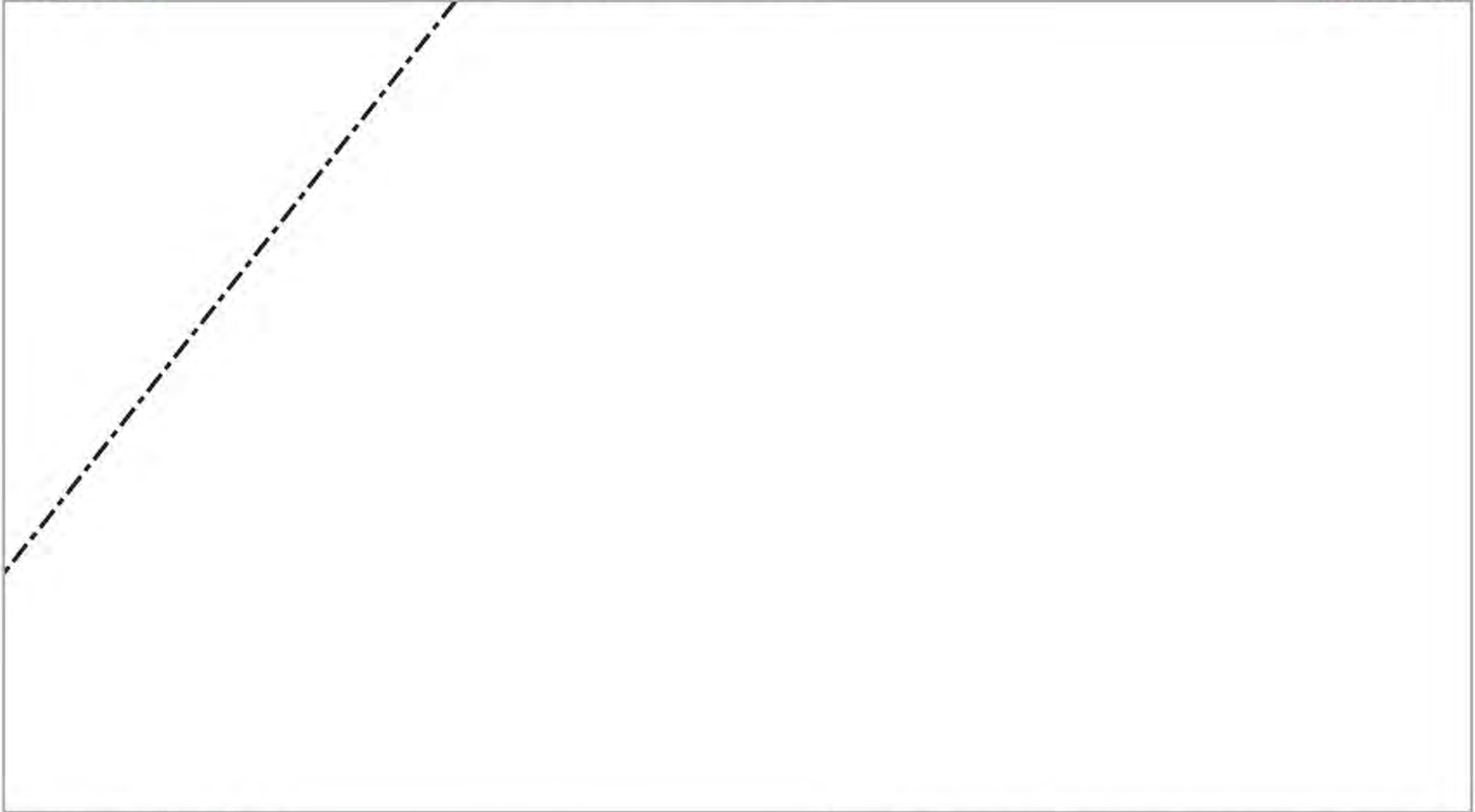
DISCLAIMER: While reasonable measures have been taken to ensure the accuracy of the information contained in this plan response, neither Liverpool City Council or PelicanCorp shall have any liability whatsoever in relation to any loss, damage, cost or expense arising from the use of this plan response or the information contained in it or the completeness or accuracy of such information. Use of such information is subject to and constitutes acceptance of these terms.












Legend | Scale: 1:1000 | Tile No: 15

- | | | |
|---|---|--|
|  Bus Stops |  Kerb and Gutter |  Cadastral |
|  Pits |  Footpaths and Cycleways |  Bridges |
|  Headwalls |  Pipes |  Environmentally Sensitive Land |

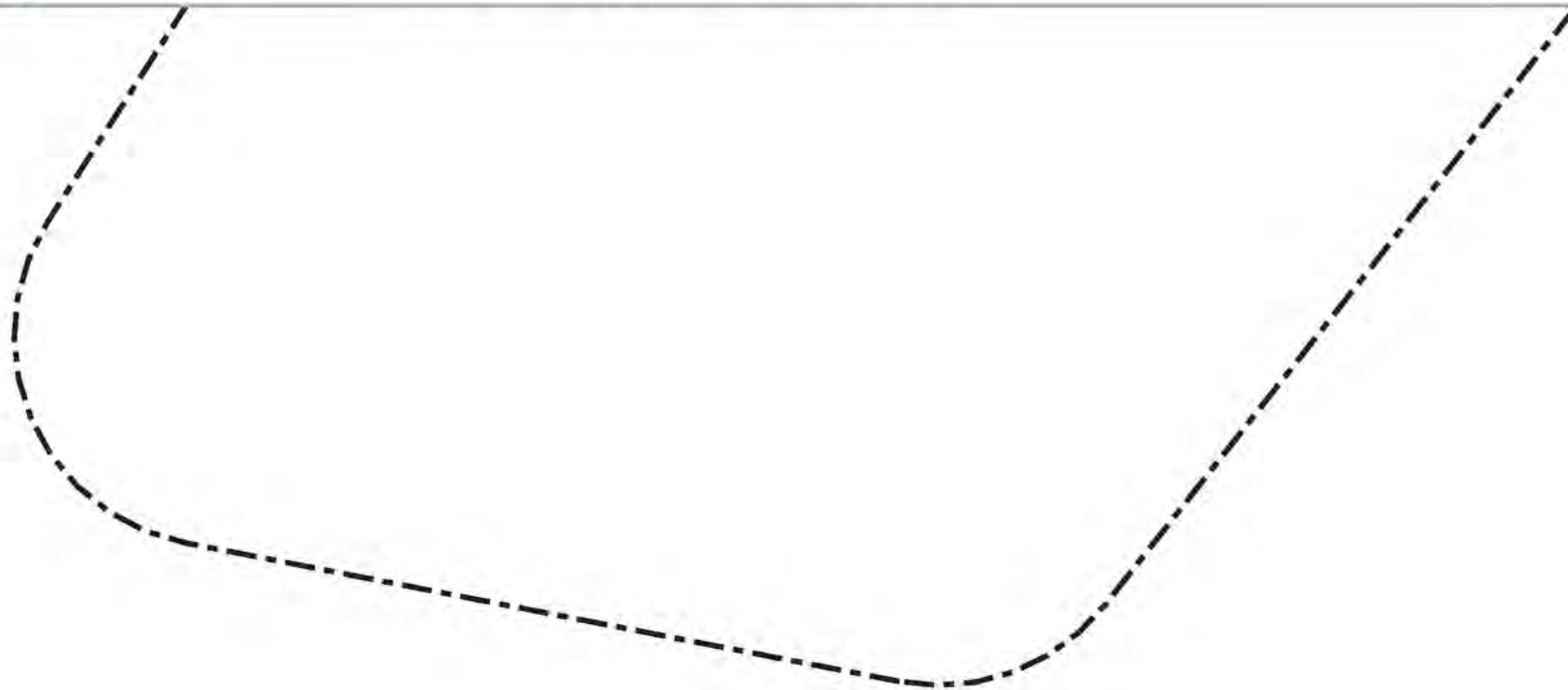
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Legend | Scale: 1:1000 | Tile No: 16

- | | | |
|---|---|--|
|  Bus Stops |  Kerb and Gutter |  Cadastre |
|  Pits |  Footpaths and Cycleways |  Bridges |
|  Headwalls |  Pipes |  Environmentally Sensitive Land |

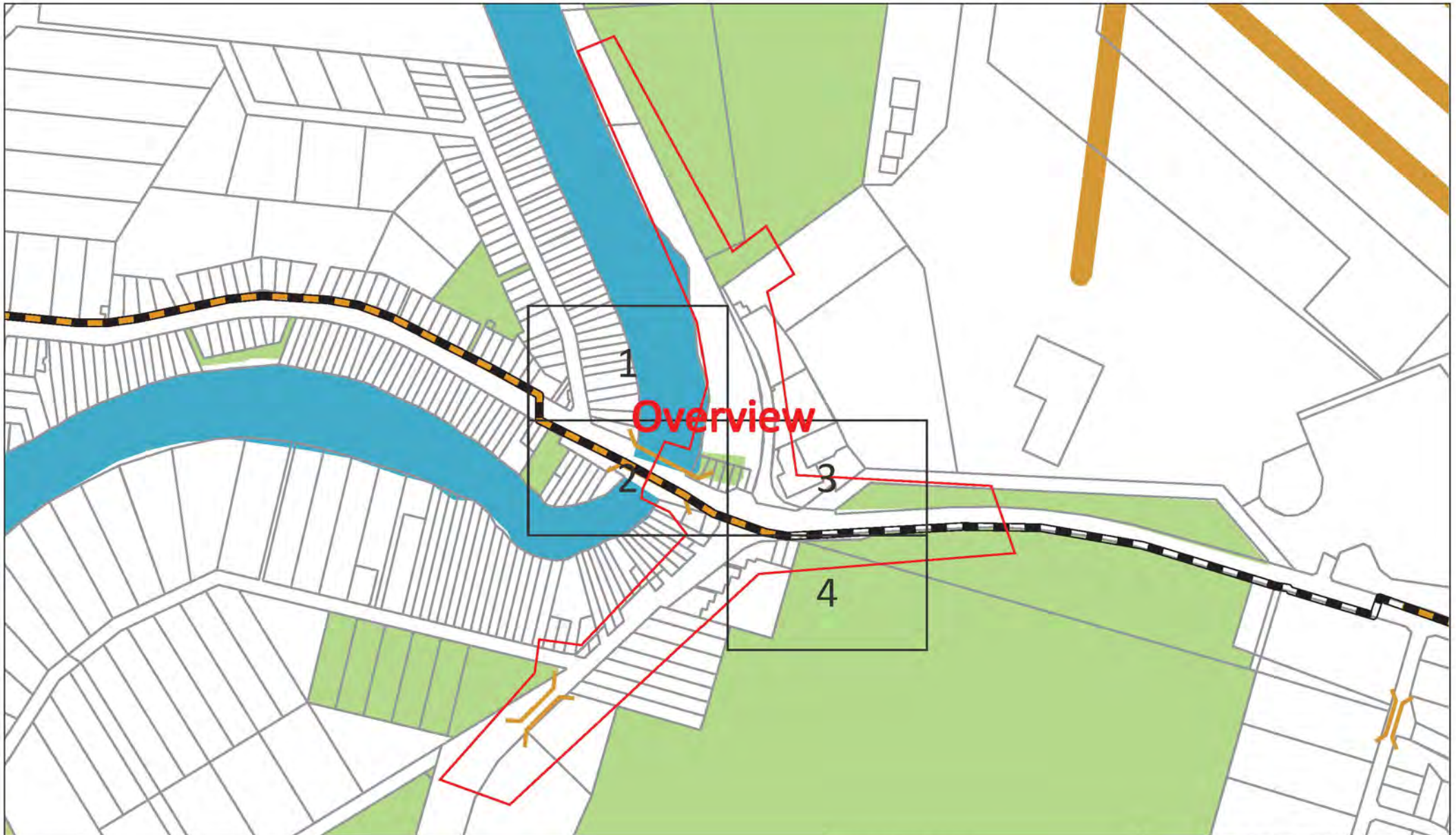
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Legend | Scale: 1:1000 | Tile No: 17

- | | | |
|---|---|--|
|  Bus Stops |  Kerb and Gutter |  Cadastre |
|  Pits |  Footpaths and Cycleways |  Bridges |
|  Headwalls |  Pipes |  Environmentally Sensitive Land |

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Sequence Number: 102165060

Date: 24/09/2020

DISCLAIMER: THIS DRAWING SHOULD NOT BE SCALED TO LOCATE CABLES. NO WARRANTY IS GIVEN THAT THE INFORMATION IS ACCURATE OR COMPLETE. IF YOU REQUIRE INFORMATION REGARDING LOCATING THE CABLE PLEASE CALL NEXTGEN. THIS DOCUMENT HAS BEEN PREPARED SOLELY FOR DIAL BEFORE YOU DIG USE. THIS PLAN CONTAINS COMMERCIAL SENSITIVE INFORMATION AND IS TO BE TREATED ACCORDINGLY. NO SUCH INFORMATION IS TO BE PASSED ONTO OTHER PARTIES WITHOUT WRITTEN CONSENT FROM NEXTGEN PTY LTD.



LEGEND

Digsite



Area

Assets



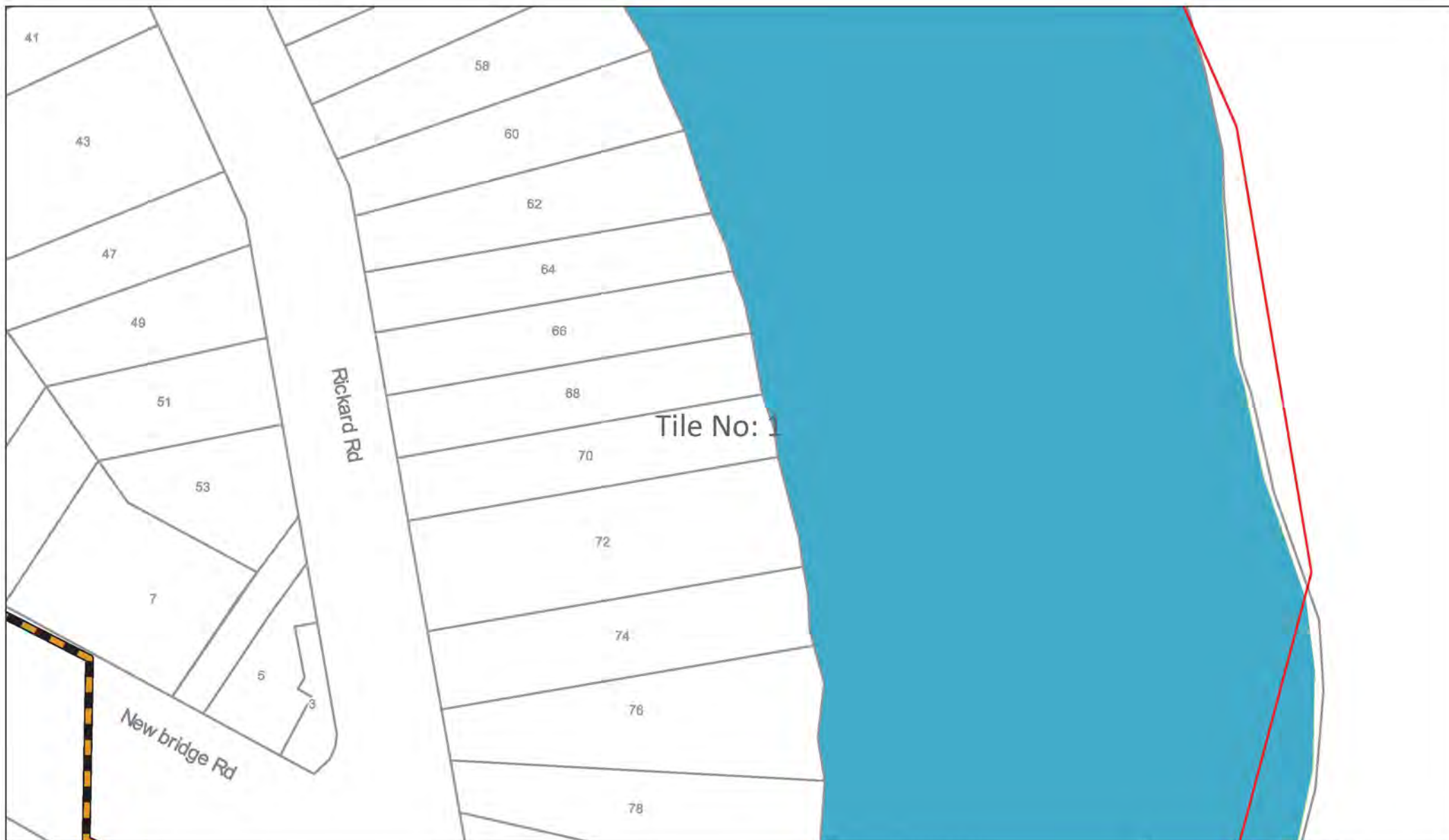
Cable



3rd Party Duct



Marker Post



Sequence Number: 102165060

Date: 24/09/2020

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LEGEND

Digsite



Area

Assets



Cable



3rd Party Duct



Marker Post



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LEGEND

Digsite



Area

Assets



Cable



3rd Party Duct



Marker Post



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LEGEND

Digsite



Area

Assets



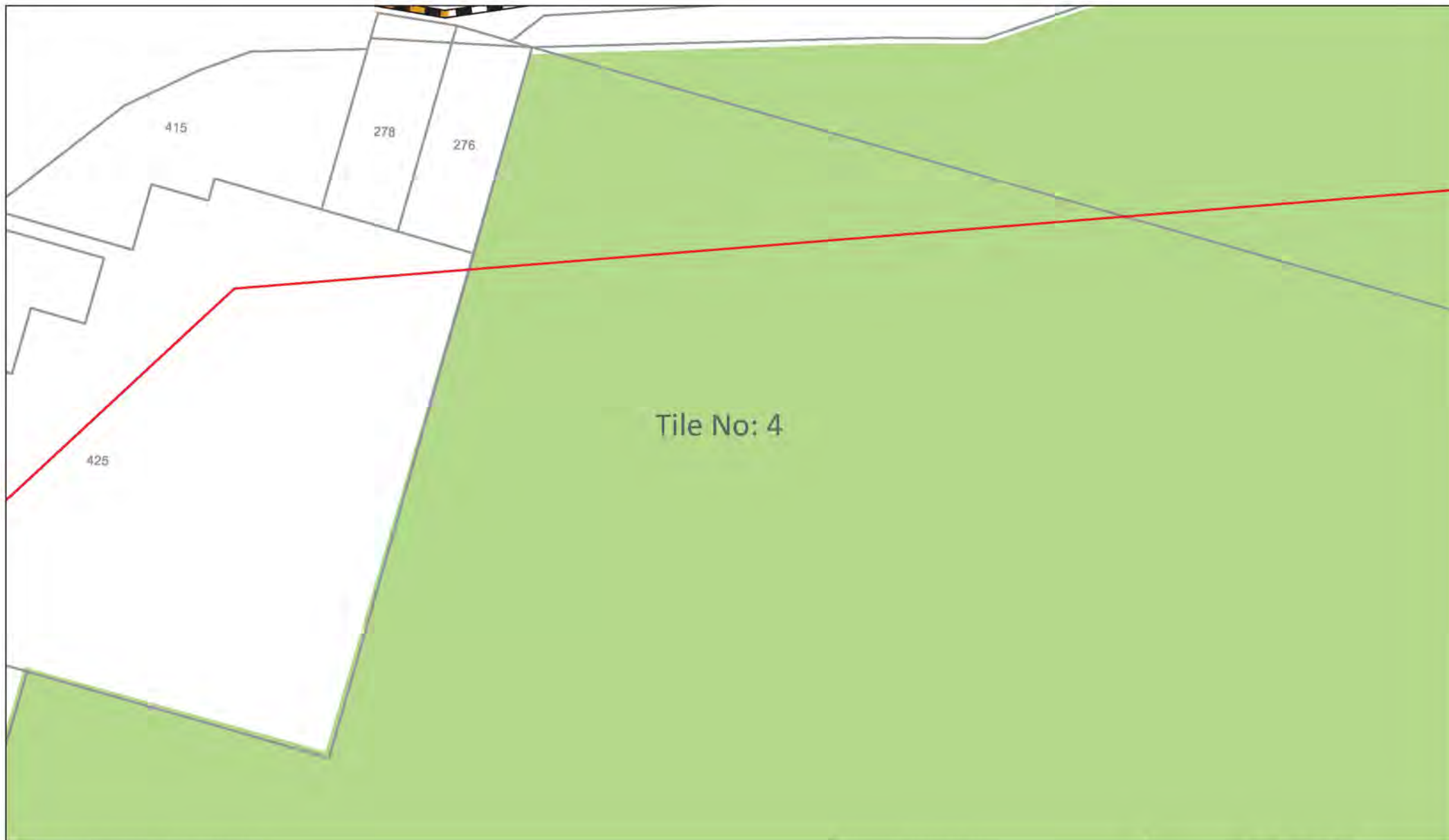
Cable



3rd Party Duct



Marker Post



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LEGEND

Digsite



Area

Assets



Cable



3rd Party Duct



Marker Post

Plant Location Details



24/09/2020

Mr Raghav Rana
Aurecon
552 Boronia Road
Wantirna VIC 3152
Phone: 0401448946
Fax: Not Supplied

Nextgen Networks Pty Ltd
Level 6, 333 Collins Street
Melbourne VIC 3000
T 1800 032 532
E Damage.Relocations@vocus.com.au

Dear Mr Raghav Rana

The following is a response to your Dial Before You Dig enquiry

Assets Affected: Nextgen Assets

Sequence No: 102165060

Location: Henry Lawson Drive, Milperra NSW 2214

IMPORTANT:

- Please read and understand all the information and disclaimers provided below
- Sketches and Plans provided by Nextgen Networks are circuit diagrams only and indicate the presence of telecommunications plant in the general vicinity of the geographical area shown; exact ground cover and alignments cannot be given with any certainty and cover may alter over time. Telecommunications plant seldom follow straight lines and careful on site investigation is essential to uncover and reveal its exact position
- The accuracy and/or completeness of the information in the plans can not be guaranteed often due to changes in the surrounding land subsequent to Nextgen's deployment and, accordingly the plans are intended to be indicative only

"DUTY OF CARE"

When working in the vicinity of telecommunications plant you have a legal "Duty of Care" that must be observed. The following points must be considered:

1. It is the responsibility of the owner and any consultant engaged by the owner, including an architect, consulting engineer, developer, and head contractor to design for minimal impact and protection of Nextgen Networks plant. Nextgen Networks will provide free plans and sketches showing the presence of its network to assist at this design stage.
2. It is the owner's (or constructor's) responsibility to:
 - a) Request plans of Nextgen Networks plant for a particular location at a reasonable time before construction begins
 - b) Visually locate Nextgen Networks plant by vacuum excavation (pot-holing) where construction activities may damage or interfere with Nextgen Networks plant (see "Essential Precautions and Approach Distances" section for more information)
 - c) Contact Nextgen Networks Network (see below for details) if Nextgen Networks plant is wholly or partly located near planned construction activities

DAMAGE

ANY DAMAGE TO Nextgen Networks NETWORK MUST BE REPORTED TO 1800 032 532 IMMEDIATELY

- The owner is responsible for all plant damage when works commence prior to obtaining Nextgen Networks plans, or failure to follow agreed instructions
- Nextgen Networks reserves all rights to recover compensation for loss or damage to its cable network or other property including consequential losses

CONCERNING NEXTGEN NETWORK PLANS

- Phone 1100. Dial Before You Dig for free plans of Nextgen Networks plant locations. Please give at least 2 business days notice
- Nextgen Networks plans and information provided are valid for 30 days from the date of issue
- Nextgen Networks retains copyright in all plans and details provided in conjunction with your request. These plans and or details should be disposed of by shredding or any other secure disposal method after use
- Nextgen Networks plans or other details are provided for the use of the applicant, its servants, or agents, and shall not be used for any unauthorised purpose
- Please contact the Network Help Desk (see below for details) immediately should you locate Nextgen Networks assets not indicated on these plans
- Nextgen Networks, its servants or agents shall not be liable for any loss or damage caused or occasioned by the use of plans and or details so supplied to the applicant, its servants and agents, and the applicant agrees to indemnify Nextgen Networks against any claim or demand for any such loss or damage
- Please ensure Nextgen Networks plans and information provided remains on-site at all times throughout your construction phase

ESSENTIAL PRECAUTION AND APPROACH DISTANCE

NOTE: If the following clearances cannot be maintained, please contact the Nextgen Network Help Desk (see below for details) for advice on how best to resolve this situation

1. On receipt of plans and sketches and before commencing excavation work or similar activities near Nextgen Networks plant, carefully locate this plant first to avoid damage. Undertake prior exposure (vacuum excavation) such as potholing when intending to excavate or work closer to Nextgen Networks plant than the following approach distances:
 - Where Nextgen Networks plant is in an area where road and footpaths are well defined by kerbs or other features a minimum clear distance of 600mm must be maintained from where it could be reasonably presumed that plant would reside
 - In non established or unformed reserves and terrain, this approach distance must be at least 1.5 metres
 - In country/rural areas which may have wider variations in reasonably presumed plant presence, the following minimum approach distances apply:
 - d) Parallel to major plant: 10 metres (for optic fibre cable)
 - e) Parallel to other plant: 5 metres

Note: Even pot-holing needs to be undertaken with extreme care, common sense and employing techniques least likely to damage cables. For example - vacuum excavation.

- If construction work is parallel to Nextgen Networks plant, then careful pot-holing at least every 5m is required to establish the location of all plant, hence continuing nominal locations before work can commence
2. Maintain the following minimum clearance between construction activity and actual location of Nextgen Networks Plant.

| | |
|--|---|
| Jackhammers/Pneumatic Breakers | <i>Not within 1.0m of actual locations</i> |
| Vibrating Plate or Wackers Packer Compactors | <i>Not within 0.5m of Nextgen Networks ducts 300mm compact clearance cover before compactor can be used across Nextgen Networks ducts, and 600mm clearance across Nextgen Networks cables in the solid</i> |
| Boring Equipment (in-line, horizontal and vertical) | <i>Not within 2.0m of actual location Constructor to check depth via vacuum excavation (pot-hole)</i> |
| Heavy Vehicle Traffic (over 3 tonnes) | <i>Not to be driven across Nextgen Networks ducts with less than 600mm cover. Not to be driven across Nextgen Networks fibre with less than 1.2m cover Constructor to vacuum excavate (pot-hole) and expose plant</i> |
| Mechanical Excavators, Boring and Tree Removal | <i>Not within 1.0m of actual location Constructor to vacuum excavate (pot-hole) and expose plant</i> |

- All Nextgen Networks pits and manholes should be a minimum of 1.2m in from the back of kerb after the completion of your work
- All Nextgen Networks conduit should have the following minimum depth of cover after the completion of your work:

Footway 450mm

Roadway 450mm at drain invert and 600mm below the pavement subgrade level invert

- All Nextgen Networks fibre in the solid should have the following minimum depth of cover after the completion of your work:

Footway 600mm

Roadway 1200mm at drain invert and 1200mm below the pavement subgrade level invert

- For clearance distances relating to Nextgen Networks above ground infrastructure please contact the Network Help Desk (see below for details)

FURTHER ASSISTANCE

Over-the-phone assistance can be obtained by calling the Network Help Desk below.

Nextgen require 5 clear business days notice to conduct an on-site location. The initial on site location visit will not normally incur a charge, but at the discretion of Nextgen subsequent site visits may incur a charge to be applied at an hourly rate.

Where an on-site location is provided, the owner is responsible for all vacuum excavation work (pot-holing) to visually locate and expose Nextgen Networks plant.

If plant location plans or visual location of Nextgen Networks plant by vacuum excavation reveals that the location of Nextgen Networks plan is situated wholly or partly where the owner plans to work, then **Nextgen Networks** must be contacted through the **Network Help Desk** to discuss possible engineering solutions.

The contact number for the **Network Help Desk** is 1800 032 532.

NOTE:

If Nextgen Networks relocation or protection works are part of the agreed solution, then payment to Nextgen Networks for the cost of this work shall be the responsibility of the principal developer. The principal developer will be required to provide Nextgen Networks with the details of their proposed work showing how Nextgen Networks plant is to be accommodated and these details must be approved by the Nextgen National Operations Manager prior to the commencement of site works.

RURAL LANDOWNER - IMPORTANT INFORMATION

Where Nextgen Networks owned cable crosses agricultural land Nextgen Networks will provide a one off free-on-site electronic cable location. Please note that the exact location of cables can only be verified by visual proving by pot holing, which is not covered by this service. The Network Integrity HelpDesk Officer will provide assistance in determining whether a free-on-site location is required. Please ring the Nextgen Network Help Desk as listed above.

PRIVACY NOTE

Your information has been provided to Nextgen Networks by DBYD to enable Nextgen Networks to respond to your DBYD request. Nextgen Networks keeps your information in accordance with its privacy statement entitled 'Protecting Your Privacy' which can be obtained from Nextgen Networks either by calling 1800 032 532 or visiting our website www.nextgengroup.com.au

Warning: Nextgen Networks plans show only the presence of cables and plant. They only show their position relative to road boundaries, property fences etc, at the time of installation and Nextgen Networks does not warrant or hold out that such plans are accurate thereafter due to changes that may occur over time.

DO NOT ASSUME DEPTH OR ALIGNMENT of cables or plant as these vary significantly.

The customer has A DUTY OF CARE when excavating near Nextgen Networks cables and plant. Before using machine excavators NEXTGEN PLANT MUST FIRST BE PHYSICALLY EXPOSED BY VACUUM EXCAVATION (potholing) to identify its location.

Nextgen Networks will seek compensation for damages caused to its property and losses caused to Nextgen Networks and its customers.

EXPERIENCED PLANT LOCATORS (for your area)

On-site assistance should be sought from an Experienced Plant Locator if the telecommunications plant cannot be located within 2.5 metres of the locations indicated on the drawings provided. On-site advice should be obtained from a suitably qualified contractor highly skilled in locating Nextgen Networks plant. If there is any doubt whatsoever about the actual location of the telecommunications plant, the best method for locating the telecommunications plant or the correct interpretation of the drawings provided. In the case where Nextgen Networks plant is outside a recognised road reserve Nextgen Networks recommends that the **Network Help Desk** is contacted for assistance prior to engaging an Experienced Plant Locator.

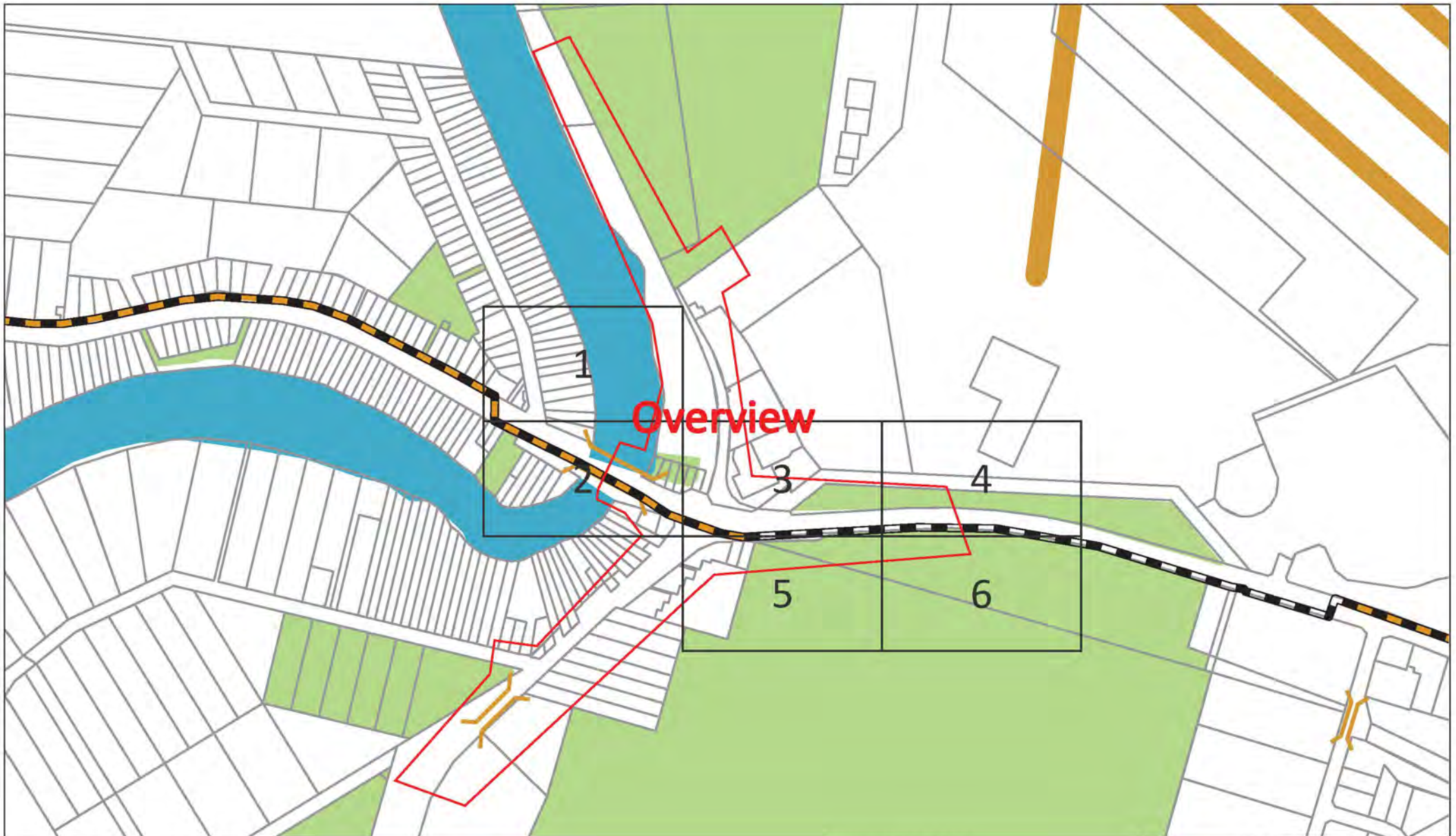
For the assistance of customers Nextgen Networks has established strict criteria to assess the skill of contractors that may be engaged by owners requiring Nextgen Networks plant locating services to perform any of the following activities if requested to do so by the owner:

- Review Nextgen Networks plans to assess the approximate location of Nextgen Networks plant
- Advise owners of the approximate location of Nextgen Networks plant according to the plans
- Advise the owners of the best method for locating Nextgen Networks plant
- Advise owners of the hazard of unqualified persons attempting to find the exact location of Nextgen Networks plant and working in the vicinity of Nextgen Networks plant without first locating its exact position
- Perform trial hole explorations by vacuum excavation (pot-holing) to expose Nextgen Networks plant with a high degree of skill, competence and efficiency and utilising all necessary safety equipment

Nextgen Networks does not accept any liability or responsibility for the performance of or advice given by any Plant Locator engaged by you but we will, if requested, recommend suitably qualified plant locators.

GENERAL DISCLAIMER

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Sequence Number: 102165060

Date: 24/09/2020

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LEGEND

Digsite



Area

Assets



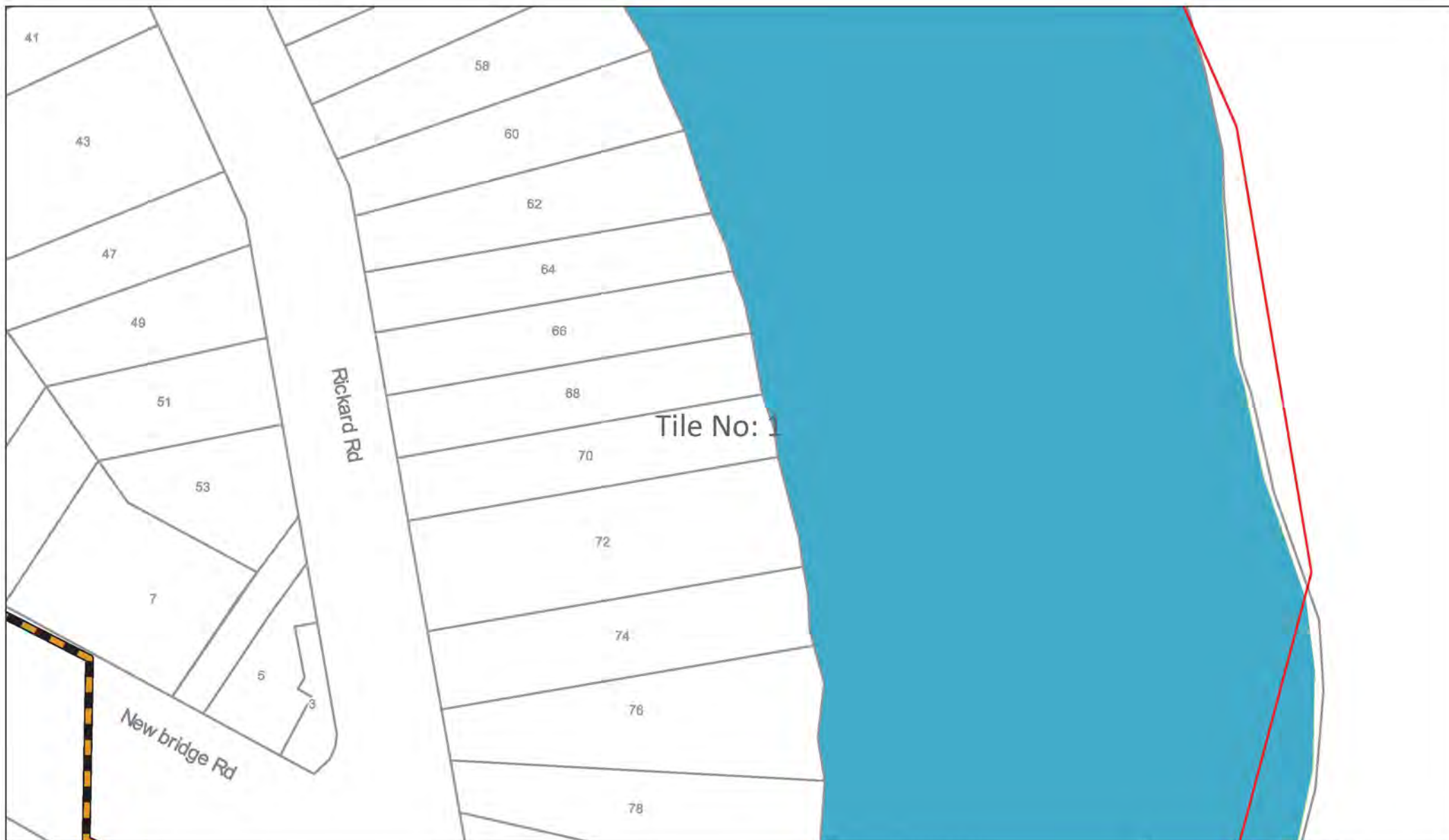
Cable



3rd Party Duct



Marker Post



Sequence Number: 102165060

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LEGEND

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LEGEND

Digsite



Area

Assets



Cable



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LEGEND

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Area

Assets



Cable



3rd Party Duct



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LEGEND

Digsite



Area

Assets



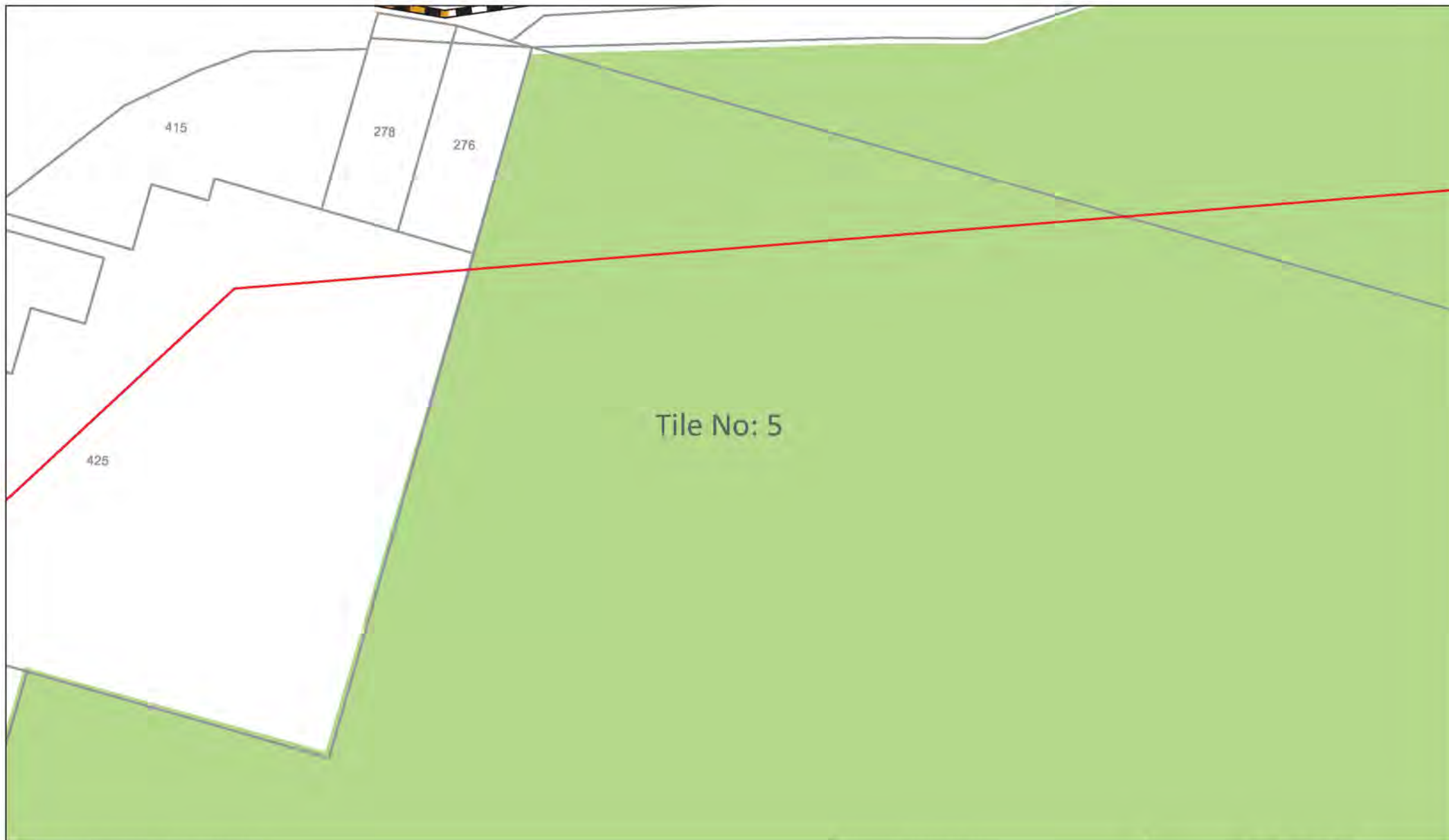
Cable



3rd Party Duct



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LEGEND

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Area

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LEGEND

Digsite



Area

Assets



Cable



3rd Party Duct



Marker Post



Date: 24/09/2020

Enquirer Name: Mr Raghav Rana
Enquirer Address: 552 Boronia Road
Email: raghav.rana@aurecongroup.com
Phone: 0401448946

Dear Mr Raghav Rana

The following is our response on behalf of each of the TPG carriers (listed below) to your Dial Before You Dig enquiry – Sequence 102165061. It is provided to you on a confidential basis under the following conditions and must be shredded or securely disposed of after use.

Assets Affected:

Carriers (each a "TPG carrier") and assets affected:

NONE

Location: Henry Lawson Drive

According to our records, the underground assets in the vicinity of the location stated in your enquiry are **NOT AFFECTED**. Please read the below information and disclaimers in addition to the any attached plans provided prior to any construction activities.

IMPORTANT INFORMATION

- The information provided is valid for 30 days from the date of this response. If your work site area changes or your construction activity is beyond 30 days please contact Dial Before You Dig on 1100 or www.1100.com.au to re-submit a new enquiry.
- Due to the nature of underground assets and the age of some assets and records, our plans are indicative of the general location only and may not show all assets in the location. You should not solely rely on these plans when undertaking construction works. It is also inaccurate to assume depth or that underground network conduit and cables follow straight lines, and careful on-site investigations are essential to locate an asset's exact position prior to excavation. It is your responsibility to locate and confirm the exact location of our infrastructure using non-destructive techniques. We make no warranty or guarantee that our plans are complete, current or error free, and to the maximum extent permitted by law we exclude all liability to you, your employees, agents and contractors for any loss, damage or claim arising out of or in connection with using our plans.
- Please note that some of our conduits carry electrical cables and gas pipes. Please exercise extreme care when working within the vicinity of these conduit and take into account the minimum clearance distances under Duty Of Care below.
- You (and your employee and contractors) must not open, move, interfere, alter or relocate any of our assets without our prior approval.
- **Note** It is a criminal offence under the *Criminal Code Act 1995 (Cth)* to tamper or interfere with communication facilities owned by a carrier. Heavy penalties may apply for breach of this prohibition, and any damages suffered, or costs incurred by us as a result of such unauthorised works may be claimed against you.

DAMAGE

- You must report immediately any damage to our network on **1800 786 306** (24hrs). We will hold you liable and seek compensation for any loss or damage to our network, our property and our customers that is caused by or arises out of your activities.

DUTY OF CARE

You have a duty of care to carefully locate, validate and protect our assets when carrying out works near our infrastructure. For construction activities that may impact on or interfere with our network, you will need to call us on **1800 786 306** to discuss a suitable engineering solution, lead time and cost involved. The below precautions must be taken when working in the vicinity of our network:

- Contact us on **1800 786 306** to discuss and obtain relevant information and plans on our infrastructure in a particular location if the information provided in this response is insufficient.
- Physically locate and mark on-site our network infrastructure using non-destructive techniques i.e. pot holing or hand digging every 5 metres prior to commencing any construction activities. Assets located must be marked to AS5488 standard. **NO CONSTRUCTION WORK IS ALLOWED UNTIL THIS STEP IS COMPLETED.** You must use an approved telecommunications accredited locator, or we can provide a locator for you at your expense. If we provide you with a locator, and this locator attended the site and is proven to be grossly negligent in physically locating and marking our infrastructure, then to the extent any TPG carrier is liable for this locator's negligence, acts and omissions, the total liability aggregated for all TPG carriers is limited, at our option, to attend the site and re-mark the infrastructure or to pay for a third party to re-mark the infrastructure.
- If you require us to locate or monitor our infrastructure, please allow five business days' notice for us to respond.
- Ensure all information, including our network requirements and any associated plans provided by us are kept confidential and remain on-site throughout your construction works.

- Use suitably qualified and supervised professionals, particularly if you are working near assets that contain electricity cables or gas pipes.
- Ensure the below minimum clearance distances between the construction activities and the actual location of our assets are met. If you need clearance distances for our above ground assets, or if the below distances cannot be met, call **1800 786 306** to discuss.

Minimum assets clearance distances.

- 300mm when laying asset inline, horizontal or vertical.
 - 1000mm when operating vibrating equipment. Eg: vibrating plates. No vibrating equipment on top of asset.
 - 1000mm when operating mechanical excavators or jackhammers/pneumatic breakers.
 - 2000mm when performing directional bore in-line, horizontal and vertical.
 - No heavy vehicle over 3 tonnes to be driven over asset with less than 600mm of cover.
- Reinstate exposed TPG network infrastructure back to original state.

PRIVACY & CONFIDENTIALITY

- Privacy Notice – Your information has been provided to us by Dial Before You Dig to respond to your Dial Before You Dig enquiry. We will keep your personal information in accordance with TPG's privacy policy, see www.tpg.com.au/about/privacy.
- Confidentiality – The information we have provided to you is confidential and is to be used only for planning and designing purposes in connection with your Dial Before You Dig enquiry. Please dispose of the information by shredding or other secure disposal method after use. We retain all intellectual property rights (including copyrights) in all our documents and plans.



TransACT



Adam Internet
Connecting SA



iiinet



AAPT

TPG Corporation Limited

DBYD Underground Search Report

Date: 24/09/2020

DBYD Sequence No: 102165062

DBYD Job No: 20310876

ENDEAVOUR ENERGY ASSETS NOT AFFECTED

| | | | |
|-------------------|--|----------|------------------------------|
| To: | Mr Raghav Rana | Company: | Aurecon |
| Address: | 552 Boronia Road, Wantirna, VIC 3152 | | |
| Cust. ID: | 2235321 | Email: | raghav.rana@aurecongroup.com |
| Phone: | 0401448946 | Mobile: | Not Supplied |
| | | Fax: | Not Supplied |
| Enquiry Location: | Henry Lawson Drive, Milperra, NSW 2214 | | |

Our Search has shown that **NO UNDERGROUND ASSETS ARE PRESENT** on our plans within the nominated enquiry location. However all persons planning excavation shall read and understand the warnings below. This search is based on the graphical position of the excavation site as denoted in the DBYD customer confirmation sheet.

WARNING

- **All electrical apparatus shall be regarded as live until proved de-energised.** Contact with live electrical apparatus will cause severe injury or death.
- In accordance with the *Electricity Supply Act 1995*, you are obliged to report any damage to Endeavour Energy Assets immediately by calling **131 003**.
- The customer must obtain a new set of plans from Endeavour Energy if work has not been started or completed within twenty **(20)** working days of the original plan issue date.
- The customer must contact Endeavour Energy if any of the plans provided have blank pages, as some underground asset information may be incomplete.
- Endeavour Energy underground earth grids may exist and their location **may not** be shown on plans. Persons excavating are expected to exercise all due care, especially in the vicinity of padmount substations, pole mounted substations, pole mounted switches, transmission poles and towers.
- Endeavour Energy plans **do not** show any underground customer service mains or information relating to service mains within private property.
- Asbestos or asbestos-containing material may be present on or near Endeavour Energy's underground assets.
- Organo-Chloride Pesticides (OCP) may be present in some sub-transmission trenches.
- All plans must be printed and made available at the worksite where excavation is to be undertaken. Plans must be reviewed and understood by the crew on site prior to commencing excavation.

SUPPLEMENTARY MATERIAL

| Material | Purpose | Location |
|--|--|-----------------------------------|
| DBYD Cover Letter | Endeavour Energy DBYD response Cover Letter | Attached |
| DBYD Important Information & Disclaimer | Endeavour Energy disclaimer, responsibilities and information on understanding plans | Attached |
| DBYD Response Plans | Endeavour Energy DBYD plans | Attached |
| Work Cover NSW "Work near underground assets: Guide" | Guideline for anyone involved in construction work near underground assets | Contact Work Cover NSW for a copy |
| Work Cover NSW "Excavation work: Code of practice" | Practical guidance on managing health and safety risks associated with excavation | URL [Click Here] |
| Safe Work Australia "Working in the vicinity of overhead and underground electric lines guidance material" | Provides information on how to manage risks when working in the vicinity of overhead and underground electric lines at a workplace | URL [Click Here] |
| Endeavour Energy Safety Brochures & Guides | To raise awareness of dangers of working on or near Endeavour Energy's assets | URL [Click Here] |

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- Depth of underground assets may vary significantly from information provided on plans as a result of changes to road, footpath or surface levels subsequent to installation.
- Such plans have been prepared solely for use by Endeavour Energy staff for design, construction and maintenance purposes.
- All enquiry details and results are kept in a register.

DISCLAIMER

Whilst Endeavour Energy has taken all reasonable steps to ensure that the information contained in the plans is as accurate as possible it will accept no liability for inaccuracies in the information shown on such plans.

LEGEND

- or ■ Street light column
- ▤ Padmount substation
- or ■ Overground pillar (O.G.Box)
- ▤ Underground pit
- Duct run
- Cable run
- ⊙ Typical duct section
- ▲ Asbestos warning



NOT TO SCALE

| | |
|--------------------|------------|
| DBYD Sequence No.: | 102165062 |
| Issued Date: | 24/09/2020 |

Overview

WARNING

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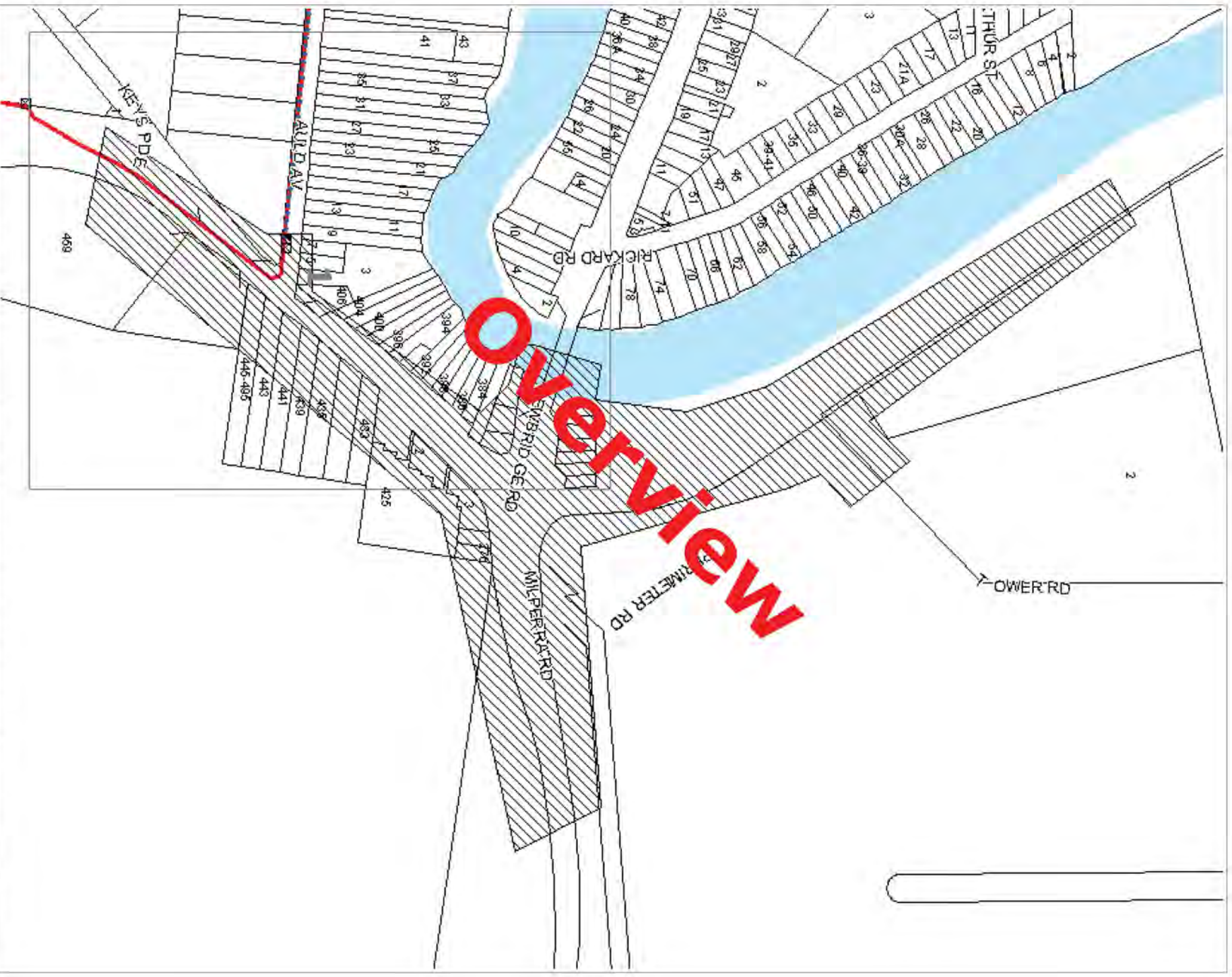
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WARNING: This document is confidential and may also be privileged. Confidentiality nor privilege is not waived or destroyed by virtue of it being transmitted to an incorrect addressee. Unauthorised use of the contents is therefore strictly prohibited. Any information contained in this document that has been extracted from our records is believed to be accurate, but no responsibility is assumed for any error or omission.

Optus Plans and information supplied are valid for 30 days from the date of issue. If this timeline has elapsed please raise a new enquiry.

Sequence Number: 102166066

Date Generated: 24/09/2020



For all Optus DBVD plan enquiries -
Email: Fibre.Locations@optus.net.au
For urgent onsite assistance contact 1800 505 777
Optus Limited ACN 052 833 208





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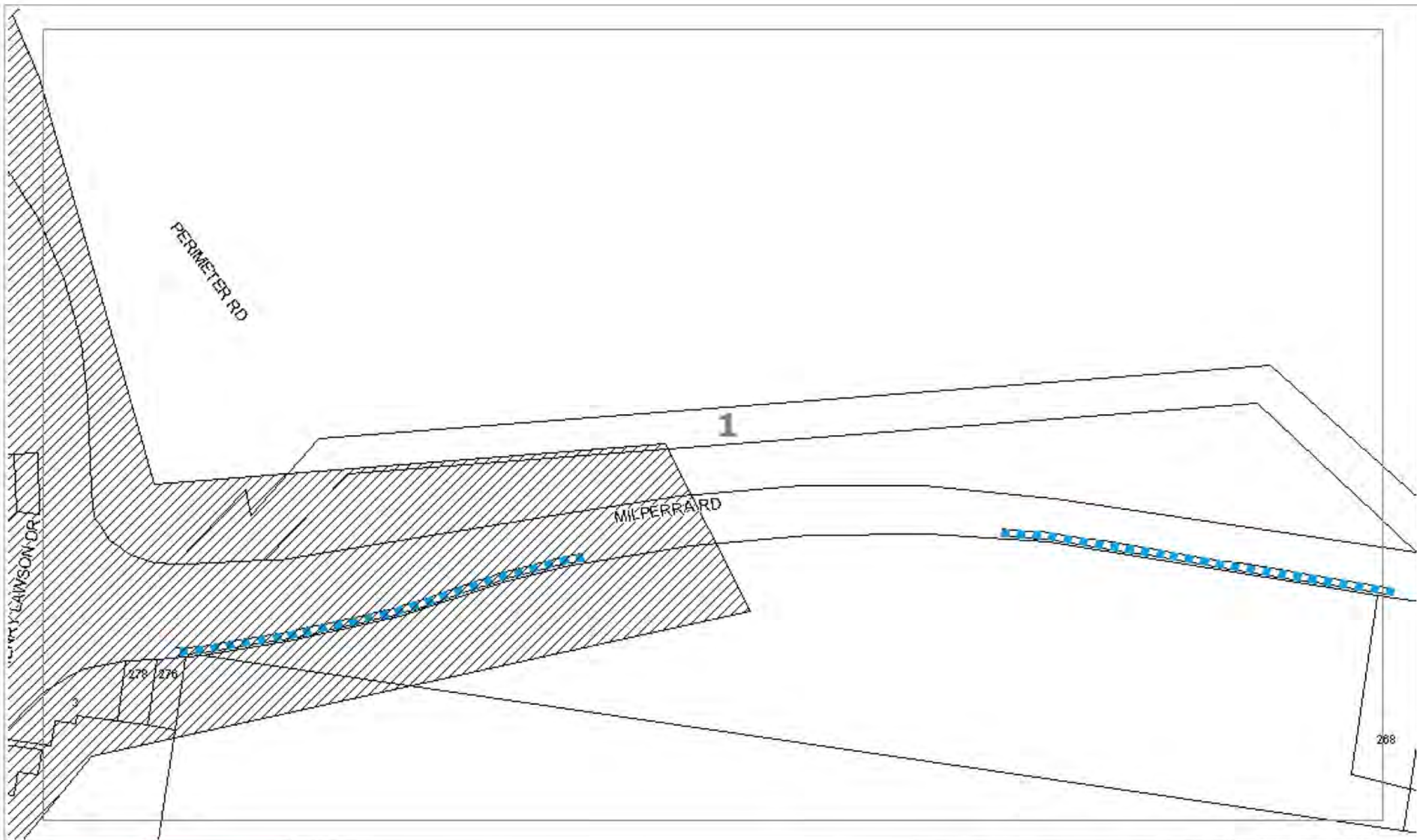
Job Location



Underground Asset



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Uecomm

Cable Uecomm Underground

Scale: #INSERT MAP SCALE#

Printed On: 24/09/2020

Sequence Number: 102165065

Location: Henry Lawson Drive



Job Location



Underground Asset



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Dial Before You Dig (DBYD)

BP Nominated Infrastructure or Area Location Information

BP Australia Pty Ltd
717 Bourke Street
Docklands, VIC 3008

To:

Aurecon - Mr Raghav Rana
552 Boronia Road
Wantirna VIC 3152

Enquiry Details

| | |
|------------------|-------------------------------------|
| Utility ID | 90146 |
| Sequence Number | 102165068 |
| Enquiry Date | 24/09/2020 14:15 |
| Response | AFFECTED |
| Address | Henry Lawson Drive Milperra |
| Location in Road | CarriageWay, Footpath, Nature Strip |
| Activity | Planning & Design |

Enquirer Details

| | | | |
|-------------|------------------------------|--------|--------------|
| Customer ID | 2235321 | | |
| Contact | Mr Raghav Rana | | |
| Company | Aurecon | | |
| Email | raghav.rana@aurecongroup.com | | |
| Phone | 0401448946 | Mobile | Not Supplied |

Enquirer Responsibilities

This asset location information must be read in conjunction with the DBYD Response Form provided to you (the enquirer) by Mipela GeoSolutions on behalf of BP Australia. (FO-RM-003 Response Form.pdf)

When working in the vicinity of an asset you have certain legal obligations with which you must comply. The purpose of these obligations is to ensure safe work.

In commencing work in the vicinity of an asset following receipt of this DBYD Response Form, you are deemed to have accepted the terms and conditions attached.

An example of the type of visible infrastructure that you may encounter is shown in the attached Photo A.



Photo A



Overview Map

Sequence No: 102165068

Henry Lawson Drive Milperra



BP Australia makes every effort that the information contained on this map is up to date and correct but accepts no responsibility for this information.

The information is provided as a guide only.



0 0.1km

Imagery sourced from Open StreetMaps

LEGEND:



Detail Map



BP Area Location



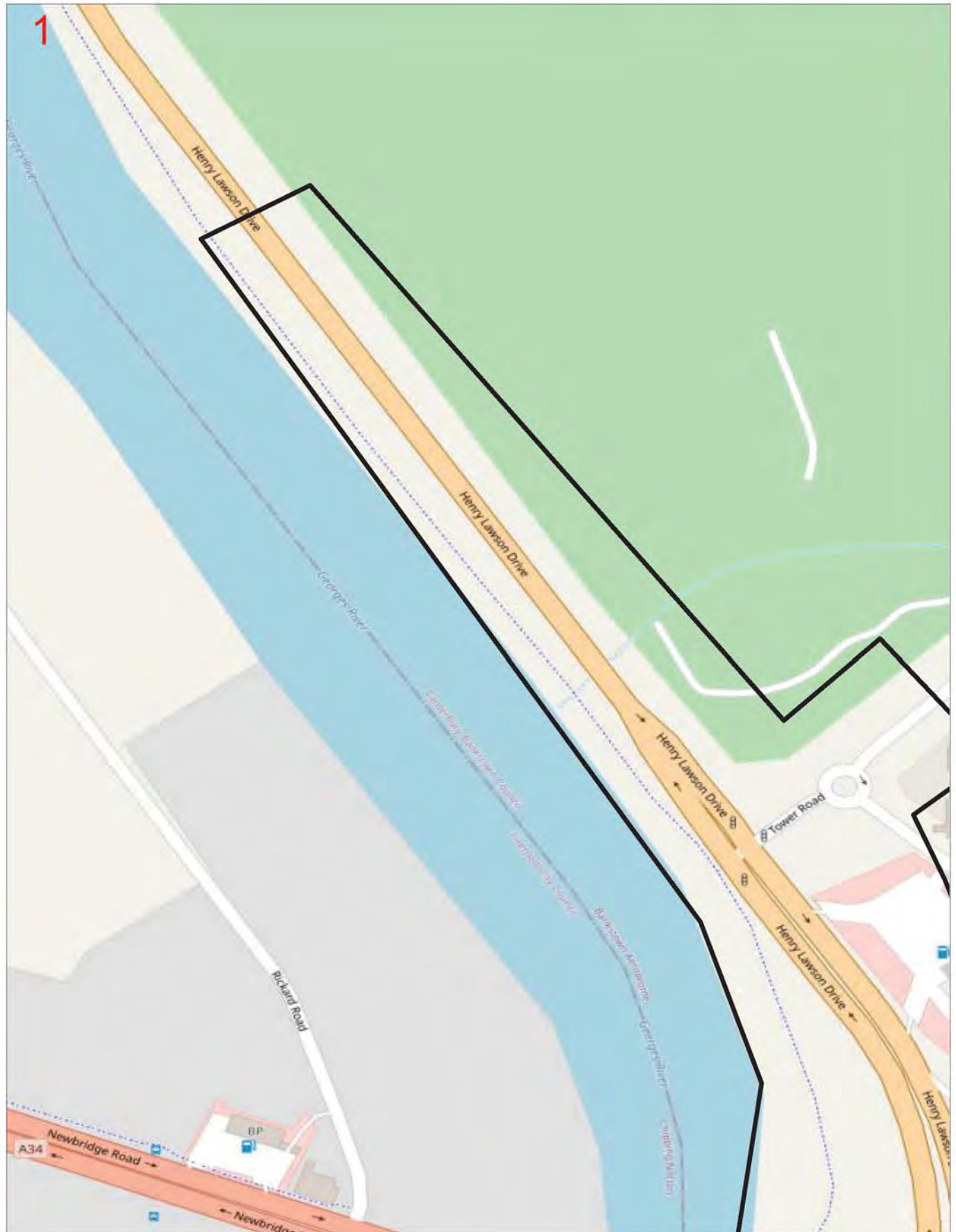
DBYD Work Area



Map 1

Sequence No: 102165068

Henry Lawson Drive Milperra



BP Australia makes every effort that the information contained on this map is up to date and correct but accepts no responsibility for this information.
The information is provided as a guide only.



0 0.02km

Imagery sourced from Open StreetMaps

LEGEND:

BP Area Location
 BP Infrastructure

DBYD Work Area



Map 2

Sequence No: 102165068

Henry Lawson Drive Milperra



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The information is provided as a guide only.



0 0.02km

Imagery sourced from Open StreetMaps

LEGEND:

BP Area Location
 BP Infrastructure

DBYD Work Area

Date: 24/09/2020
To: Mr Raghav Rana
Company:
Address: 552 Boronia Road
Wantirna, VIC 3152

ENQUIRY DETAILS

Location: Henry Lawson Drive, Milperra, NSW 2214
Sequence No.: 102165065
DBYD Reference: 20310876

In relation to your enquiry concerning the above location, Optus advises as follows:

Optus records indicate that there ARE underground Optus FIBRE OPTIC TELECOMMUNICATIONS ASSETS in the vicinity of the above location as per the attached drawing(s).

This reply is valid for a period of 30 days from the date above.

IMPORTANT INFORMATION

Asset location drawings provided by Optus are reference diagrams and are provided as a guide only. The completeness of the information in these drawings cannot be guaranteed. Exact ground cover and alignments cannot be provided with any certainty as these may have altered over time. Depths of telecommunications assets vary considerably as do alignments. It is essential to identify the location of any Optus assets in the vicinity prior to engaging in any works.

All Optus assets in the vicinity of any planned works will need to be electronically located to ascertain their general location. Depending on the scope of planned works in the vicinity, the assets may also need to be physically located.

You MUST engage the services of one of the Optus Asset Accredited Locators to carry out asset location (refer to list of Accredited Locators attached to this DYBD response).

Unless otherwise agreed with Optus, where an on-site asset location is required, the requestor is responsible for all costs associated with the locating service including (where required) physically exposing the Optus asset.

DUTY OF CARE

When working in the vicinity of telecommunications assets you have a legal "Duty of Care" and non-interference that must be observed.

It is your responsibility as the requesting party (as a landowner or any other party involved in the planned works) to design for minimal impact to any existing Optus asset. Optus can assist at the design stage through consultation.

It is also your, as the requesting party (or your representative's), responsibility to:

- a) Obtain location drawings (through the Dial Before You Dig process) of any existing Optus assets at a reasonable time before any planned works begin;
- b) Have an Optus Accredited Asset Locator identify the general location of the Optus asset and physically locate the asset where planned works may encroach on its alignment; and
- c) Contact Optus for further advice where requested to do so by this letter.

DAMAGE TO ANY OPTUS ASSET MUST BE REPORTED TO 1800 500 253 IMMEDIATELY

You, your head contractor and any relevant subcontractor are all responsible for any Optus asset damage as a result of planned activities in the vicinity of Optus assets.

This applies where works commence prior to obtaining Optus drawings, where there is failure to follow instructions or during any construction activities.

Optus reserves the right to recover compensation for loss or damage to its assets including consequential loss. Also, you, your head contractor and any relevant subcontractor may also be liable for prosecution under the Criminal Code Act 1995 (Cth).

ASSET RELOCATIONS

You are not permitted by law to relocate, alter or interfere with any Optus asset under any circumstance. Any unauthorised interference with an Optus asset may lead to prosecution under the Criminal Code Act 1995 (Cth).

Enquiries relating to the relocation of Optus assets must be referred to the relevant Optus Damages and Relocations Team (refer to "FURTHER ASSISTANCE").

APPROACH DISTANCES

On receipt of Optus asset location drawings and prior to commencing any planned works near an Optus asset, engage an Optus Accredited Locator to undertake a general location of the Optus asset.

Physical location of the Optus asset by an Optus Accredited Locator will also be required where planned works are within the following approach distances of the general location of the Optus asset:

- a) In built up metropolitan areas where road and footpaths are well defined by kerbs or other features a minimum clear distance of 1 meter must be maintained from the general location of the Optus asset.
- b) In non-established or unformed metropolitan areas, a minimum clear distance of 3 meters must be maintained from the general location of the Optus asset.
- c) In country or rural areas where wider variations may exist between the general and actual location of an Optus asset may exist, then a minimum clear distance of 5 meters must be maintained from the general location of the Optus asset.

If planned works are parallel to the Optus asset, then the Optus asset must be physically located by an Optus Accredited Locator at a minimum of 5 meter intervals along the length of the parallel works prior to work commencing.

Under no circumstances is crossing of any Optus asset permitted without physical location of the asset being carried out by an Optus Accredited Locator. Depending on the asset involved an Optus representative may be required onsite.

The minimum clearances to the physical location of Optus assets for the following specific types of works must be maintained at all times.

Note: Where the clearances in the following table cannot be maintained or where the type of work differs from those listed then advice must be sought from the relevant Optus Damages and Relocations Team (refer to "FURTHER ASSISTANCE").

| Type of Works | Clearance to Physical Location of Optus Asset |
|--|--|
| Jackhammers / Pneumatic Breakers | Not within 1 meter. |
| Light duty Vibrating Plate or Wacker Packer type compactors (not heavy road construction vibrating rollers etc.) | 500mm compact clearance cover before a light duty compactor can be used over any Optus conduit. No compaction permitted over Optus direct buried cable without prior approval from Optus. |
| Boring Equipment (in-line, horizontal and vertical) | Not within 5 meters parallel of the Optus asset location without an Accredited Optus Asset Locator physically exposing the Optus asset and with an Optus representative onsite. Not to cross the Optus asset without an Accredited Optus Asset Locator physically exposing the Optus asset and with an Optus representative onsite. |

| Type of Works | Clearance to Physical Location of Optus Asset |
|--|--|
| Heavy vehicle Traffic (over 3 tonnes) | <p>Not to be driven across Optus conduits with less than 600mm of cover.</p> <p>Not to be driven across Optus direct buried cable with less than 1.2 meters of cover.</p> <p>Once off crossings permitted, multiple crossing (e.g. road construction or logging) will require Optus approval.</p> <p>Accredited Optus Asset Locator to physically expose the Optus asset to verify actual depth.</p> |
| Mechanical Excavators, Farm Ploughing, Vertical Hole installation for water bore or fencing etc. | <p>Not within 1 meter.</p> <p>Accredited Optus Asset Locator to physically expose the Optus asset to verify actual location.</p> |

ASSET CLEARANCES AFTER COMPLETION OF WORKS

All Optus pits and manholes must be a minimum of 1 meter from the back of any kerb, 3.5 meters of the road surface without a kerb or not within 15 meters of street intersection.

In urban areas Optus conduit must have the following minimum depth of cover:

- Footway 600mm;
- Roadway 1 meter at drain invert and at road centre crown.

In rural areas Optus conduit must have a minimum depth of cover of 1 meter and direct buried cable 1.2 meters.

In cases where it is considered that the above clearances cannot be maintained at the completion of works, advice must be sought from the relevant Optus Damages and Relocations Team (refer "Further Assistance").

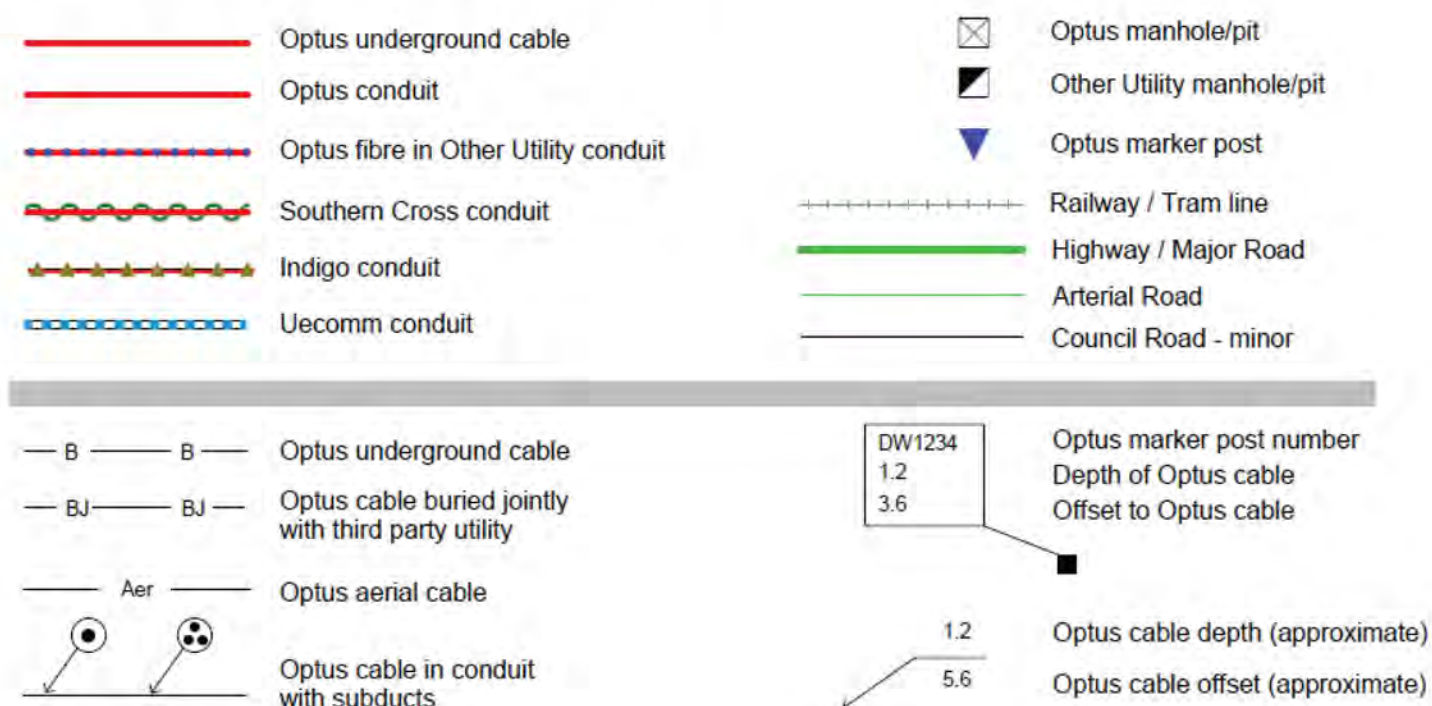
FURTHER ASSISTANCE

Further assistance on asset clearances, protection works or relocation requirements can be obtained by contacting the relevant Optus Damages and Relocations Team on the following email address:

NFODamages&RelocationsDropbox@optus.com.au

Further assistance relating to asset location drawings etc. can be obtained by contacting the Optus Network Operations Asset Analysis Team on 1800 505 777.

OPTUS ENGINEERING DRAWING SYMBOLS



OPTUS

Optus Accredited Asset Locators

| Name | Company Name | Phone | Email | State | Region/Service Area |
|-------------------|--------------------------------------|------------------------------|--|-----------------|---|
| Alan Cordner | Alcom Fibre Services Pty Ltd | 0400 300 337 | alcomfibre@bigpond.com | NSW / ACT | Sydney |
| Brad McCorkindale | Bradmac Locating Services | 0434 157 409 | brad.mac@bigpond.com | NSW / ACT | All |
| Troy Redden | On Point Utility Locating | 1300 6676 468 | troy@onpointlocating.com.au | NSW | Sydney Only |
| Shane Buckley | Cable & Pipe Locations | 0408 730 430 | sabuckley@bigpond.com | NSW / QLD | Armidale, Casino, Coffs Harbour, Dorrigo, Glenn Innes, Grafton, Inverell, Kempsey, Lismore, Nambucca, Port Macquarie, Tamworth, Taree, Tenterfield, Yamba |
| Philip Pegler | Down Under Detection Services (DUDS) | 0418 267 964 | apegler@duds.net.au | NSW | All |
| Noreen Egan | SureSearch Underground Services | 1300 884 520 0418 920 245 | Noreen@suresearch.com.au | NSW / ACT / QLD | NSW, Sydney, Northern NSW, Canberra, QLD, South East QLD. |
| Leonard McGowan | Pipesure Australia | 1300 411 811 | len@pipesure.com.au | NSW | Sydney |
| Bruce Whittaker | Optical Fibre Technologies | 0402 354 322 | opticaltek1@aol.com | NSW | Sydney/Wollongong |
| Darryl Smith | Darryl Smith Electrical | 02 6642 3731 | office@dsmithelectrical.com.au | NSW | Grafton |
| George Koenig | Downunder Locations NSW Pty | 0438 243 856 | Downunderlocations@gmail.com | NSW | Tweed Heads, Gold Coast, Brisbane |
| Michael Grant | M&K Grant Bega Bobcats Pty Ltd | 0427 260 423 | zzbobcat@bigpond.net.au | NSW | Bega, Far South Coast |
| Antony Critcher | Geotrace Pty Ltd | 0417 147 945 | antony@geotrace.com.au | NSW | All Areas, Sydney, Wollongong, Newcastle, ACT |

| | | | | | |
|-------------------|---|------------------------------|--|-----------|--|
| Anthony Lane | Hydro Digga | 0447 774 000 | locator@hydrodigga.com | NSW | All of NSW, ACT & South East Qld |
| Grant Pearson | Australian Utilities Management Pty Ltd | 0427 833 222 | aine@ausutilities.net.au | NSW | Sydney Metro |
| Nathan Ellis | Utility Locating Services | 0404 087 555 | nathan@utilitylocatingservices.com.au | NSW | Sydney |
| Rodney Pullen | Provac | 0450 268 012 | rod@provac.net.au | NSW /QLD | South East QLD, Northern NSW |
| Rodney Pullen | One Find Cables | 0451 268 012 | rod@provac.net.au | NSW /QLD | South East QLD, Northern NSW |
| Drew Misko | Australian Subsurface Pty Ltd | 0427 879 600 | admin@australiansubsurface.com | NSW / ACT | All of NSW/ACT |
| Scott O'Malley | Coastal Cable Locators Pty Ltd | 0427 975 777 | skomalley@bigpond.com | NSW | South Coast- Snowy Mountains- Southern Highlands |
| Liam Bolger | Brandon Construction Services | 0438 044 008 | liam.bolger@hotmail.com | NSW | Bathurst, Orange, Dubbo |
| Brett Pickup | All About Pipes | 02 8763 4200 | Brett.Pickup@allaboutpipes.com.au | NSW / VIC | All |
| Karen Joyce | Durkin Construction Pty Ltd | 02 9712 0308 | karen@durkinconstruction.com.au | NSW | Sydney |
| Timothy Laidler | Locate & Map | 0431 191 669 | tim@locateandmap.com.au | NSW | Sydney, Central Coast |
| Ken Brown | Riteway Traffic Control Pty Ltd | 0419 212 969 | kbrowne@ritewaytc.com.au | NSW | Central Coast, Hunter |
| Walter R Johansen | Steger & Associates | 02 6296 4089 | enquiries@steger.com.au | ACT / NSW | Canberra |
| Jean-Max Monty | Civilscan | 0416 068 060 | civilscan@bigpond.com | NSW | Sydney – Central Coast – Newcastle – Wollongong – Hunter Valley – Blue Mountains |
| Alan Hunter | Hunter Ground Search | 02 4953 1244 0418 684 819 | huntergroundsearch@bigpond.com | NSW | Newcastle, Central Coast, Hunter Valley, Mid North Coast, Liverpool Plains, Central West NSW |
| Gilbert J Cook | Datateks Communications Specialists | 0408 693 660 | datateks@datateks.com.au | NSW | Southern NSW |

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|-----------------|------------------------------------|------------------------------|--|-----------------|--|
| Damien Black | Mid North Coast Hydro Digging | 0418 409 465 | dblack1@bigpond.com | NSW | Newcastle -Foster -Taree -Wauchope -Port Macquarie -Kempsey -Coffs harbour |
| Neil Blenkinsop | Utility Mapping Pty Ltd | 0427 318 681 | nblenkinsop@utilitymapping.com.au | NSW | Sydney |
| Daniel Fox | Epoca Environmental Pty Ltd | 02 4739 2465 0433 100 642 | daniel@epocaenvironmental.com.au | NSW | All NSW, ACT |
| Rod Shaw | Cable Find | 0478 887 073 | rod@cablefind.com.au | NSW | Northern Rivers |
| Danny Carter | Online Pipe & Cable Locating | 1300 665 384 | danny@onlinepipe.com.au | NSW | Sydney, Newcastle, Canberra, Blue Mountains |
| Sam Romano | Locating Services | 0403 065 510 | sam.romano@locatingservices.com.au | NSW | NSW All |
| Scott Allison | Crux Surveying Australia | 02 9540 9940 | sydneyoffice@cruxsurveying.com.au | NSW | Sydney Metro & Surrounding Areas |
| Ian Brown | Peter Ellsmore & Associates | 0439 423 708 | ian.brown@ellsmore.com.au | NSW | Wollongong, Illawarra, South Coast, Southern Highlands, Macarthur & Sydney |
| Donna Wullaert | Commence Communications Pty Ltd | 02 6226 3869 0428 595 620 | admin@commencecomms.com.au | NSW | Canberra, Yass, Bungendore, Goulburn and Surrounding regional Areas |
| Stephen Fraser | Advanced Ground Locations | 02 4930 3195 0412 497 488 | steve_agl@hotmail.com | NSW | Newcastle, Hunter Valley, Central Coast, Taree & Surrounding Areas |
| Andrew Findlay | LiveLocates | 0429 899 777 | info@livelocates.com.au | NSW | South Coast/ACT, Snowy Mountains |
| Graeme Teege | Armidale Electrical | 02 6772 3702 | office@armidale-electrical.com.au | NSW | Armidale |
| Myles Green | Australian Locating Services | 1300 761 545 | myles@locating.com.au | NSW | Sydney |
| Brett Wallin | Utility Scan | 0426 354 051 | brett@utilityscan.net | NSW | Sydney CBD and Regional areas |
| Daniel Hudson | One Search Locators | 1300 530 420 | daniel@onesearchlocators.com.au | NSW | All NSW, ACT |
| Tim Galaz | Utec Solutions | 02 9389 0040 | office@utecsolutions.com.au | NSW/QLD /VIC | All areas, NSW, QLD, VIC |

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|-----------------|--|------------------------------|--|-----|---|
| Gary Laneyrie | Laneyrie Electrical | 0412 079 079 0413 048 048 | bindy@laneyieelectrical.com.au | NSW | Illawarra, South Coast, Hunter Region |
| Reece Gainsford | East Coast Locating Services | 0431 193 111 | eastcoastlocating@hotmail.com | NSW | Sydney, Maitland, Newcastle, Hunter, Port Stephens, Central Coast |
| Allan Clarke | The Control Group Pty Ltd | 0421 960 017 | allan@thecontrolgroup.com.au | NSW | Northern NSW |
| Simon Cook | Douglas Partners | 0431 507 667 | simon.cook@douglaspartners.com.au | NSW | NSW All |
| Samual Boesen | Rubicof Cable & Pipe Locators | 0403 285 352 0418 103 369 | rubicof@optusnet.com.au | NSW | Cessnock |
| Craig Vallery | Aqua Freeze & Locate Pty Ltd | 0458 774 440 | service@aquafreeze.com.au | NSW | Sydney |
| Laurence Mead | Veris | 0419 770 560 | i.mead@veris.com.au | NSW | Sydney |
| Bobby Friesz | Vac Group Operations (T/A Earth Radar) | 0447 837 267 | Bobby.Friesz@vacgroup.com.au | NSW | Sydney |
| Chris Hall | D C Locators Pty Ltd | 0419 679 741 | dcloc@powerup.com.au | QLD | Brisbane, Ipswich |
| Jeff Trackson | J.R & L.M Trackson Pty Ltd | 0417 600 978 | jtrackson@tracavoid.com.au | QLD | All |
| Benji Lee | LADS | 0478 915 237 | benji@ladsqld.com.au | QLD | South East QLD |
| Andrew Watson | Lambert Locations Pty Ltd | 07 5562 8400 | admin@lambertlocations.com.au | QLD | South East QLD & Northern NSW |
| Ross Clarke | FNQ Cable Locators Pty Ltd | 0428 775 655 | onlineco@bigpond.net.au | QLD | Far North QLD, Cape York & Peninsula |
| Col Greville | Bsure Locators | 0488 520 688 | admin@bsurelocators.com.au | QLD | Wide Bay Burnett and Central Qld |
| Mikael White | All Asset Locations | 0478 846 025 | allassetlocations@gmail.com | QLD | Sunshine Coast |
| Andrew Cowan | VAC Group Operations (T/A Earth Radar) | 0447 008 806 | andrew.cowan@vacgroup.com.au | QLD | South East and Central QLD |
| Jimmy Wilkins | GeoRadar Australia | 0425 677 227 | jimmy@georadar.net.au | QLD | Emerald, Bundaberg |
| Beaumont Blake | PipeHawk CCTV | 0435 558 533 | accounts@pipehawkcctv.com.au | QLD | South East QLD & Northern NSW |
| Craig Waite | C Locate | 0437 808 444 | clocate@bigpond.com | QLD | South East QLD |

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|-----------------|---|------------------------------|--|-----|--------------------------------------|
| QLD Operations | Utility Location Services | 0499 775 095 07 3807 3552 | qldops@utilitylocationservices.com.au | QLD | SouthEast QLD, Northern NSW |
| Andrew Watson | RPS AUS East | 0408 839 723 | andrew.watson@rpsgroup.com.au | QLD | Brisbane |
| Luke Steadman | Utility Mapping Pty Ltd | 0472 867 197 | lsteadman@utilitymapping.com.au | QLD | All |
| Robert Reed | All Asset Locations Pty Ltd | 0478 846 025 | allassetlocations@gmail.com | QLD | Sunshine Coast |
| Jenny Dziduch | 1300 Locate Pty Ltd | 1300 562 283 | admin@1300locate.com.au | QLD | All Queensland, Northern NSW |
| Sam Hazel | Utility ID Underground Service Locators | 0401 202 515 | sam@utilityid.com.au | QLD | Southern QLD |
| Brendon Smith | Dynamic Hydro Excavations | 1300 822 878 | admin@dynamicexcavation.com.au | QLD | QLD, NSW, VIC |
| Marty Carlson | Surveywerx Pty Ltd | 0488 842 110 | mike@surveywerx.com | QLD | South East QLD |
| Adam Lloyd | Aussie HydroVac Services | 07 3287 7818 | adam.lloyd@aussiehydrovac.com.au | QLD | All |
| Gary Poppi | Ace Cable Locations | 0431 517 837 | garypoppi@bigpond.com | QLD | Wide Bay Burnett |
| Josh Taylor | Advanced Locations Victoria | 0427 846 716 | josh@advancedlocationsvic.com.au | VIC | All |
| Ben Minutoli | Geelong Cable Locations | 1800 449 543 | ben@geelongcablelocations.com.au | VIC | Melbourne, Geelong, Country Victoria |
| Mick McGoldrick | Cavan Constructions | 0404 241 679 | mick@locatecables.com | VIC | Western Victoria |
| David Kelleher | Construction Sciences | 03 9553 7236 | utilities@constructionsciences.net | VIC | Victoria |
| Stuart Miles | ELS Environmental Location Systems | 03 8795 7461 | accounts@radiodetection.com.au | VIC | Victoria |
| Darren Dean | Asset Survey Solutions | 1300 035 796 | darren.dean@assetsurvey.com.au | VIC | Victoria |
| Alex Jones | Utility Mapping Pty Ltd | 0417 413 353 | ajones@utilitymapping.com.au | VIC | |
| Adam Linford | Gippsland Pipe & Cable Locations | 0409 386 817 | gippspac@hotmail.com | VIC | Gippsland |
| Thomas Pitt | Access Utility Engineering (AUE) | 03 9580 0440 | info@accessue.com.au | VIC | Victoria |
| Bernie Acabal | Taylors Development Strategists | 03 9501 2800 0419 758 794 | b.acabal@taylorsds.com.au | VIC | Victoria |

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|-------------------------------|---|--------------|--|-----|---|
| Philong Nguyen | Asset Detection Services Pty Ltd | 0413 949 400 | phi.nguyen@assetdetection.com.au | VIC | VIC, NSW, TAS All areas |
| Maurice Tobin | Drain Solutions | 1300 546 348 | info@drainsolutions.com.au | VIC | Melbourne Metro |
| Nathan Kelleher | Seeker Utility Engineering | 0439 691 840 | nathan.kelleher@seekerutility.com.au | VIC | Melbourne |
| Jeffrey Ramos | VAC Group Operations (T/A Earth Radar) | 0436 635 011 | Jeffrey.ramos@earthradar.com.au | VIC | All |
| Infrastructure Civil Services | Trenchless Pipelaying Contractors (TPC) | 08 8376 5911 | tpc@trenchlesspipelaying.com.au | SA | All |
| Sean Nemeth | Enerven Energy Infrastructure Pty Ltd | 0488 167 772 | sean.nemeth@enerven.com.au | SA | Adelaide |
| SADB | SADB Civil Construction & Trenchless | 08 8168 7200 | reception@sadb.com.au | | |
| Galen Shanahan | Vac Group Operations (T/A Earth Radar) | 0447 837 000 | Galen.Shanahan@vacgroup.com.au | SA | All |
| Marilyn Dentice | Cable Locates & Consulting | 08 9524 6600 | accounts@cablelocates.com.au | WA | Metro & Country |
| Lisa Scofield | Abaxa | 08 9256 0100 | accounts@abaxa.com.au | WA | All |
| Derek McShane | Subterranean Service Locations | 0420 862 426 | Derek@sslwa.com.au | WA | Midwest/Gascoyne |
| Ben Upton | TerraVac Vacuum Excavation | 0427 531 119 | locations@terravac.com.au | WA | All |
| Dale Shearsmith | Subtera Subsurface Locating | 1300 046 636 | dale@subtera.com.au | WA | All |
| Liam Davies | Bunbury Telecom Service Pty Ltd | 08 9726 0088 | liam@btswa.com.au | WA | South West WA |
| Tammy Thorp | B.C.E Spatial | 08 9364 6408 | admin@bcespatial.com.au | WA | Perth Metro & Regional |
| Scott Anderton | Utility Mapping Pty Ltd | 0438 630 146 | sanderton@utilitymapping.com.au | WA | |
| Chris Lee | Pulse Locating | 0437 289 861 | enquiries@pulselocating.com.au | WA | Perth |
| Morgan O'Connor | Kier Contracting | 1300 543 728 | morgan@kier.com.au | WA | Perth Metro & Greater region, Regional WA |
| Nigel Nunn | CCS Group / Utility Locating Solutions | 08 9385 5000 | enquiry@ccswa.com.au | WA | Perth |

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|------------------|--|--------------|--|-----|-------------------------|
| Paul Stevenson | Geographe Underground Services | 0427 523 811 | paul.stevenson@geographeunderground.com.au | WA | All |
| Jeremy Brown | Spotters Asset Locations Pty Ltd | 0459 130 677 | jeremy@spottersassetlocations.com.au | WA | All |
| Reece Topham | Prime Locate | 0400 888 406 | reece@primelocate.com.au | WA | All |
| Jonathon Sylva | Advance Scanning Services | 1300 738 118 | bookings@advancescanning.com | WA | All |
| Tim Daws | Award Contracting | 0411 878 895 | info@awardcontracting.com.au | WA | City & Regional |
| Dave Turner | Anywair Pipe & Cable | 0418 890 071 | dave@anywair.com.au | NT | All NT, WA, QLD |
| Steve Gault | Northern Comms | 0407 904 319 | steve@northerncomms.net.au | NT | All |
| Wayne Parslow | Danisam | 0417 089 865 | danisam@westnet.com.au | NT | Darwin NT and Surrounds |
| Elizabeth Young | Archers Underground Services Locations (AUS Locations) | 03 6245 1298 | admin@auslocations.com.au auslocations@bigpond.com | TAS | All |
| Patrick Monaghn | Paneltec Group | 0447 797 544 | patrick@paneltec.com.au | TAS | All |
| Scott Richardson | AJ Water & Leak Detection | 0457 710 680 | admin@ajwater.com.au | TAS | All |

To: Mr Raghav Rana

552 Boronia Road
Wantirna, VIC, 3152



Uecomm Pty Limited
ABN 56 079 083 195

Building 8, 658 Church St,
Richmond, VIC 3121
Ph: (03) 9221 4100
Fax: (03) 9221 4193
Ah: 1800 707 447

LOCATION OF UNDERGROUND FIBRE OPTIC CABLE INFORMATION SHEET

IMPORTANT: PLEASE READ ALL INFORMATION AND CONDITIONS BELOW AND THE NOTICE ON THE REVERSE SIDE OF THE PLAN/S.

"Dial Before You Dig" Sequence No 102165065
Customer ID 2235321

Issue Date: 24/09/2020
Issue By:

Location: Henry Lawson Drive, Milperra, NSW 2214
Map Ref: 270J3, 270J4, 270J7, 270J8, 270K4, 270K5, 270K6, 270K7, 270K8, 270L5, 270L6, 270M6
Uecomm Asset Location No. 102165065
Dial Before You Dig Job No. 20310876

In relation to your enquiry at the above address, Uecomm advises as follows:

The records of Uecomm Limited disclose that there ARE underground FIBRE OPTIC / TELECOMMUNICATIONS cables in the vicinity of the above enquiry as per attached plan/s.

- The underground cables referred to in this advice are defined as the underground communications cables owned or controlled by Uecomm Pty Limited.
- The person/company responsible for submitting the inquiry should take care to ensure all plans listed above have been received. For any plan listed above but not received please contact **1800 707 447**.
- Any information provided is valid only for **30 days** from the date of issue set out above.
- If the work operations extends beyond this period, or if the designs are altered in any way, you are requested to resubmit your proposal for reassessment.
- Further assistance may be obtained if necessary by telephoning **1800 707 447**.

PLEASE READ ALL INFORMATION AND DISCLAIMERS BELOW:

1. Due to the nature of underground cables and the age of some cables and records, it is impossible to conclusively ascertain the location of all cables. The accuracy and/or completeness of the information cannot be guaranteed and, accordingly, they are intended to be indicative only and, as a result, Uecomm does not accept any responsibility for any inaccuracies of its plans. They should not be solely relied upon when undertaking underground works. It is also inaccurate to assume that fibre optic cables follow straight lines and careful on-site investigations are essential to locate its exact position.
2. The following minimum clearances must be maintained:
 - 300mm when laying asset's inline, horizontal or vertical.
 - 500mm when operating vibrating equipment, e.g., jackhammers or vibrating plates.
 - 1000mm when operating mechanical excavators.
3. Due to the inherent dangers associated with excavation in the vicinity of underground cables, precautions should be taken in the undertaking of any underground works, including (but not limited to) the following:
 - All excavation sites should be examined for underground cables by careful hand excavation. Cable cover slabs if present must not be disturbed. Hand excavation needs to be undertaken with extreme care to minimise the likelihood of damage to the cable, e.g., blades of hand equipment should be orientated parallel to the line of the cable rather than digging across the cable.
 - If any undisclosed underground cables are located, Uecomm Limited should be notified immediately.
 - All personnel must be properly briefed, particularly those associated with the use of earthmoving equipment, trenching, boring and pneumatic equipment.
 - All excavations must be undertaken in accordance with the relevant legislation and regulations.

4. **DAMAGE. ANY DAMAGE TO UECOMM'S NETWORK MUST BE REPORTED IMMEDIATELY TO 1800 707 447.**
5. Uecomm recommends using Uecomm approved location contractors to provide on-site location services for Uecomm plant. You can arrange Uecomm on-site visits by calling Uecomm on 1800 707 447 and Uecomm or its approved representative will attend your site to provide guidance to the location of the Uecomm assets (the "*Uecomm Asset Alignment*"). **Uecomm requires 3 clear business days notice to conduct an on-site location.** The initial on-site visit by Uecomm will not normally incur a charge, but at the discretion of Uecomm, subsequent site visits may incur a charge to be applied at an hourly rate.
6. Uecomm will hold the relevant party responsible for any damage to Uecomm plant and all expenses incurred by Uecomm as a result of asset damage.
7. Except to the extent that liability may not be capable of lawful exclusion, Uecomm Pty Limited and its servants and agents and the related bodies corporate of Uecomm Pty Limited and their servants and agents shall be under no liability whatsoever to any person for any loss or damage (including indirect or consequential loss or damage) however caused (including, without limitation, breach of contract negligence and/or breach of statute) which may be suffered or incurred from or in connection with this information sheet or any Plans attached hereto. Except as expressly provided to the contrary in this information sheet or the attached Plans, all terms, conditions, warranties, undertakings or representations (whether expressed or implied) are excluded to the fullest extent permitted by law.

We thank you for your enquiry and appreciate your continued use of the Dial Before You Dig Service and/or Uecomm Asset Analysis Service. If you require further information please contact Uecomm on **1800 707 447**.

IMPORTANT *This document may be confidential and privileged. Unauthorised use is prohibited. If you have it in error, please notify us and shred this document. Thank you.*

To: Mr Raghav Rana

552 Boronia Road
Wantirna, VIC, 3152



Uecomm Pty Limited
ABN 56 079 083 195

Building 8, 658 Church St,
Richmond, VIC 3121
Ph: (03) 9221 4100
Fax: (03) 9221 4193
Ah: 1800 707 447

LOCATION OF UNDERGROUND FIBRE OPTIC CABLE INFORMATION SHEET

IMPORTANT: PLEASE READ ALL INFORMATION AND CONDITIONS BELOW AND THE NOTICE ON THE REVERSE SIDE OF THE PLAN/S.

"Dial Before You Dig" Sequence No 102165065
Customer ID 2235321

Issue Date: 24/09/2020
Issue By:

Location: Henry Lawson Drive, Milperra, NSW 2214
Map Ref: 270J3, 270J4, 270J7, 270J8, 270K4, 270K5, 270K6, 270K7, 270K8, 270L5, 270L6, 270M6
Uecomm Asset Location No. 102165065
Dial Before You Dig Job No. 20310876

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- The person/company responsible for submitting the inquiry should take care to ensure all plans listed above have been received. For any plan listed above but not received please contact **1800 707 447**.
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PLEASE READ ALL INFORMATION AND DISCLAIMERS BELOW:

1. Due to the nature of underground cables and the age of some cables and records, it is impossible to conclusively ascertain the location of all cables. The accuracy and/or completeness of the information cannot be guaranteed and, accordingly, they are intended to be indicative only and, as a result, Uecomm does not accept any responsibility for any inaccuracies of its plans. They should not be solely relied upon when undertaking underground works. It is also inaccurate to assume that fibre optic cables follow straight lines and careful on-site investigations are essential to locate its exact position.
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6. Uecomm will hold the relevant party responsible for any damage to Uecomm plant and all expenses incurred by Uecomm as a result of asset damage.
7. Except to the extent that liability may not be capable of lawful exclusion, Uecomm Pty Limited and its servants and agents and the related bodies corporate of Uecomm Pty Limited and their servants and agents shall be under no liability whatsoever to any person for any loss or damage (including indirect or consequential loss or damage) however caused (including, without limitation, breach of contract negligence and/or breach of statute) which may be suffered or incurred from or in connection with this information sheet or any Plans attached hereto. Except as expressly provided to the contrary in this information sheet or the attached Plans, all terms, conditions, warranties, undertakings or representations (whether expressed or implied) are excluded to the fullest extent permitted by law.

We thank you for your enquiry and appreciate your continued use of the Dial Before You Dig Service and/or Uecomm Asset Analysis Service. If you require further information please contact Uecomm on **1800 707 447**.

IMPORTANT *This document may be confidential and privileged. Unauthorised use is prohibited. If you have it in error, please notify us and shred this document. Thank you.*

High Pressure - Assets Affected

This information is only valid for 28 days from the date of issue

In reply to your enquiry, there are **High Pressure Gas Mains** in the vicinity of your intended work, as generally illustrated on the attached map. There may also be other mains or services at the location, as discussed in the warning below. **For an explanation of the map, please see the information below and the legend attachment.**

Excavation Guidelines

Prior to **any** excavations in this area, you **must** contact the High Pressure Response Coordinator to arrange a survey via:

<http://mygasservices.jemena.com.au> (High Pressure Works / High Pressure Standby)

Please note that a duty of care exists to ensure gas assets are not compromised or damaged. Jemena's expectation is the excavator operator holds a current Verification of Competency (VOC) or equivalent for the machine to be used near Jemena High Pressure Gas Assets.

Further standby enquiries can be directed to the High Pressure Coordinator -

E: infrastructureprotection@jemena.com.au or **PH:** 1300 665 380

Appointments will be coordinated with availability of a Jemena Representative to arrange a survey. For all works in the vicinity of High Pressure Gas Mains you **must** arrange for a Jemena Representative to attend and supervise all excavations. Charges may apply.

In accordance with clause 34(5) of the Gas Supply (Safety and Network Management) Regulation 2013 (NSW), you should be informed that all excavation, (including pot-holing by hand to confirm the location of pipes) should be performed in accordance with "**Work Near Underground Assets Guideline**" published in 2007 by the Work Cover Authority.

A copy of this Guideline is available at: www.safework.nsw.gov.au

Warning: The enclosed plans show the position of Jemena Gas Networks (NSW) Ltd's underground gas mains and installations in public gazetted roads only. **Individual customers' services and services belonging to other third parties are not included** on these plans. These plans have been prepared solely for the use of Jemena Gas Networks (NSW) Ltd and Jemena Asset Management Pty Ltd (together "**Jemena**") and any reliance placed on these plans by you is entirely at your own risk. The plans may show the position of underground mains and installations relative to fences, buildings etc., as they existed at the time the mains etc were installed. The plans may not have been updated to take account of any subsequent change in the location or style of those features since the time at which the plans were initially prepared. Jemena makes no warranty as to the accuracy or completeness of the enclosed plans and does not assume any duty of care to you nor any responsibility for the accuracy, adequacy, suitability or completeness of the plans or for any error, omission, lack of detail, transmission failure or corruption in the information provided. Jemena does not accept any responsibility for any loss that you or anyone else may suffer in connection with the provision of these plans, however that loss may arise (including whether or not arising from the negligence of Jemena, its employees, agents, officers or contractors). The recipient of these plans must use their own care and diligence in carrying out their works and must carry out further surveys to locate services at their work site. Persons excavating or carrying out other earthworks will be held responsible for any damage caused to Jemena's underground mains and equipment. Jemena advises that you may be required to carry out potholing by hand if required by a Jemena Representative to confirm the location of Jemena's main and installations. This must also be performed by you under the supervision of a Jemena Representative and be carried out in accordance with the Working Near Underground Assets Guideline published in 2007 by Work Cover Authority

In case of Emergency Phone 131 909 (24 hours)

Admin 1300 880 906

Network Mains

| | |
|---------|---|
| | Proposed New Main (coloured as per kPa) |
| | Proposed Isolate (coloured as per kPa) |
| | Unknown kPa |
| | 2kPa Low Pressure gas main |
| | 7kPa Low Pressure gas main |
| | 30kPa Medium pressure gas main |
| | 100kPa Medium Pressure gas main |
| | 210kPa Medium Pressure gas main |
| | 300kPa Medium Pressure gas main |
| | 400kPa Medium Pressure gas main |
| | 1050kPa High Pressure gas main |
| | 3500kPa High Pressure gas main |
| | 7000kPa High Pressure gas main |
| | >7000kPa Transmission pipeline |
| | Isolated Service - Former Med/High Pressure |
| | Isolated Steel Main - Treat as High Pressure |
| | Conduit or Casing |
| 100 PVC | Size & Material (see conduit material codes) |
| | Critical Main - Treat as High Pressure (Main coloured as per kPa) |
| | Exposed Main section EXPOSED |
| | Shallow Main section: see Protection Code below, no code assume no protection |
| SP | Steel Plate |
| PP | PE Plate |
| CS | Concrete Slab |
| CE | Concrete Encased |
| UNK | Unknown Type |

Network Assets

| | |
|--|---|
| | Siphon |
| | Network Valve |
| | High Pressure Automatic Line Break Valve (>1050kPa) |
| | Distribution Regulator Set (=<1050kPa) |
| | High Pressure Regulating Station (>1050kPa) |

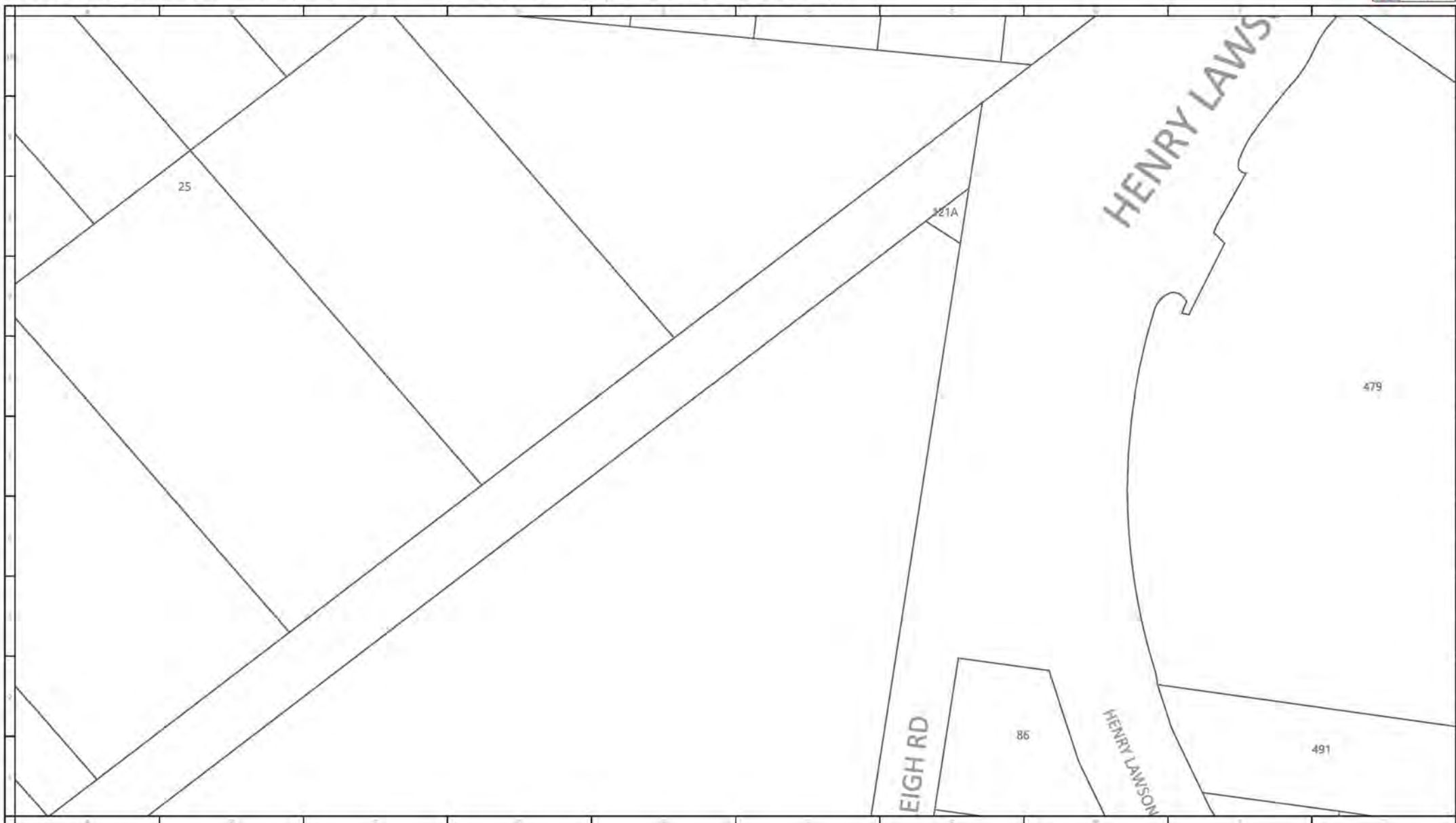
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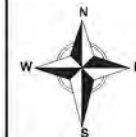
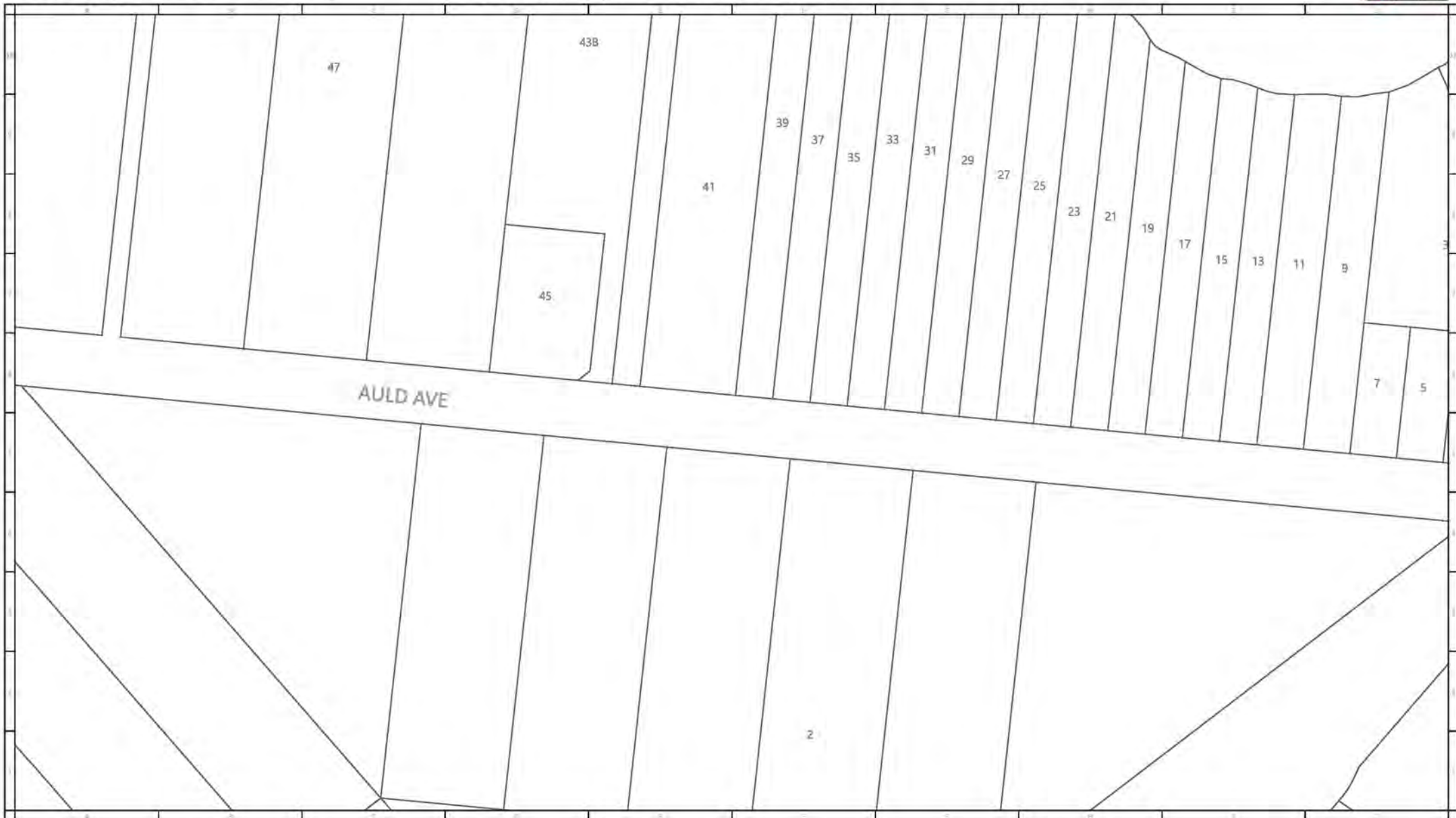
Pipe and Conduit Material Codes

| | | | |
|------|---------------------|------|--------------------------|
| NY | Nylon | NB | Nominal Bore – Cast Iron |
| PE | Polyethylene | ST | Steel |
| P/PL | Plastic (undefined) | C/CO | Copper |
| PVC | Polyvinyl Chloride | | |

Pipe code combinations and dimension references

| | |
|--------------|--|
| ⑥NB 50MM NY | 50mm Nylon main inserted into 6 inch (Nominal Bore) Cast Iron pipe |
| ⑤0MM 32MM NY | 32mm Nylon main inserted into 50mm Steel pipe |
| ~1.5 | Distance (in metres) of main from Boundary Line (MBL) |
| MBK | Distance in Metres Back of Kerb |
| MKL | Distance in Metres from Kerb Line |
| MEBL | Distance in Metres from Eastern Boundary Line (North/South/West) |
| MCL | Distance in Metres from Centre Line of Road |
| MFL | Distance in Metres from Fence Line |







For legend details, please refer to the Coversheet attachment provided as part of this DBYD response.



Scale: 1:2000

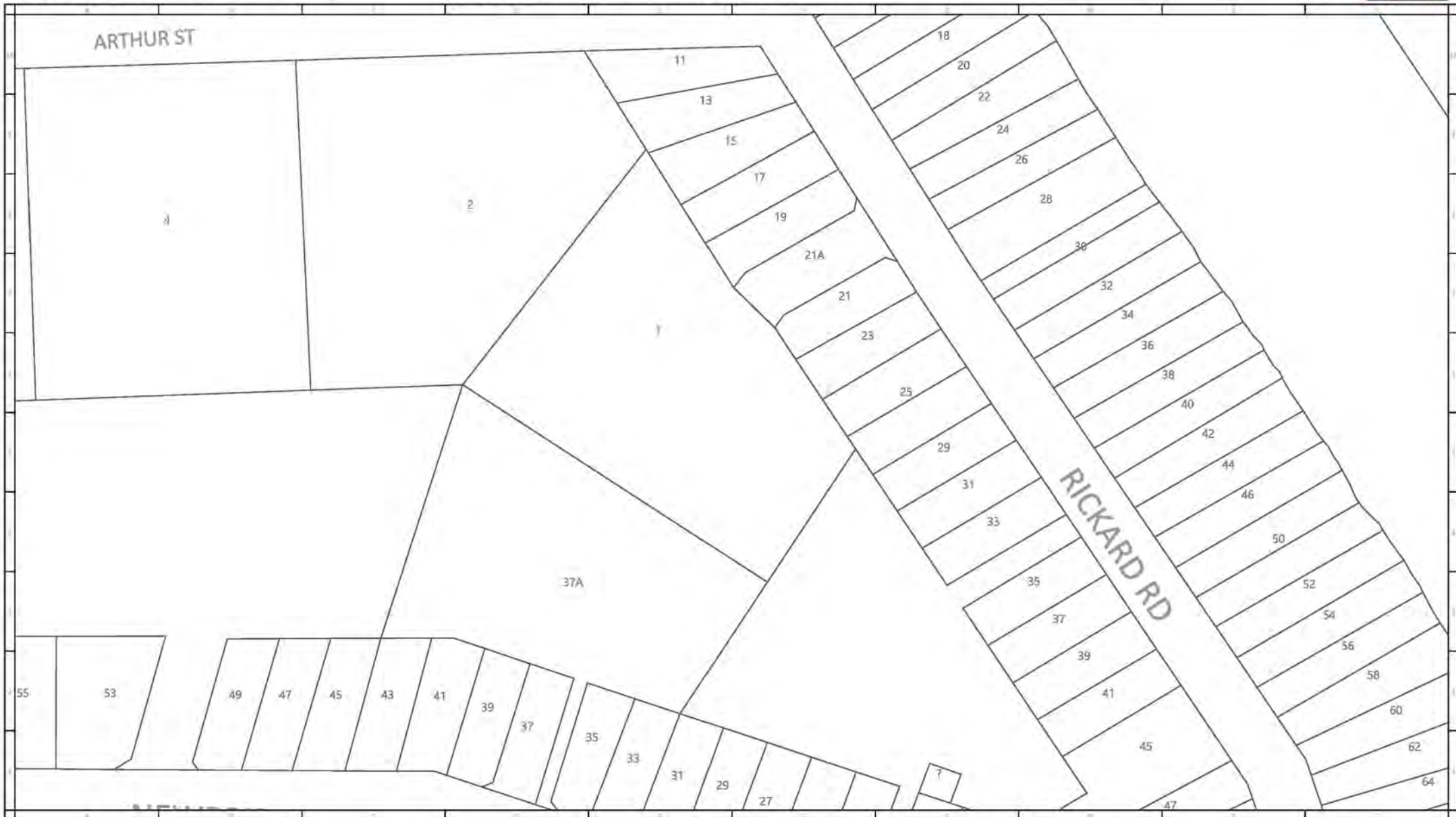
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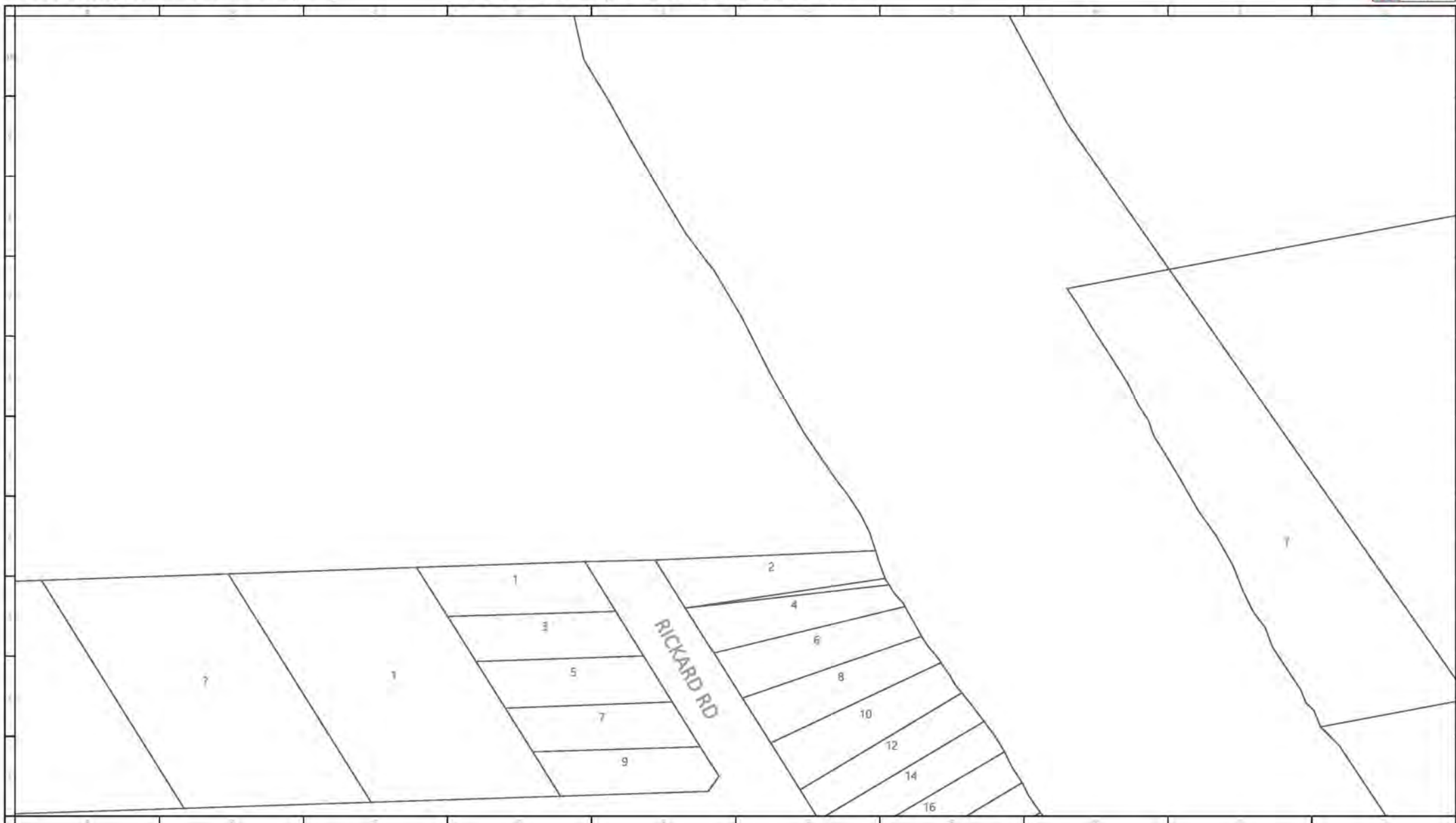
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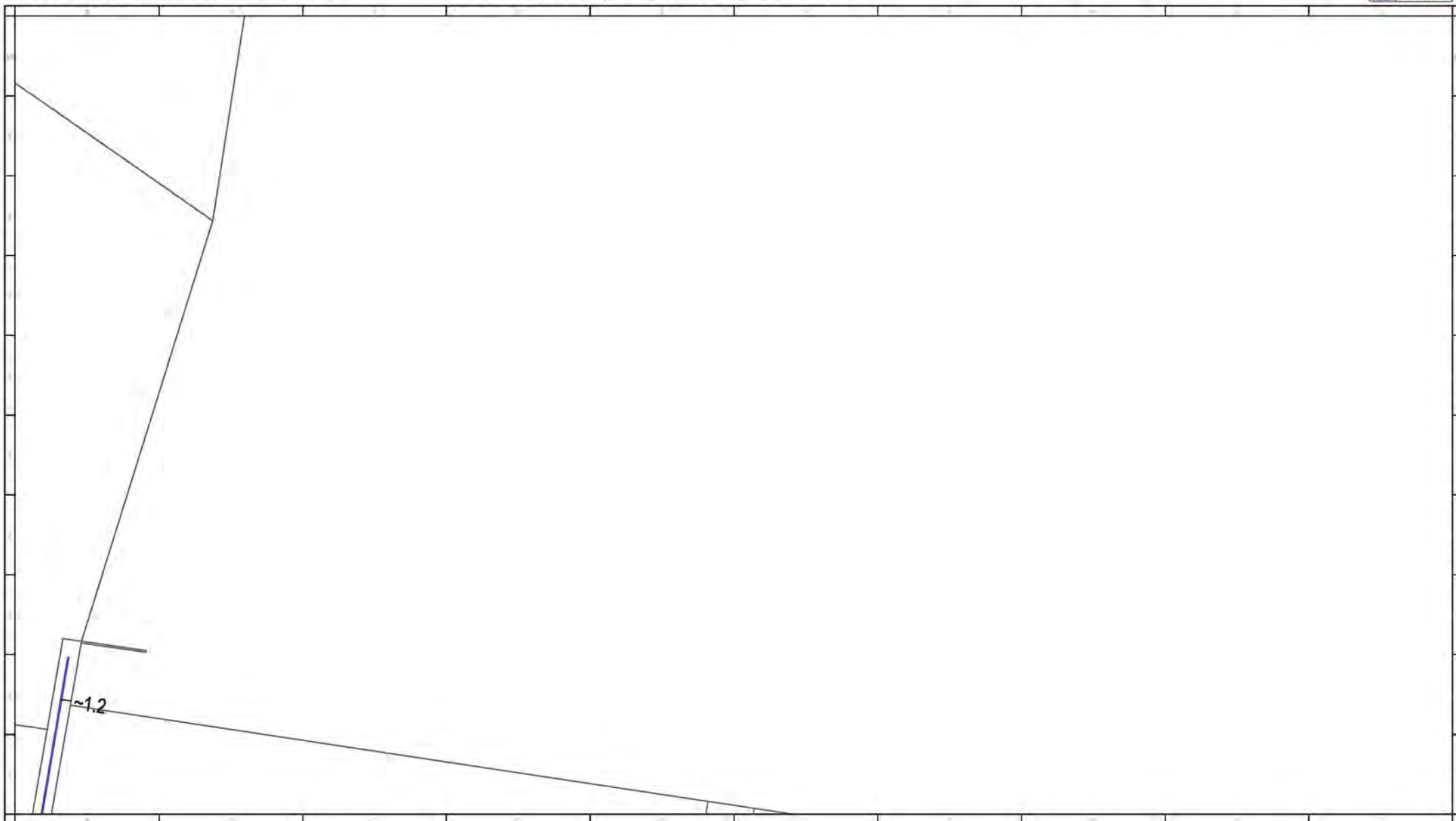
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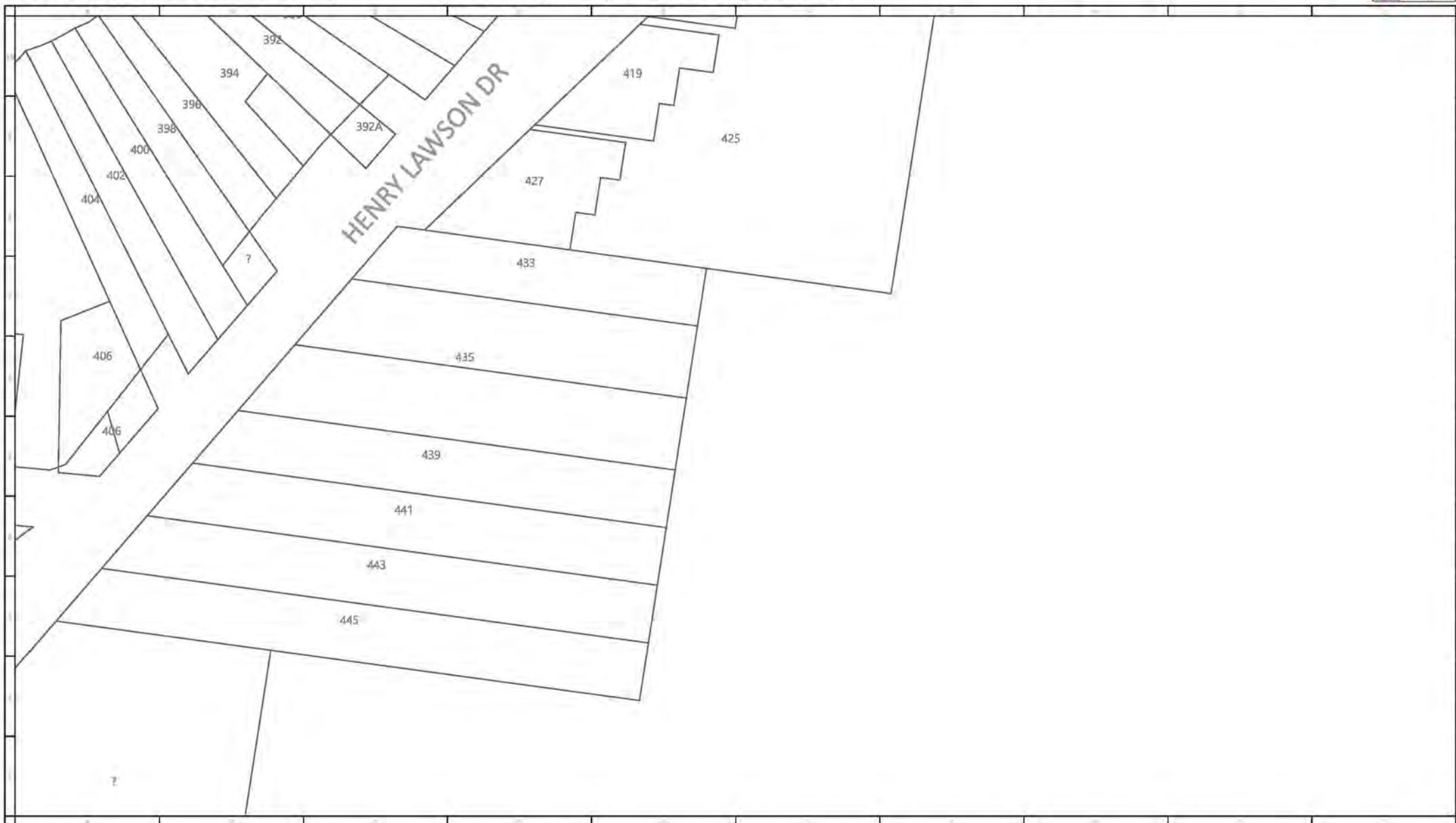
0m 10m 20m 30m 40m 50m 60m 70m 80m

WARNING: This is a representation of Jemena Gas Networks underground assets only and may not indicate all assets in the area. It must not be used for the purpose of exact asset location in order to undertake any type of excavation. This plan is diagrammatic only, and distances scaled from this plan may not be accurate. Please read all conditions and information on the attached information sheet. This extract is subject to those conditions. The information contained on this plan is only valid for 28 days from the date of issue.









For legend details, please refer to the Coversheet attachment provided as part of this DBYD response.



Scale: 1:2000

Issue Date: 24/09/2020

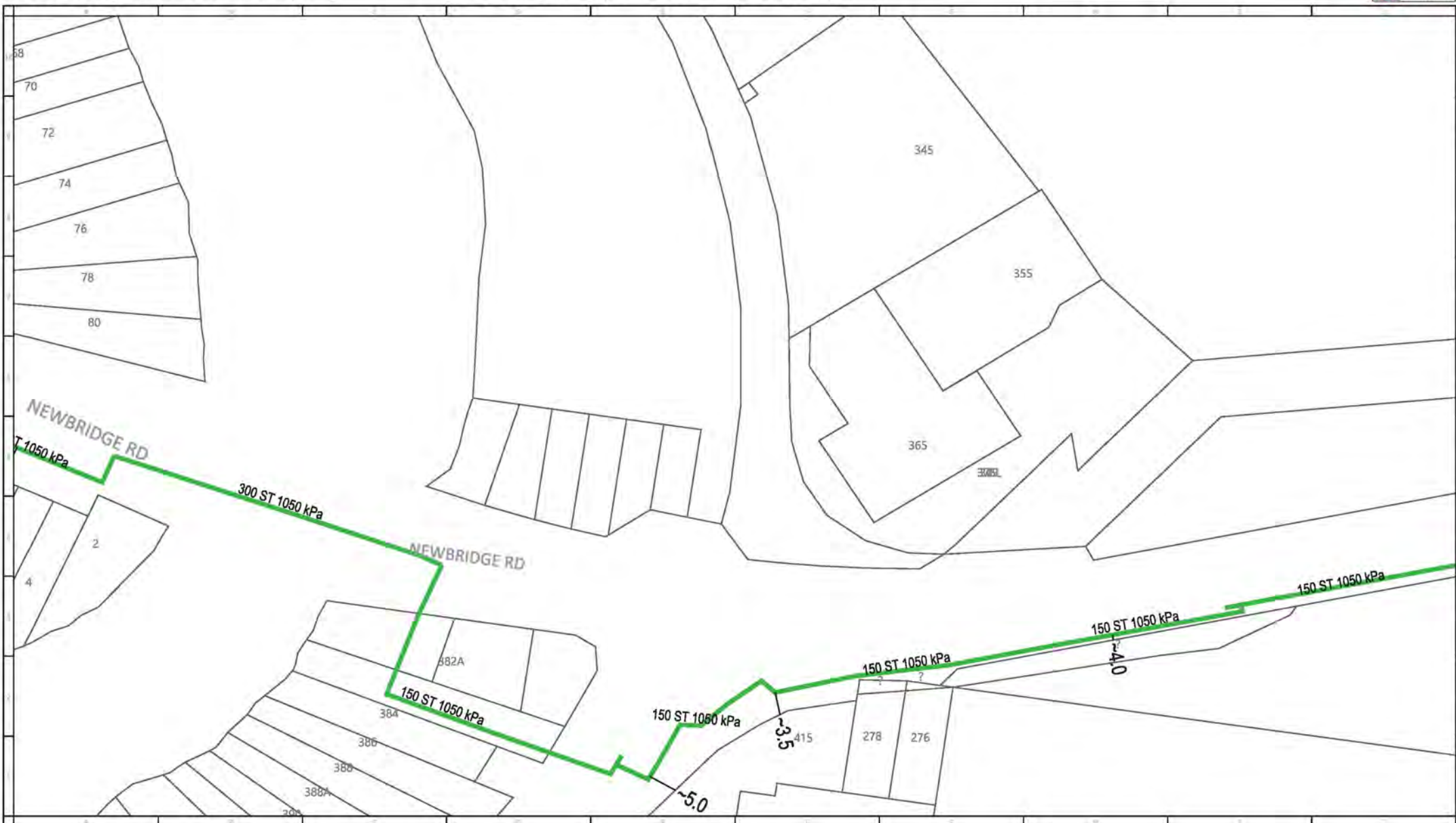
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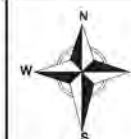
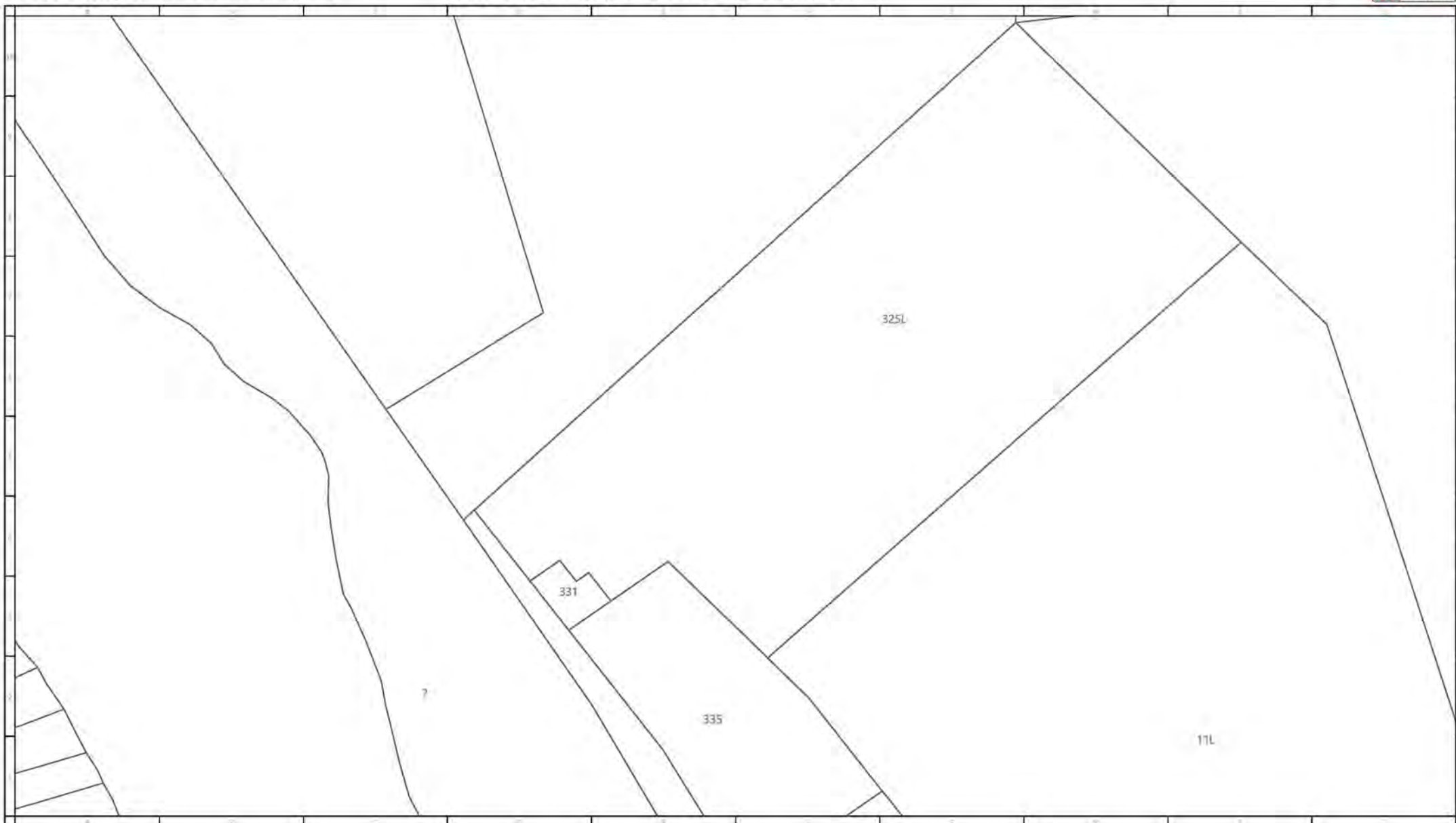
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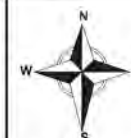
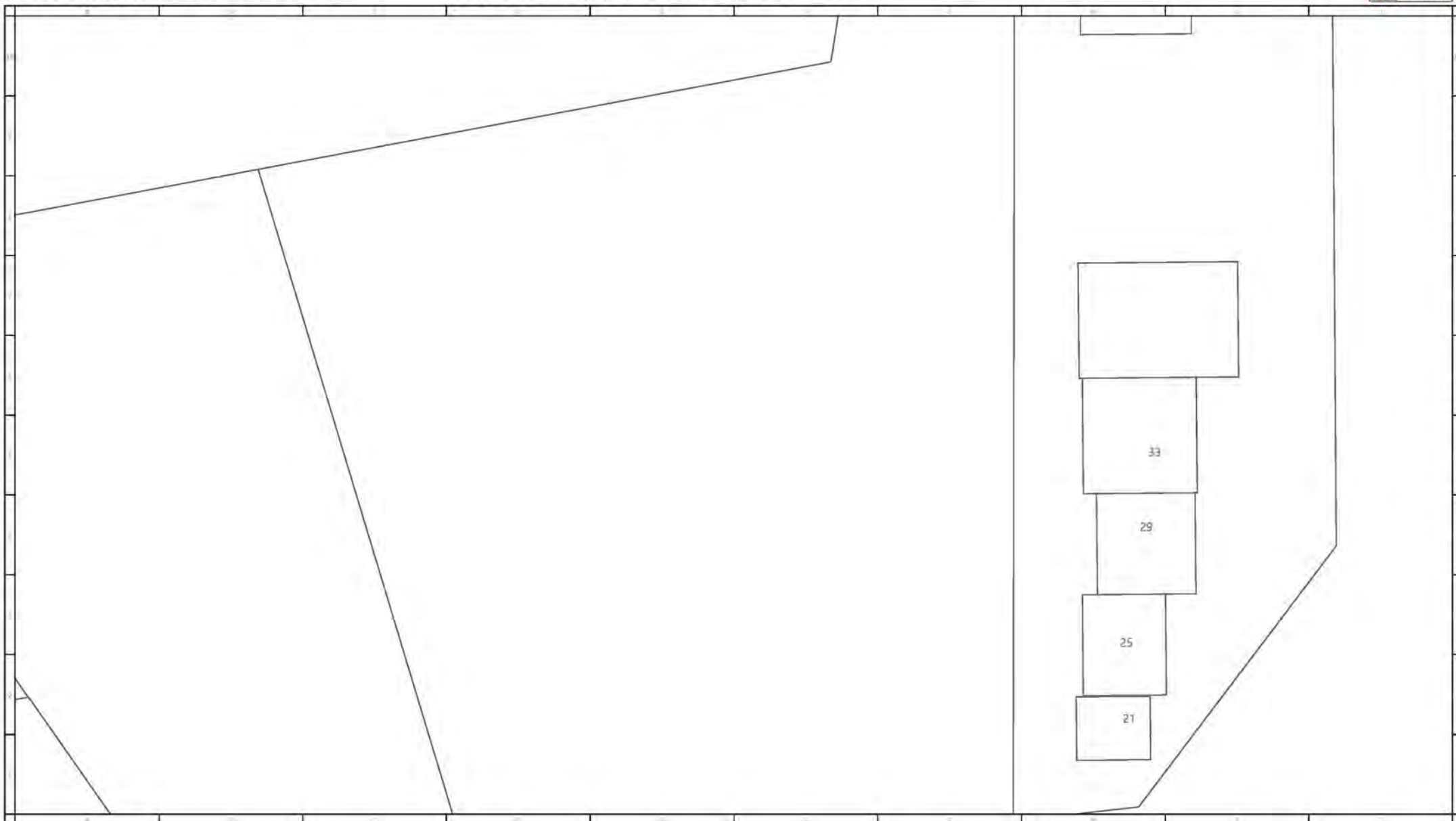
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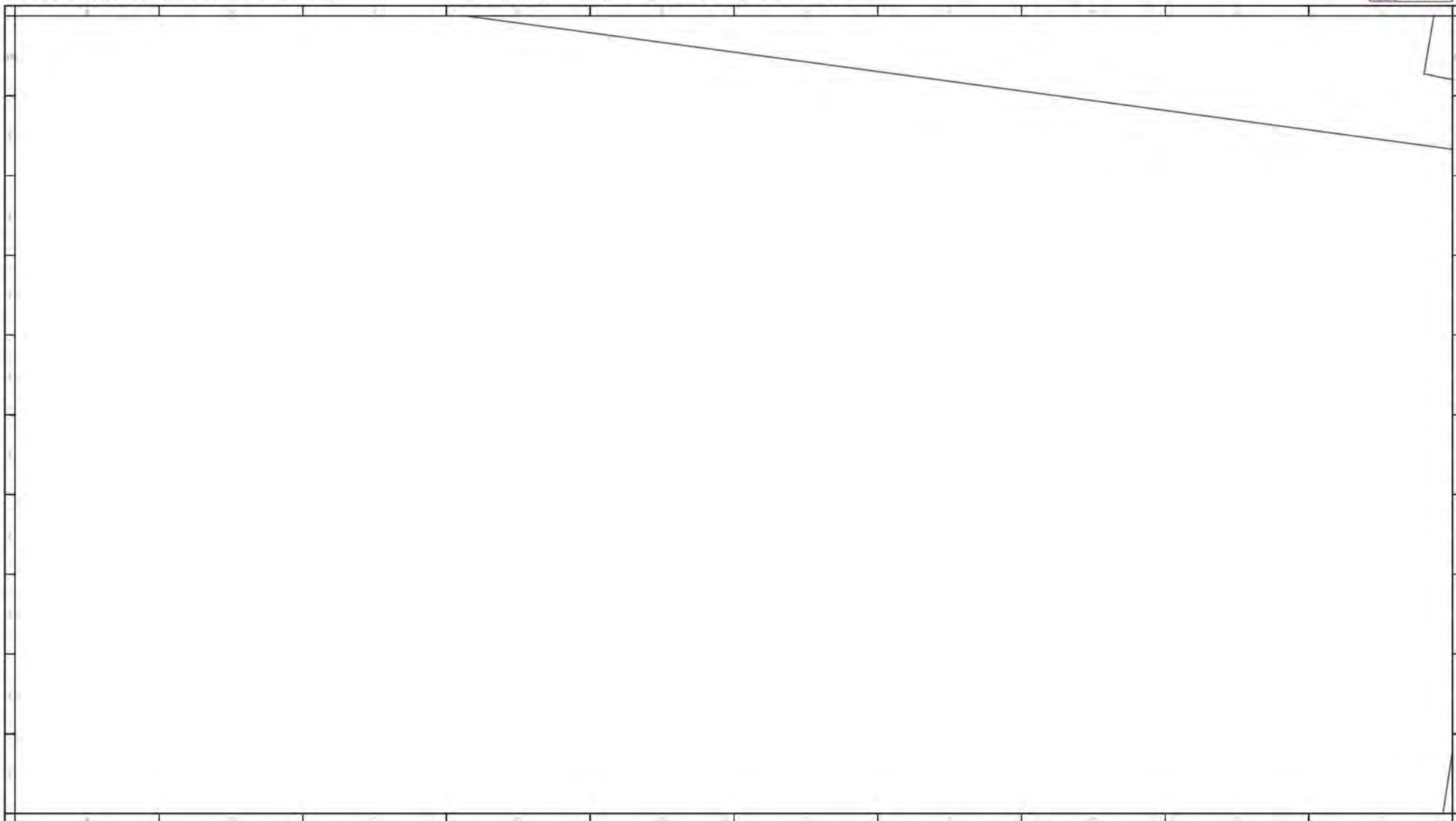


WARNING: This is a representation of Jemena Gas Networks underground assets only and may not indicate all assets in the area. It must not be used for the purpose of exact asset location in order to undertake any type of excavation. This plan is diagrammatic only, and distances scaled from this plan may not be accurate. Please read all conditions and information on the attached information sheet. This extract is subject to those conditions. The information contained on this plan is only valid for 28 days from the date of issue.









For legend details, please refer to the Coversheet attachment provided as part of this DBYD response.



Scale: 1:2000

Issue Date: 24/09/2020

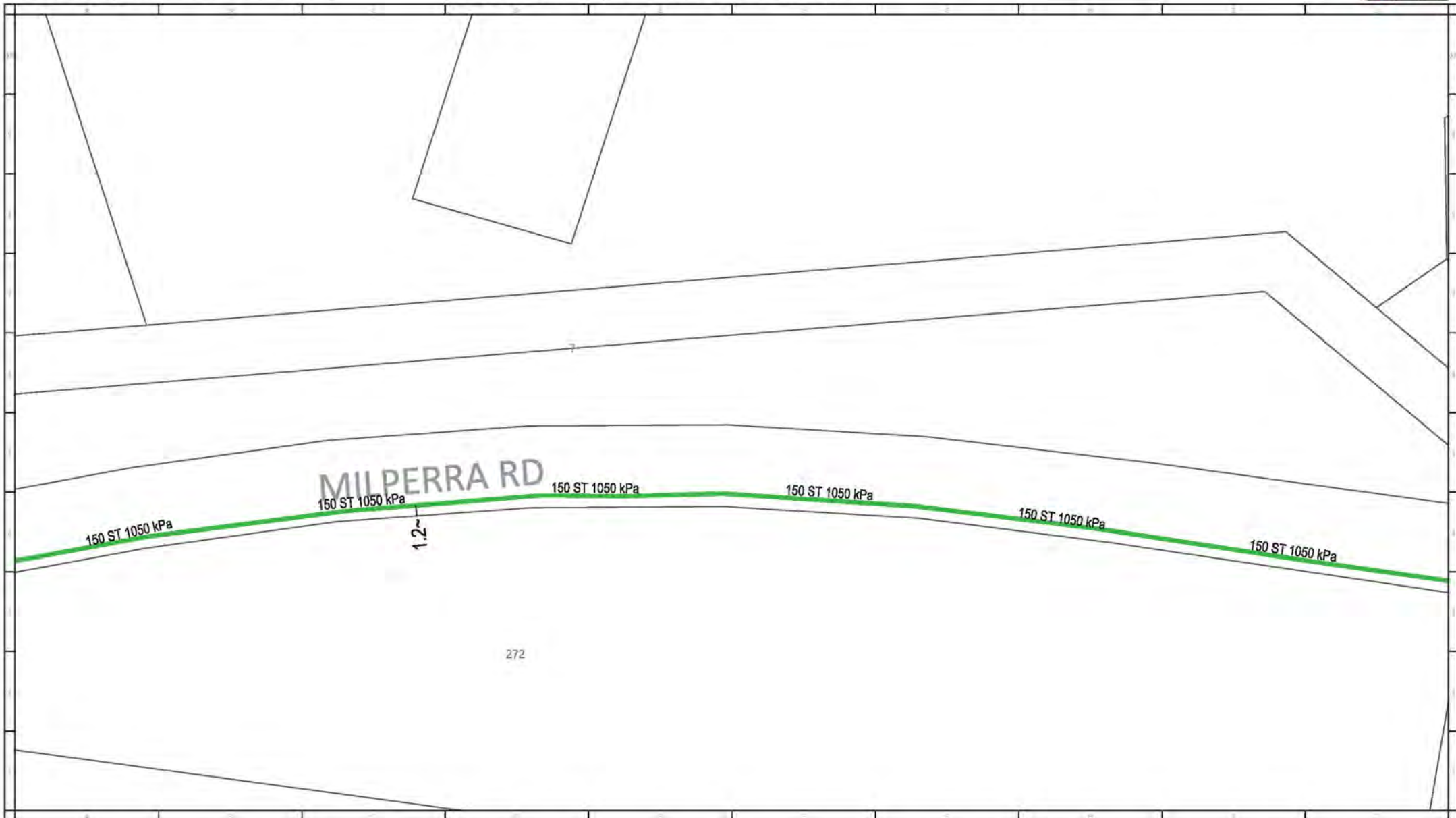
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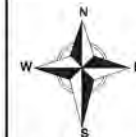
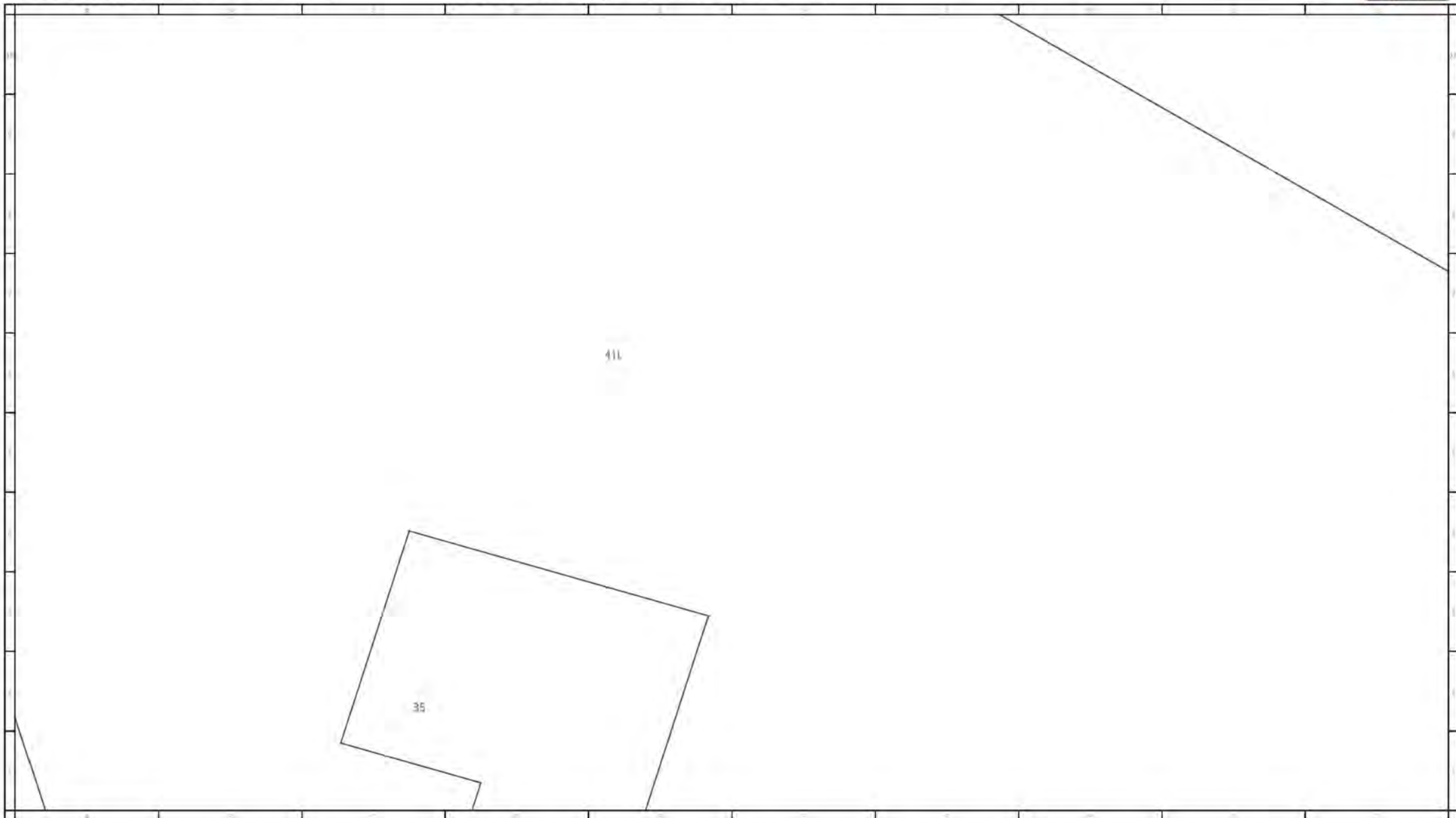
DBYD Job No: 20310876

0m 10m 20m 30m 40m 50m 60m 70m 80m



WARNING: This is a representation of Jemena Gas Networks underground assets only and may not indicate all assets in the area. It must not be used for the purpose of exact asset location in order to undertake any type of excavation. This plan is diagrammatic only, and distances scaled from this plan may not be accurate. Please read all conditions and information on the attached information sheet. This extract is subject to those conditions. The information contained on this plan is only valid for 28 days from the date of issue.










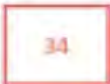




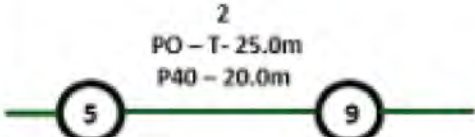





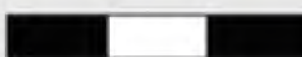
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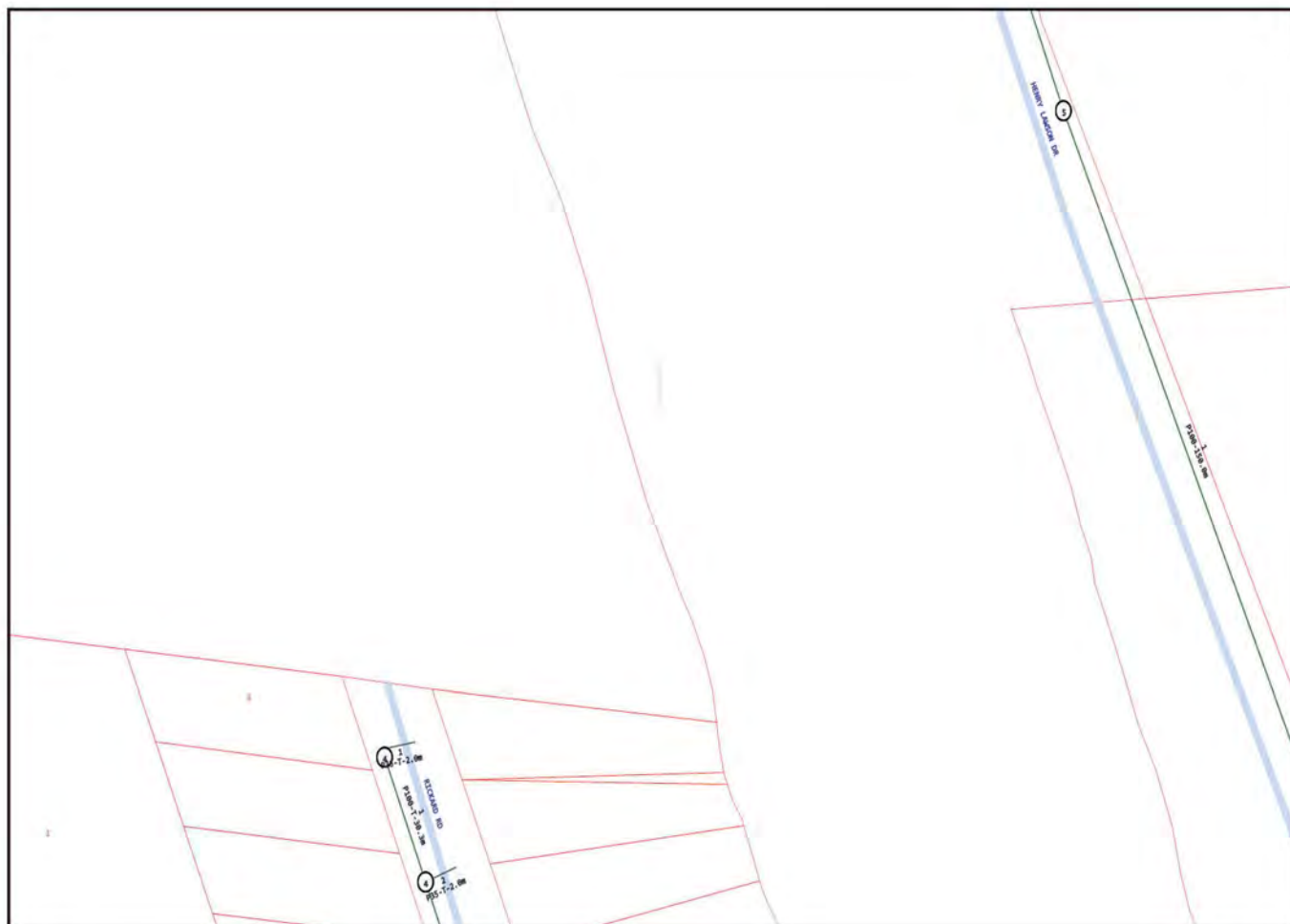
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| Issue Date: | 24/09/2020 |  DIAL BEFORE YOU DIG www.1100.com.au |
| Location: | Henry Lawson Drive , Milperra , NSW , 2214 | |

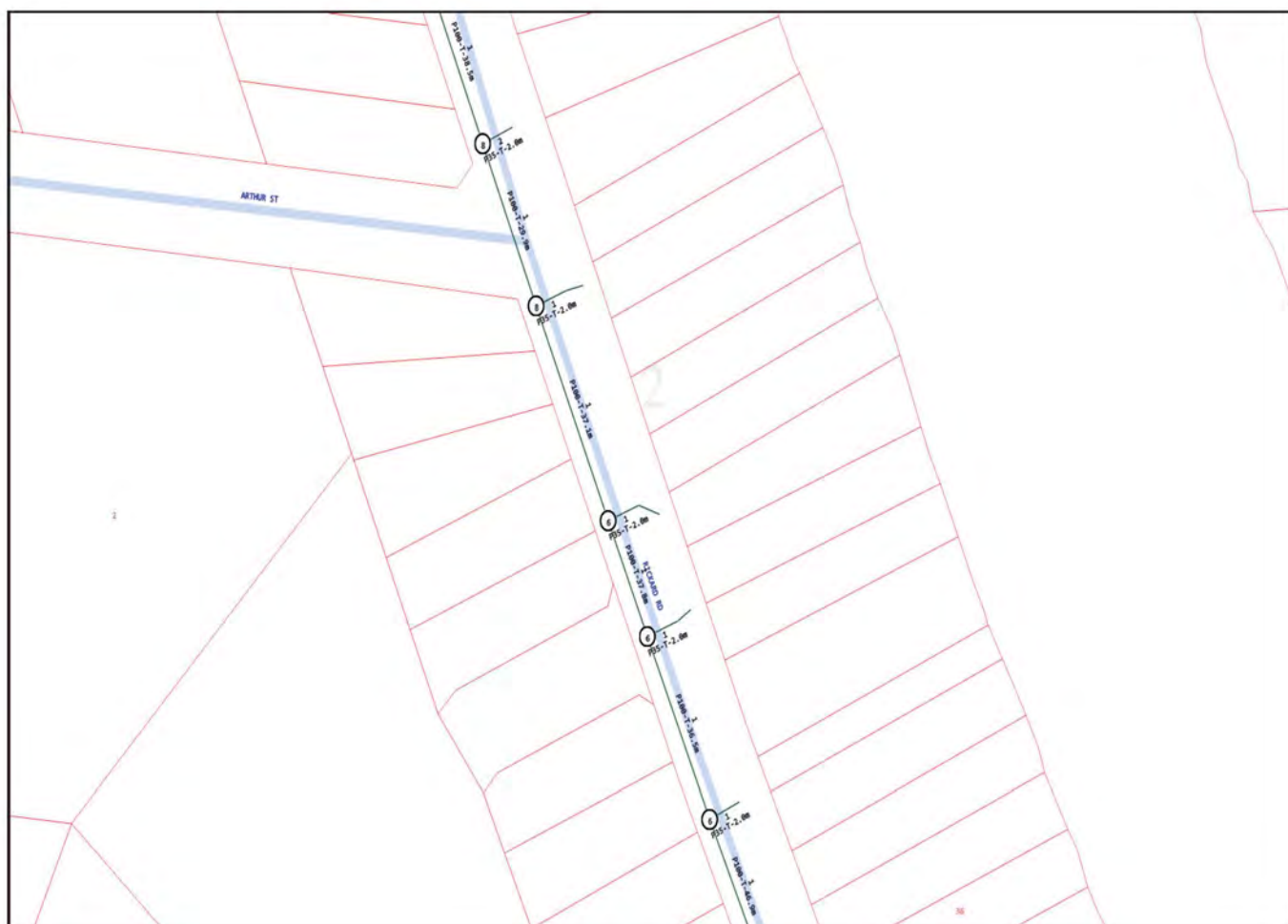
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| 3 | 10 | 17 |
| 4 | 11 | 18 |
| 5 | 12 | 19 |
| 6 | 13 | 20 |
| 7 | 14 | 21 |

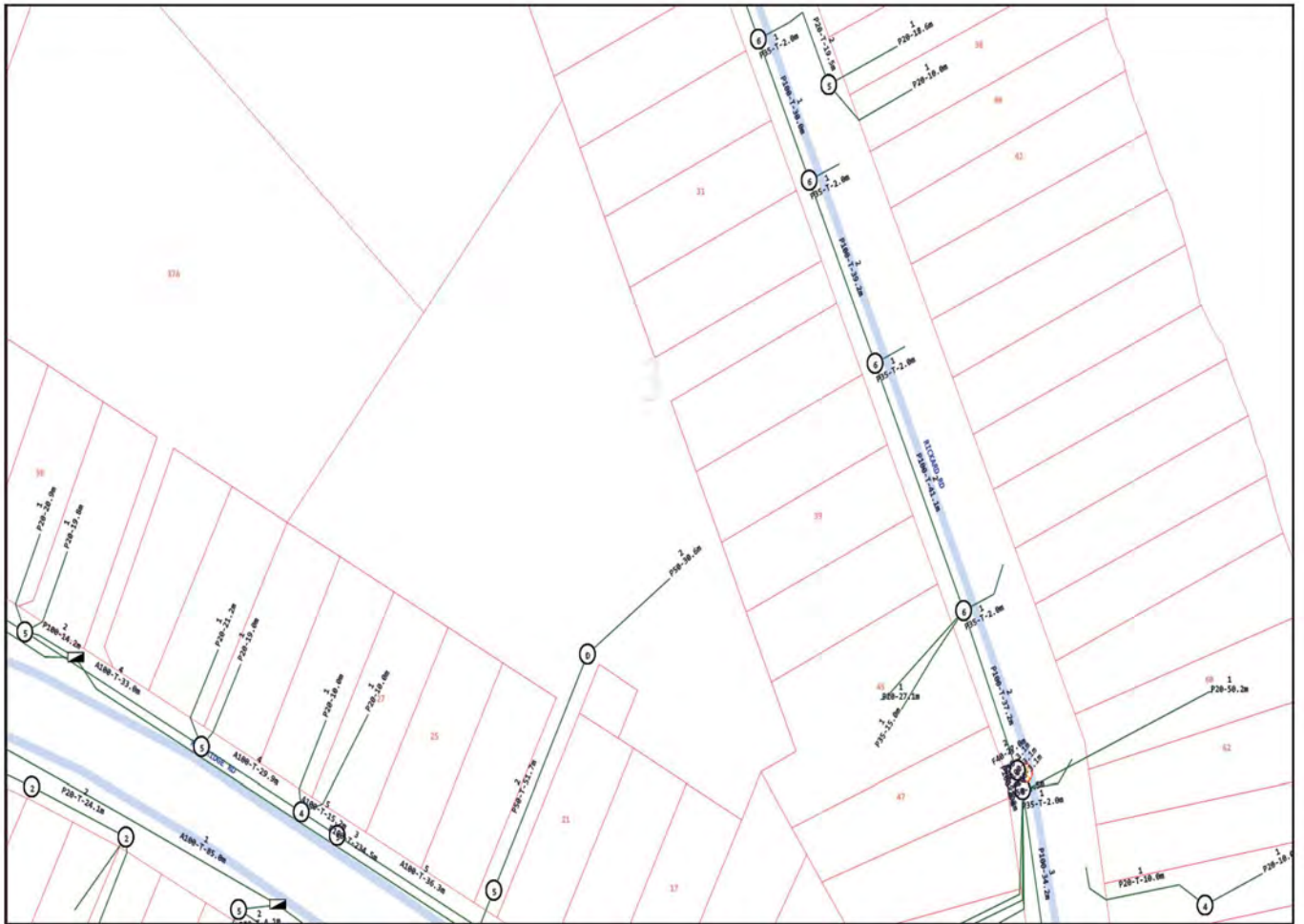


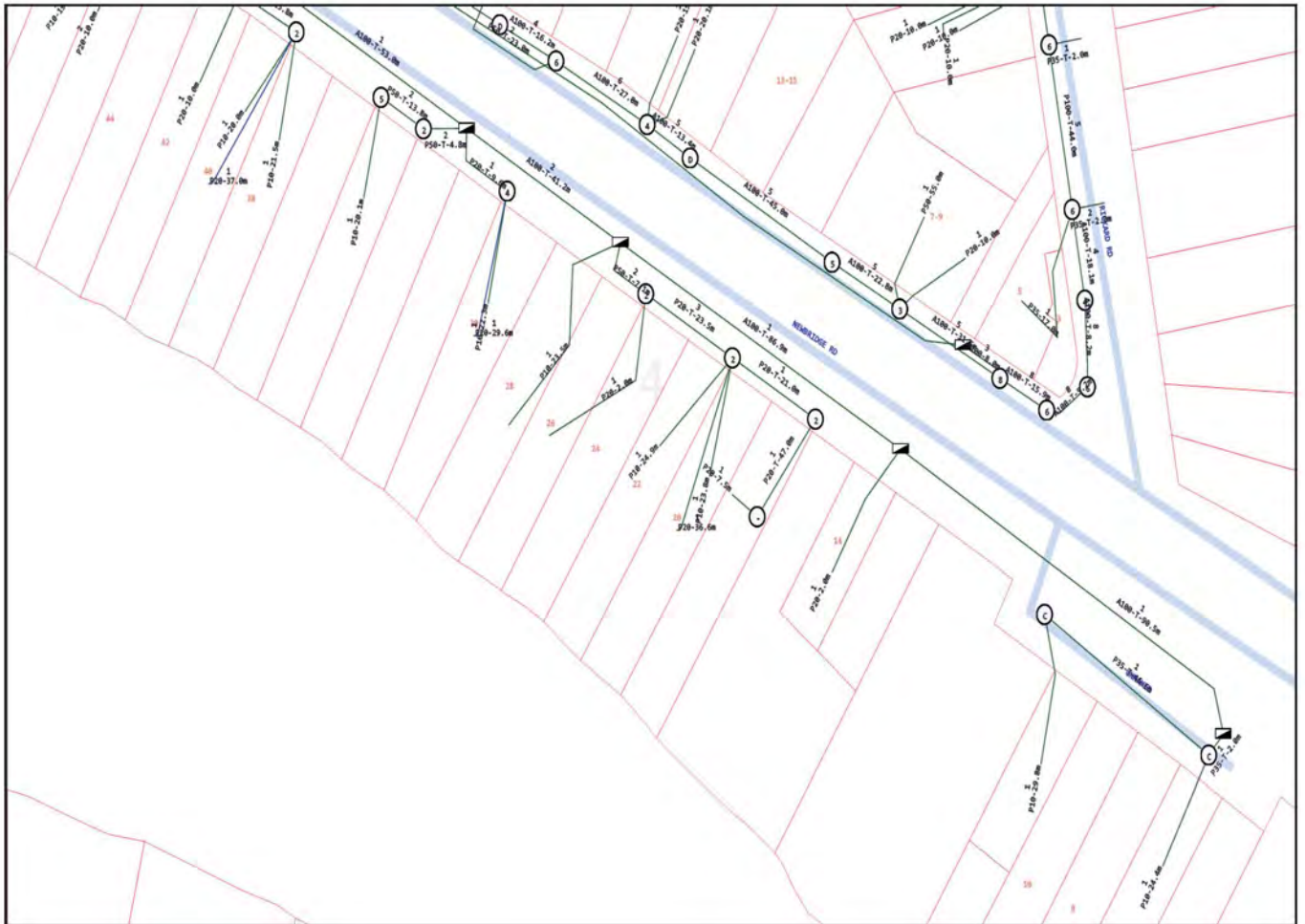
LEGEND

| | |
|---|--|
|  | Parcel and the location |
|  | Pit with size "5" |
|  | Power Pit with size "2E". Valid PIT Size: e.g. 2E, 5E, 6E, 8E, 9E, E, null. |
|  | Manhole |
|  | Pillar |
|  | Cable count of trench is 2. One "Other size" PVC conduit (PO) owned by Telstra (-T-), between pits of sizes, "5" and "9" are 25.0m apart. One 40mm PVC conduit (P40) owned by NBN, between pits of sizes, "5" and "9" are 20.0m apart. |
|  | 2 Direct buried cables between pits of sizes, "5" and "9" are 10.0m apart. |
|  | Trench containing any INSERVICE/CONSTRUCTED (Copper/RF/Fibre) cables. |
|  | Trench containing only DESIGNED/PLANNED (Copper/RF/Fibre/Power) cables. |
|  | Trench containing any INSERVICE/CONSTRUCTED (Power) cables. |
|  | Road and the street name "Broadway ST" |
| Scale | 0 20 40 60 Meters 1:2000 1 cm equals 20 m  |

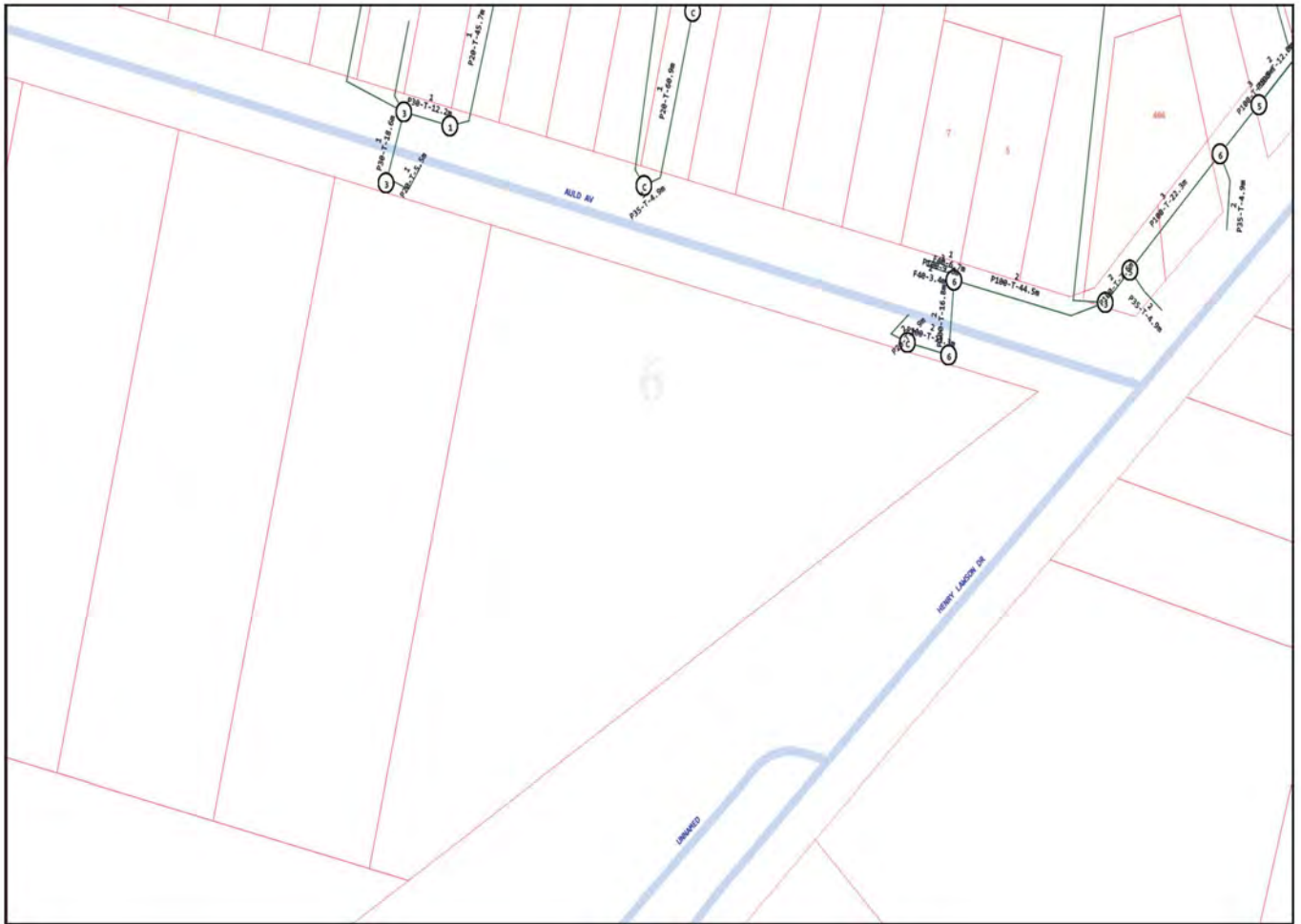


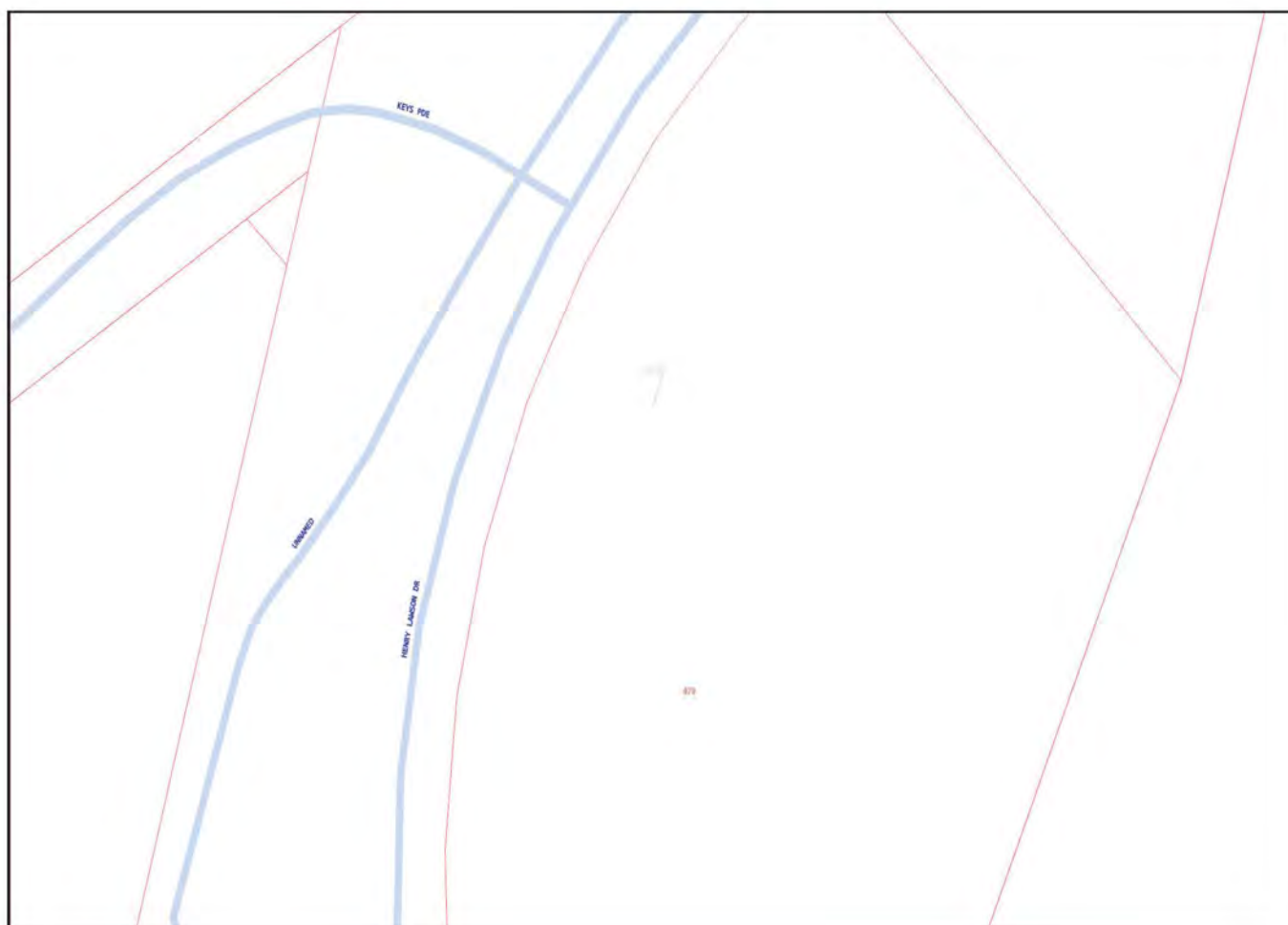




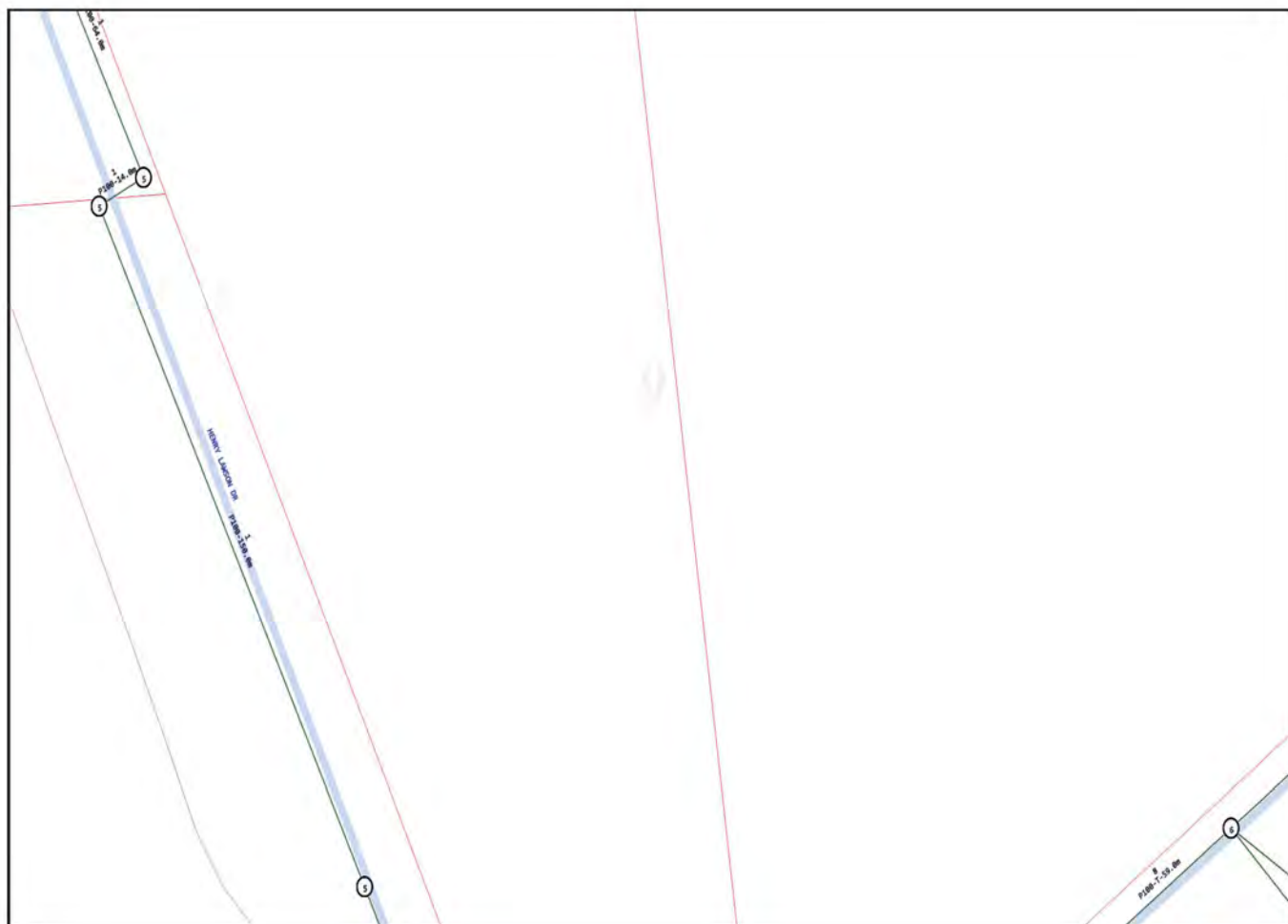


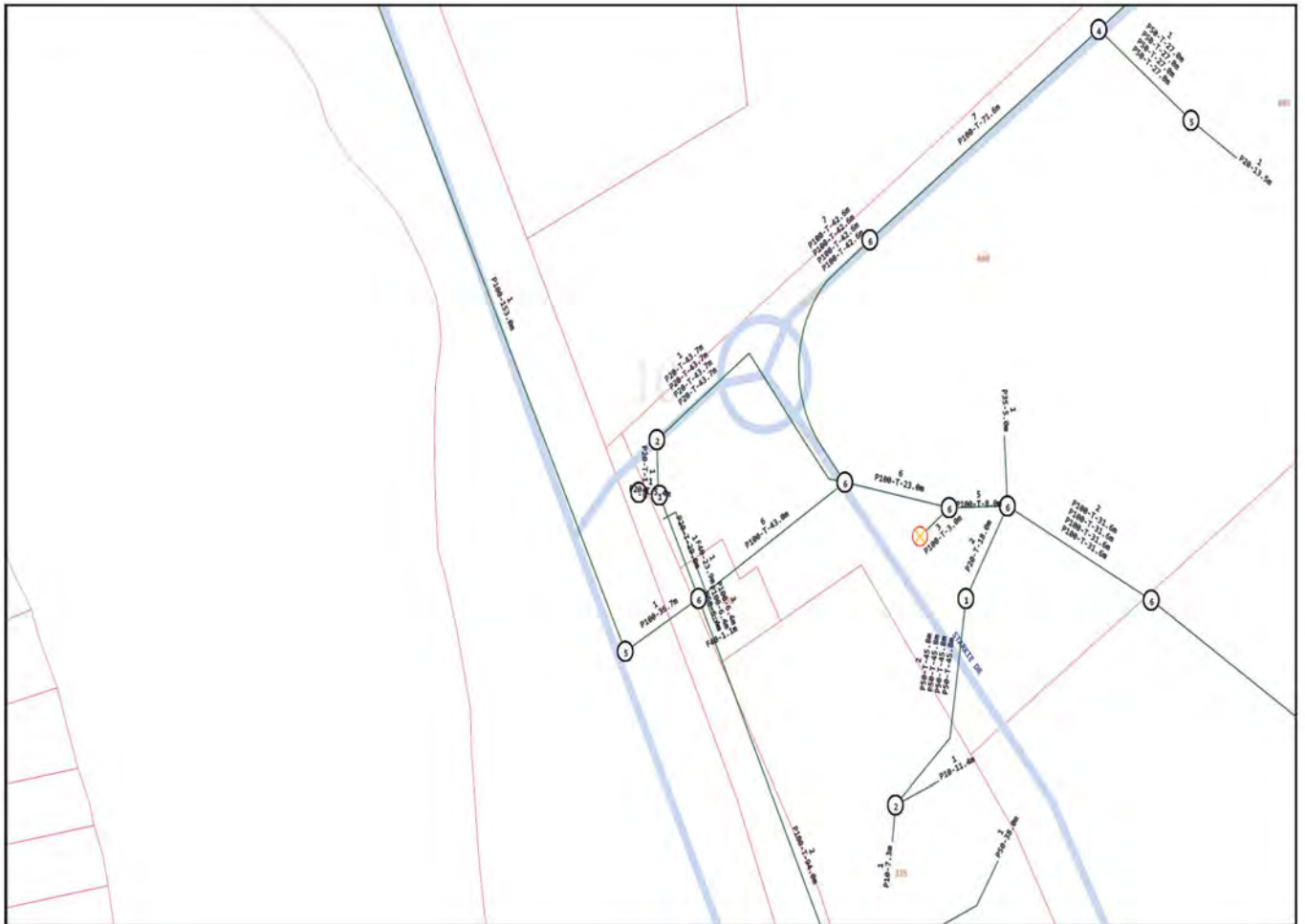


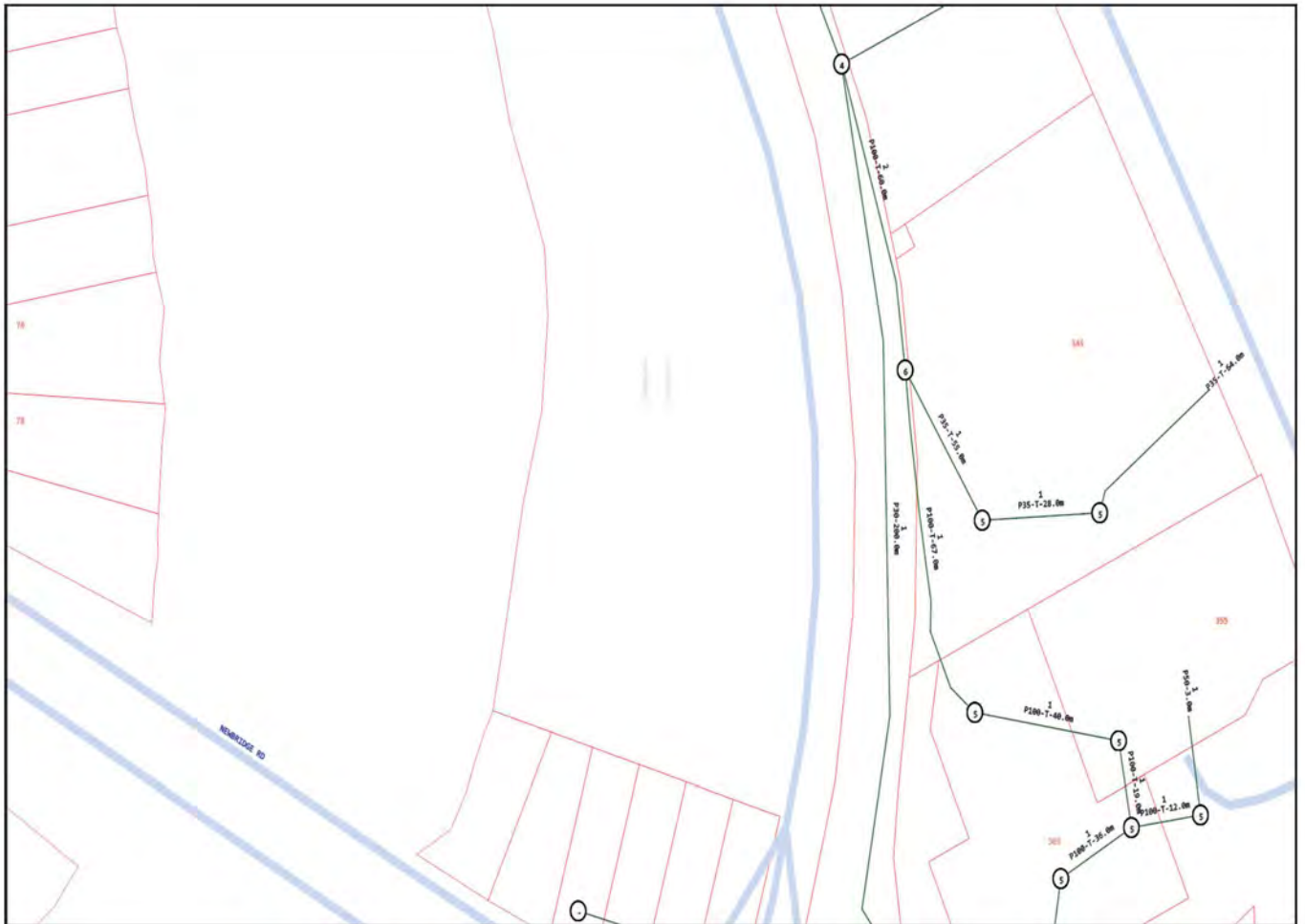


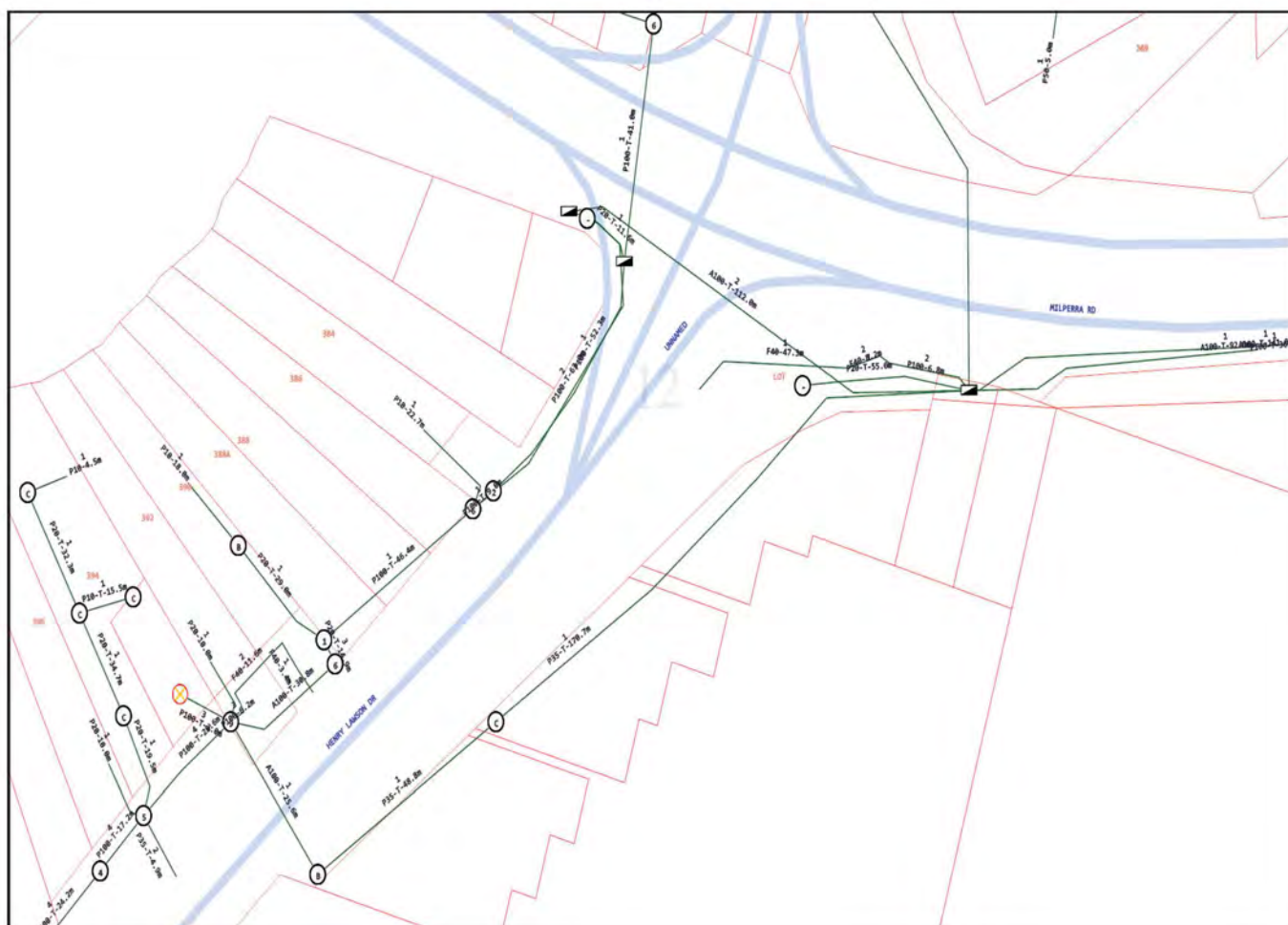


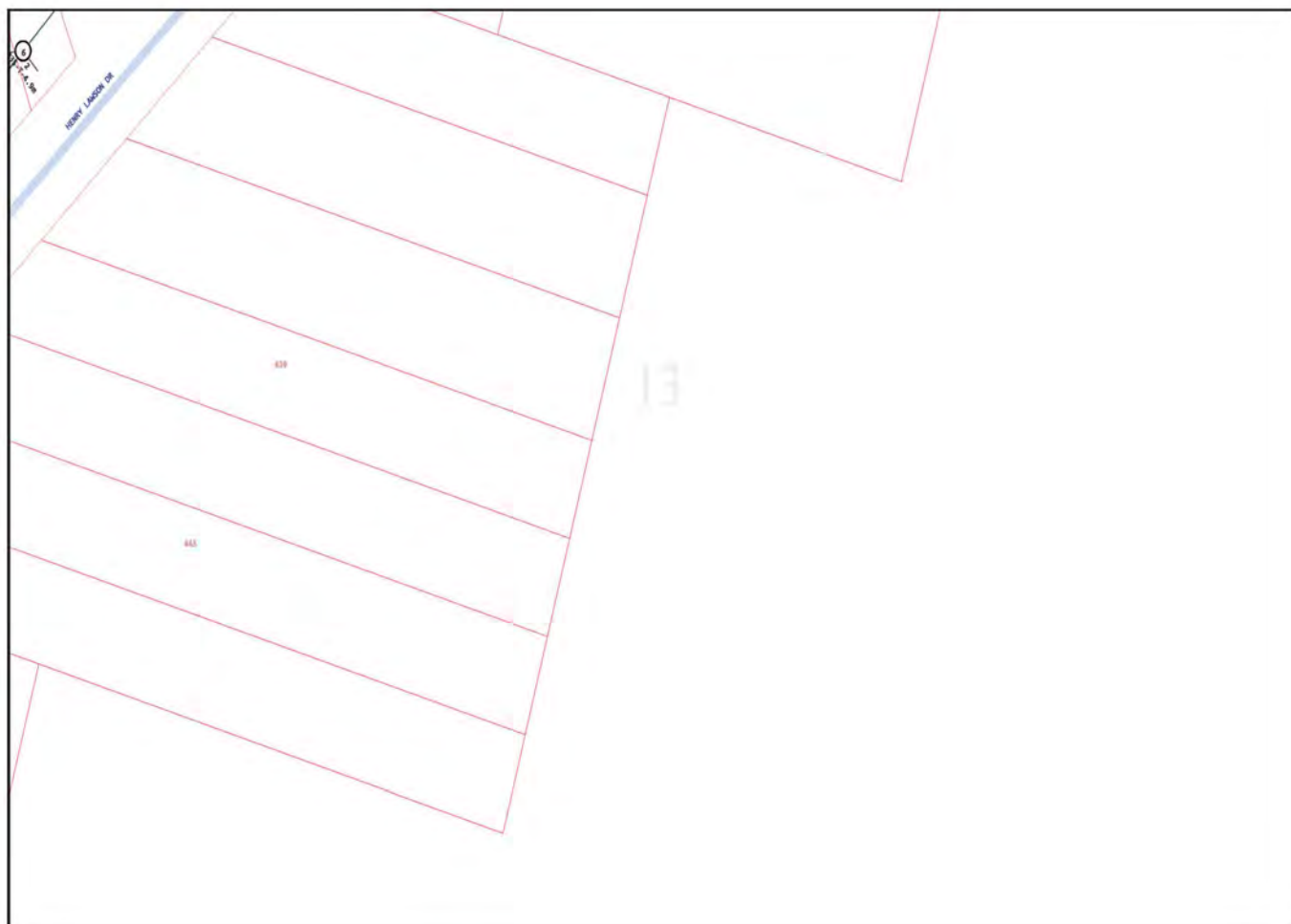


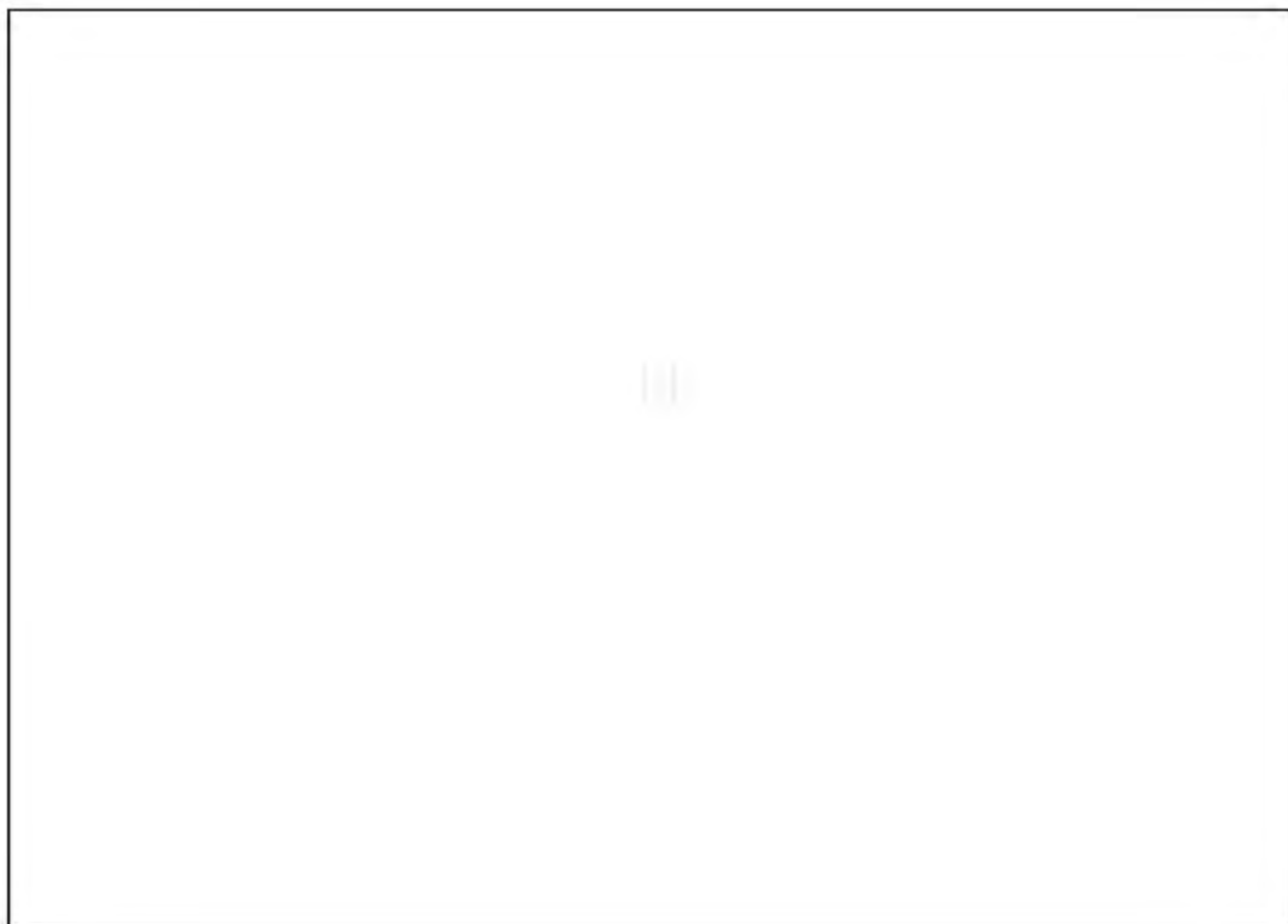


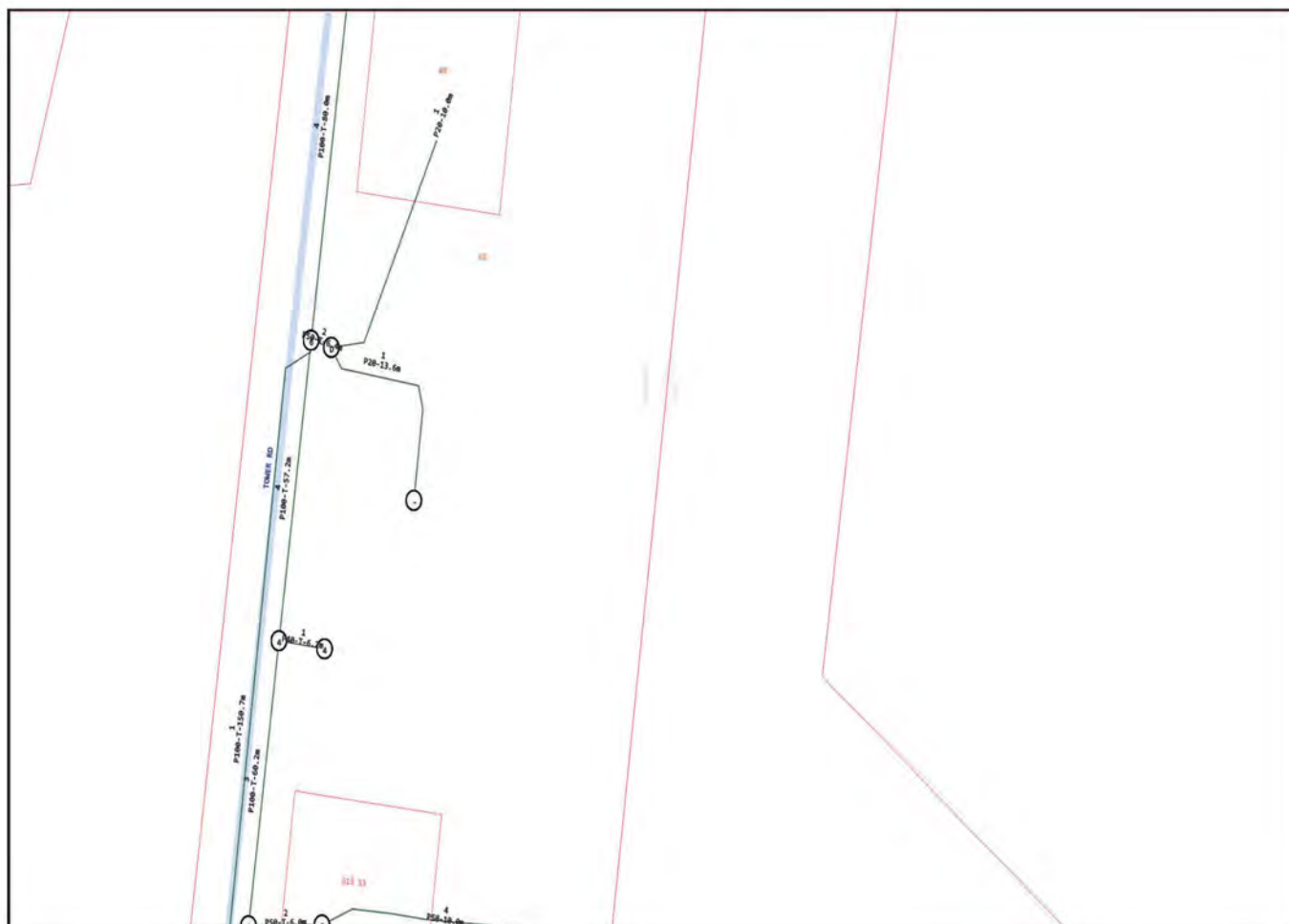


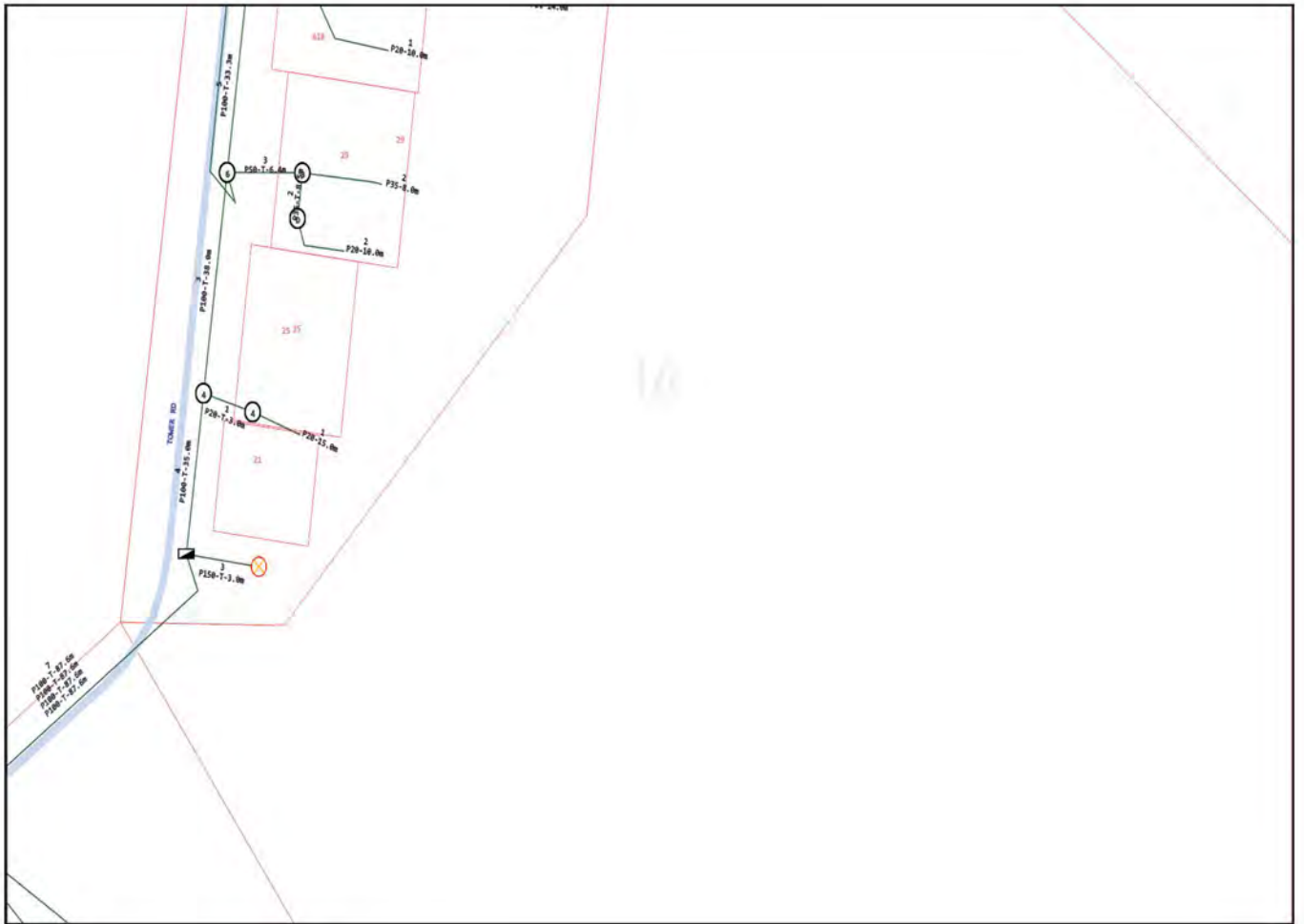


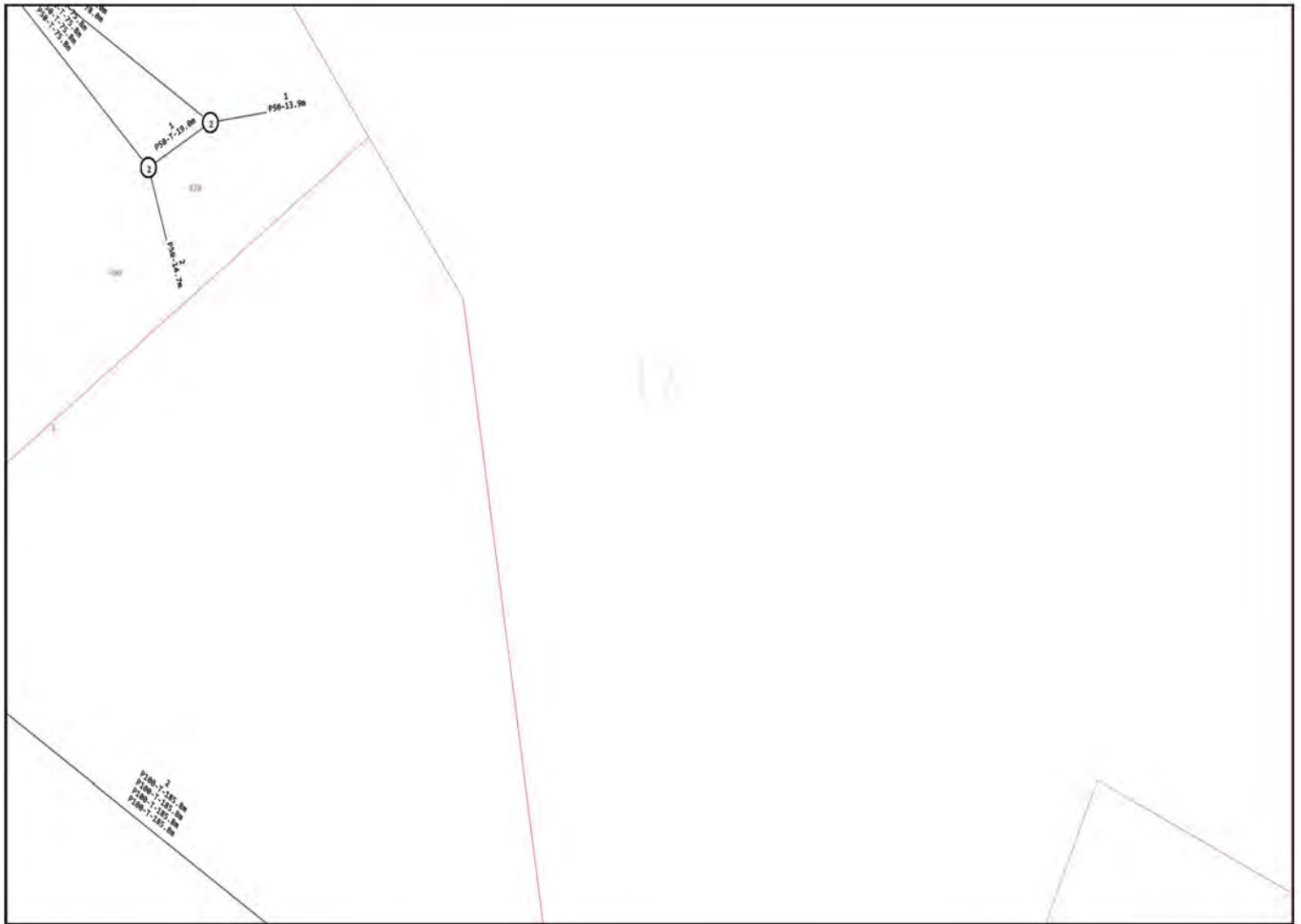


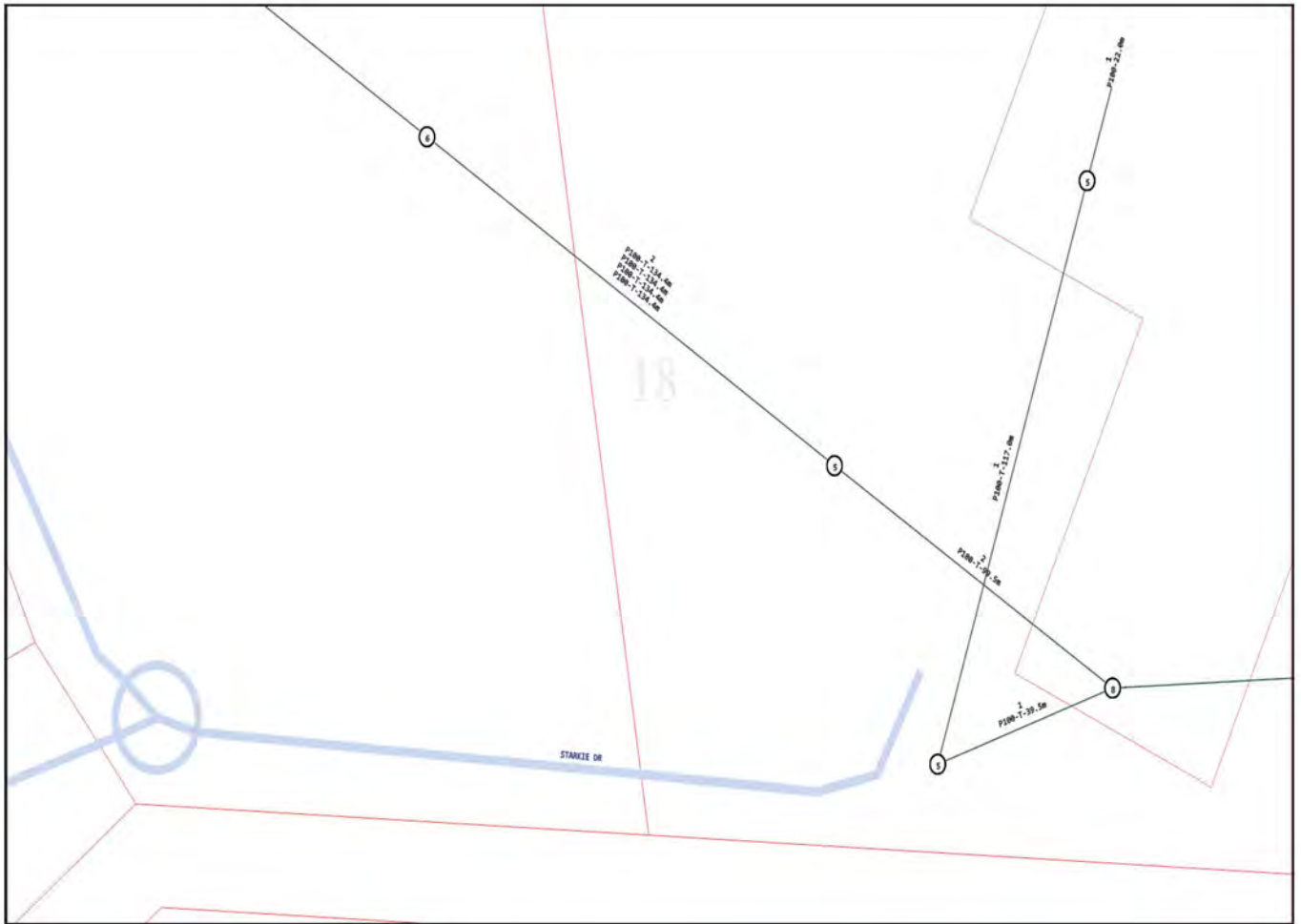


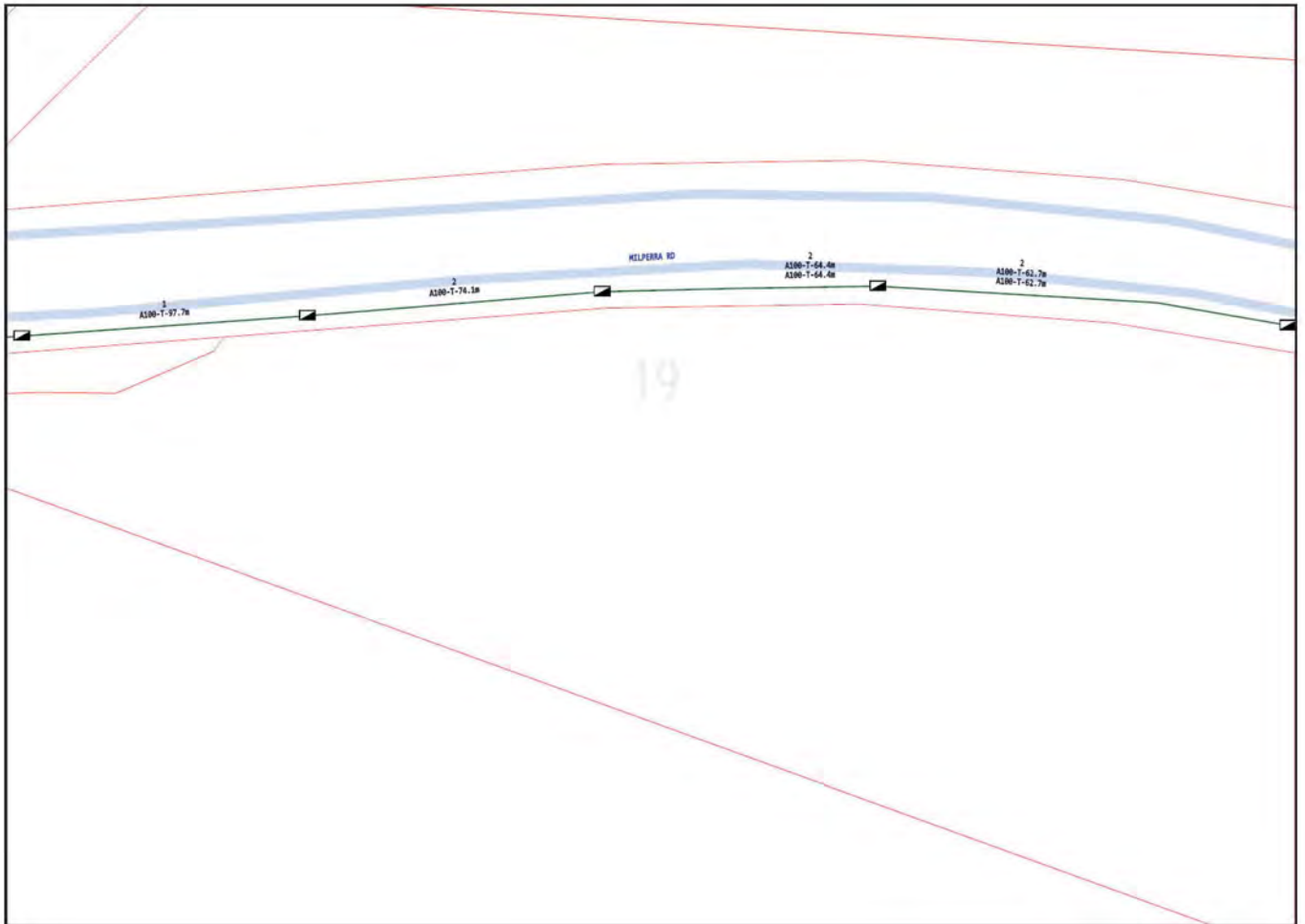


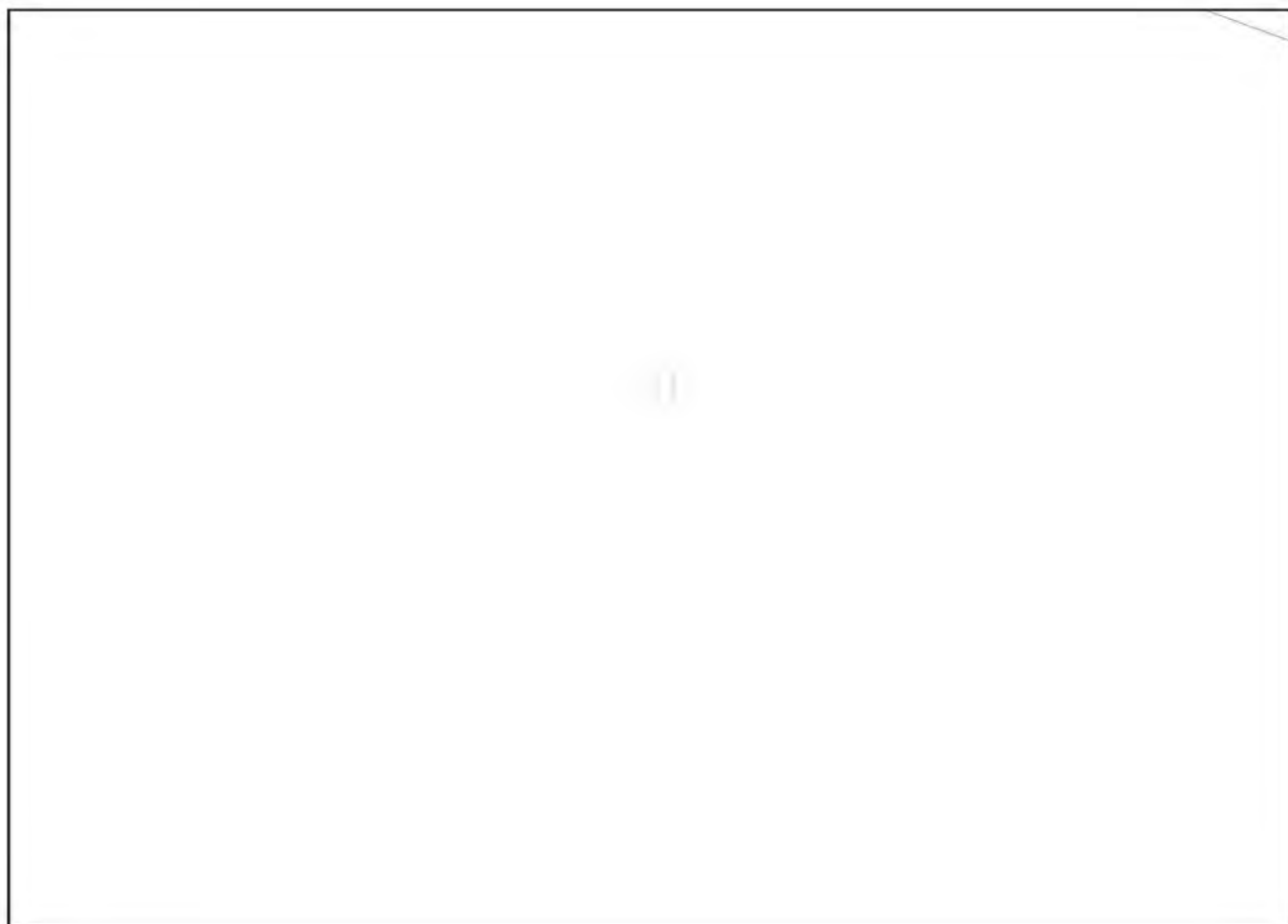


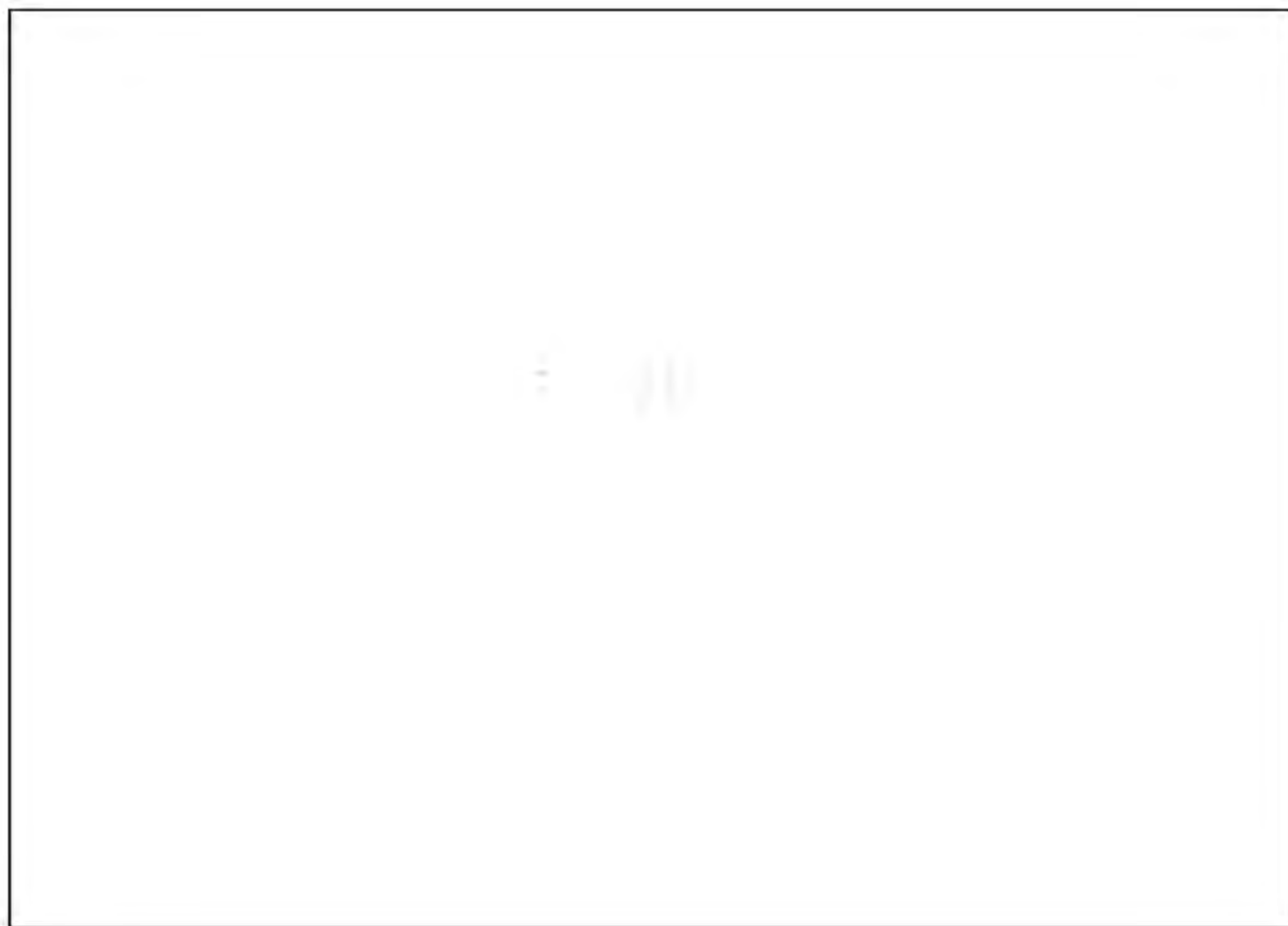













Emergency Contacts

You must immediately report any damage to **nbn™** network that you are/become aware of. Notification may be by telephone - 1800 626 329.



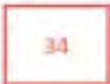




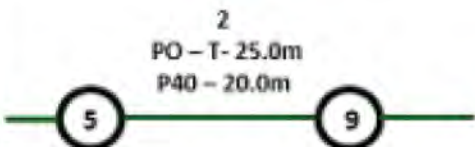






Indicative Plans

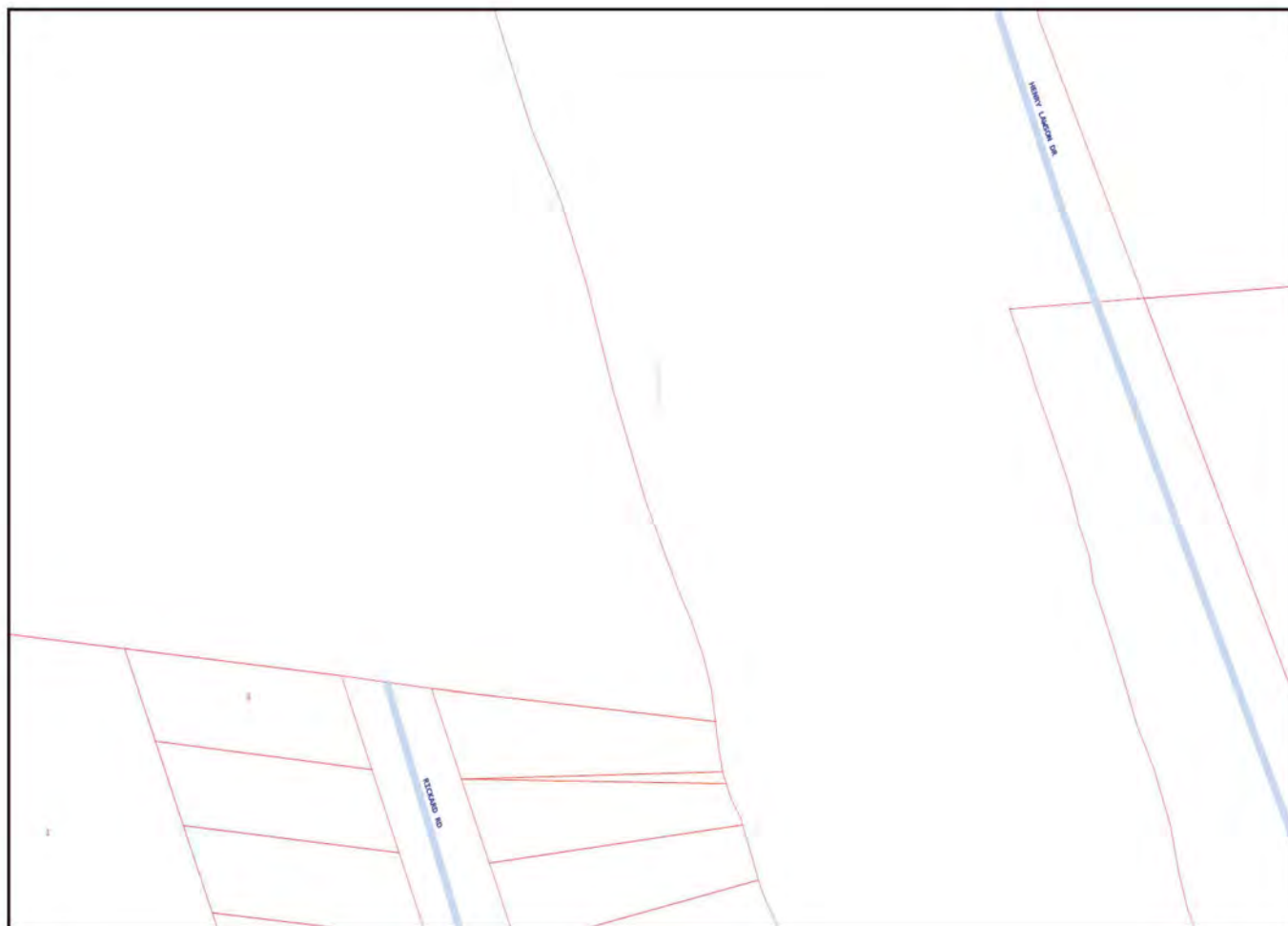
| | | |
|-------------|--|--|
| Issue Date: | 24/09/2020 |  DIAL BEFORE YOU DIG www.1100.com.au |
| Location: | Henry Lawson Drive , Milperra , NSW , 2214 | |

| | | |
|---|----|----|
| 2 | 9 | 16 |
| 3 | 10 | 17 |
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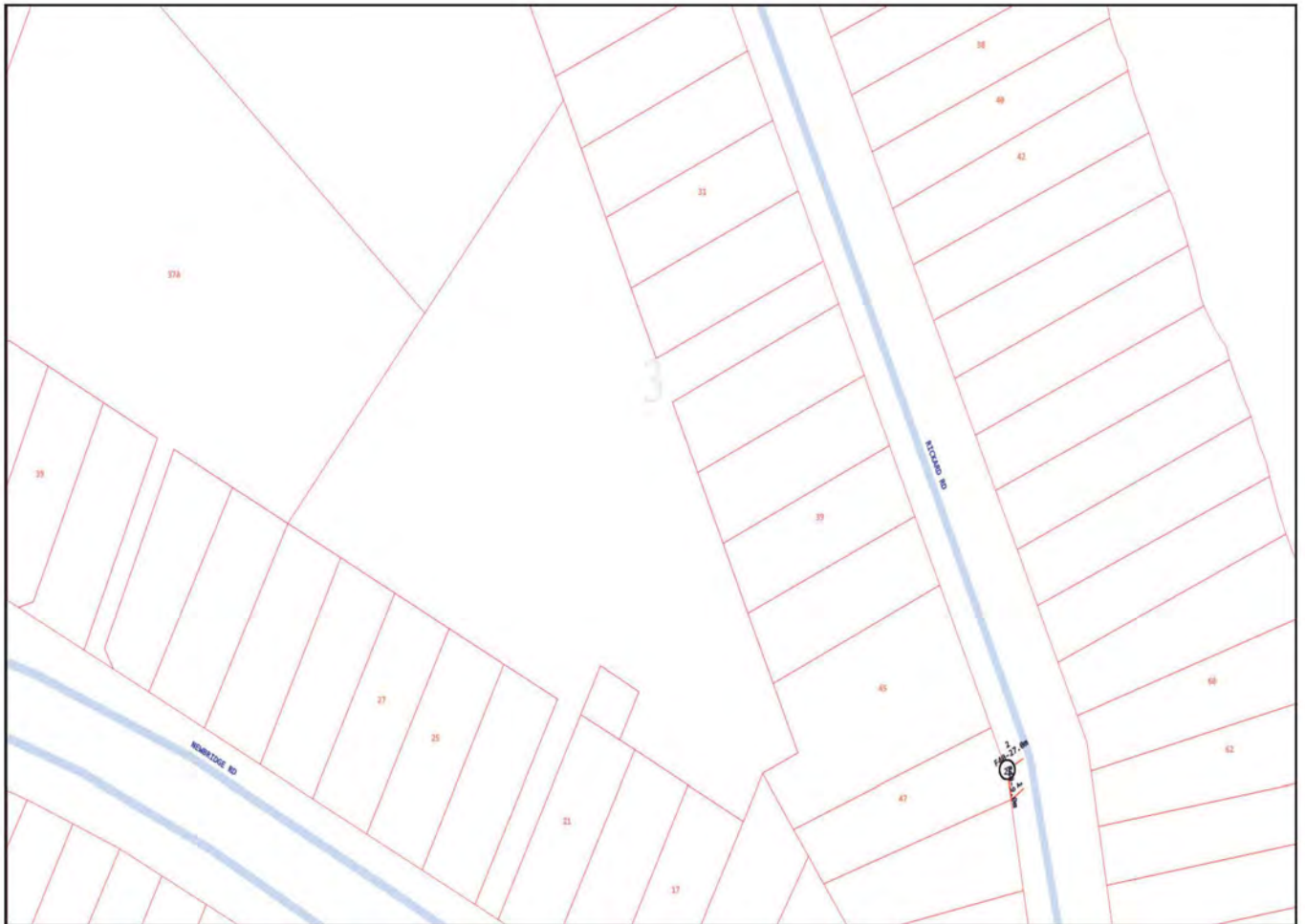


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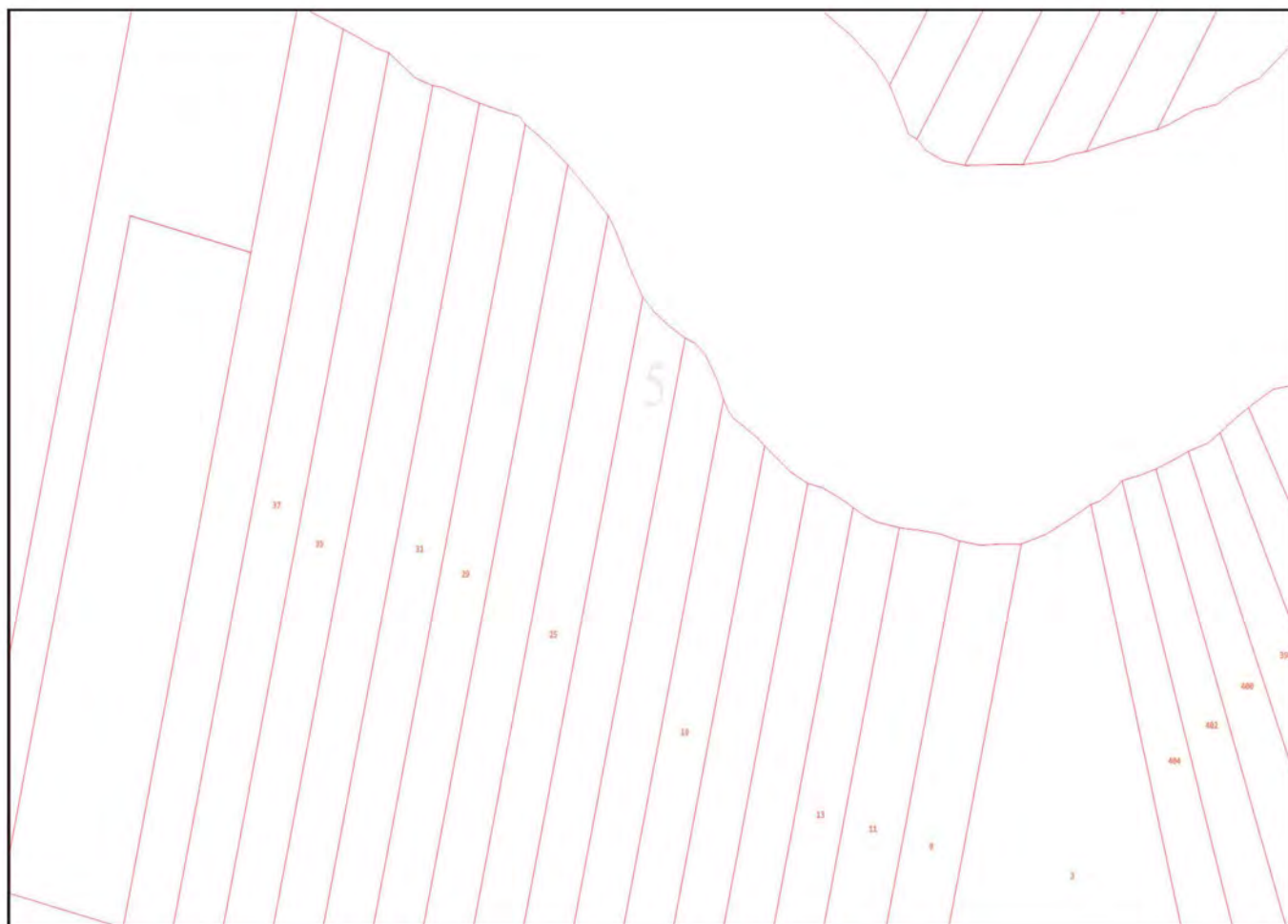
| | |
|---|--|
|  | Parcel and the location |
|  | Pit with size "5" |
|  | Power Pit with size "2E". Valid PIT Size: e.g. 2E, 5E, 6E, 8E, 9E, E, null. |
|  | Manhole |
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| Scale | 0 20 40 60 Meters 1:2000 1 cm equals 20 m  |



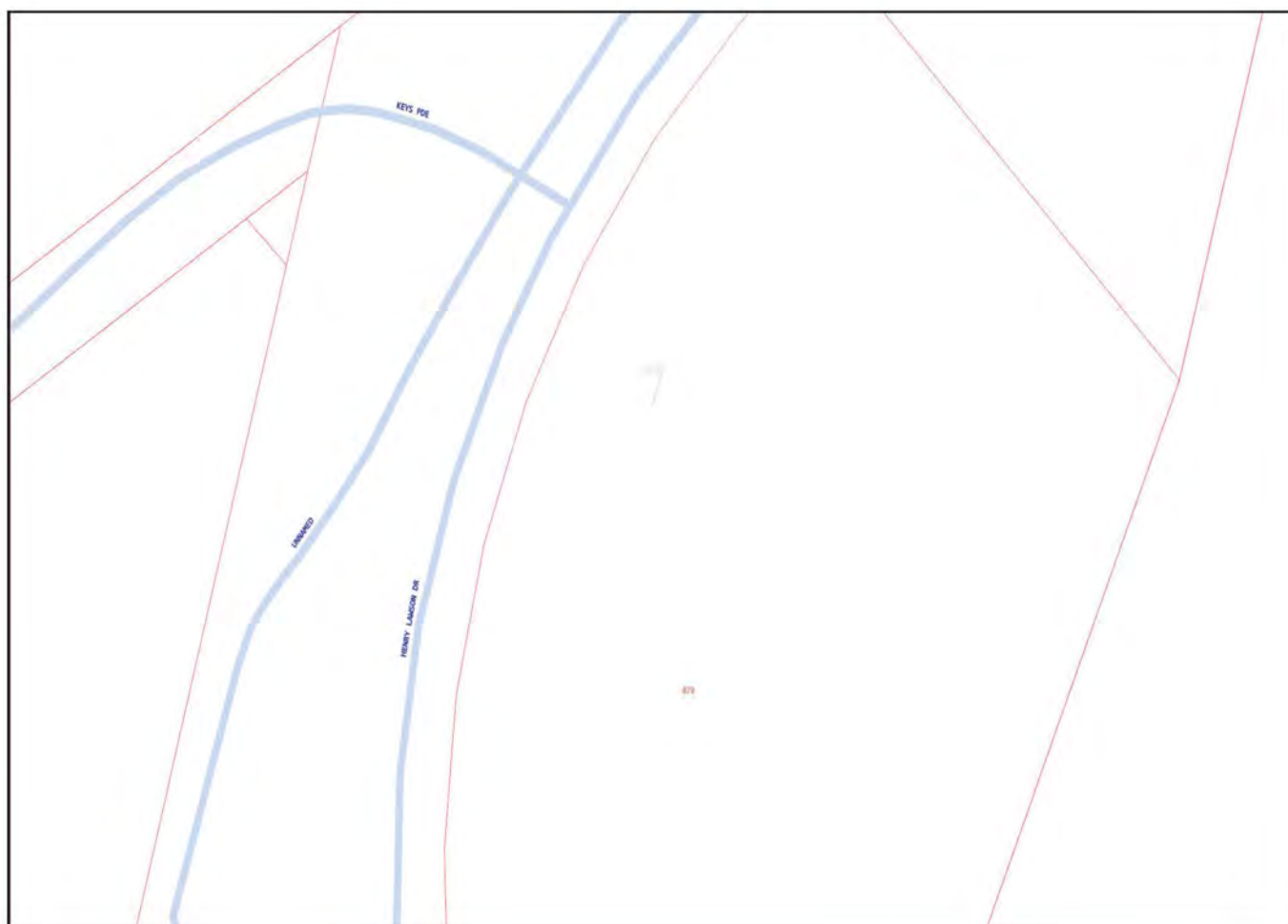




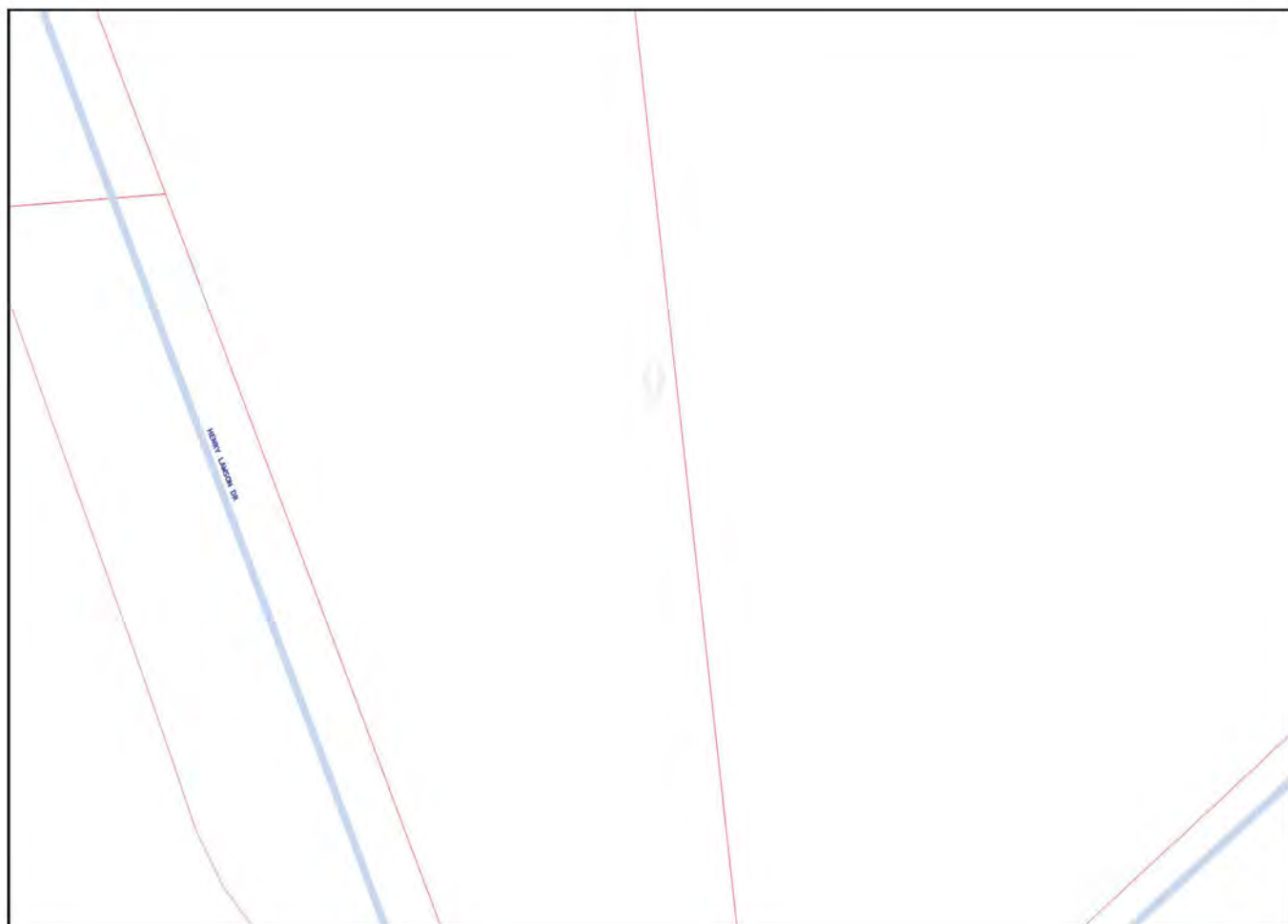






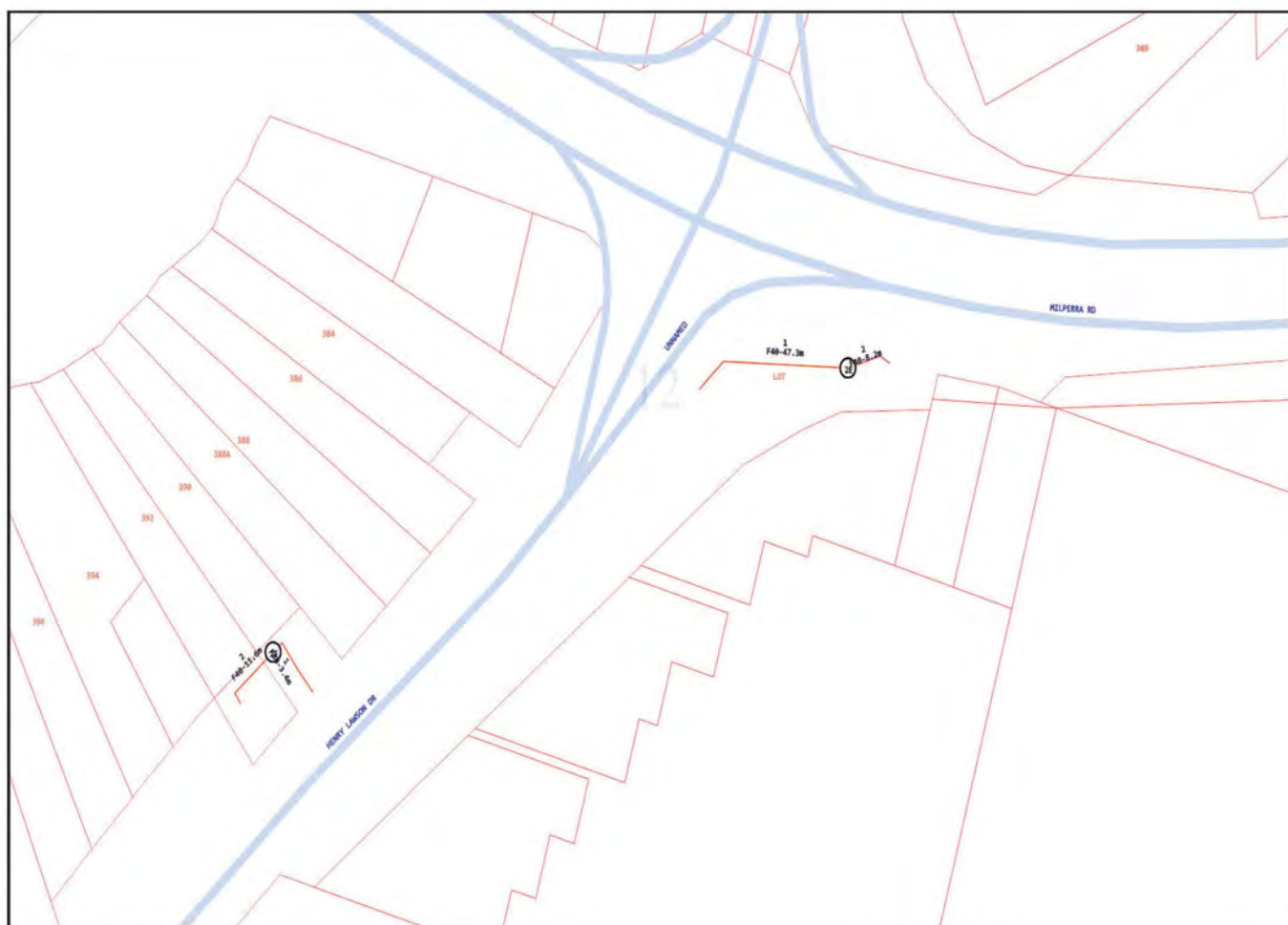


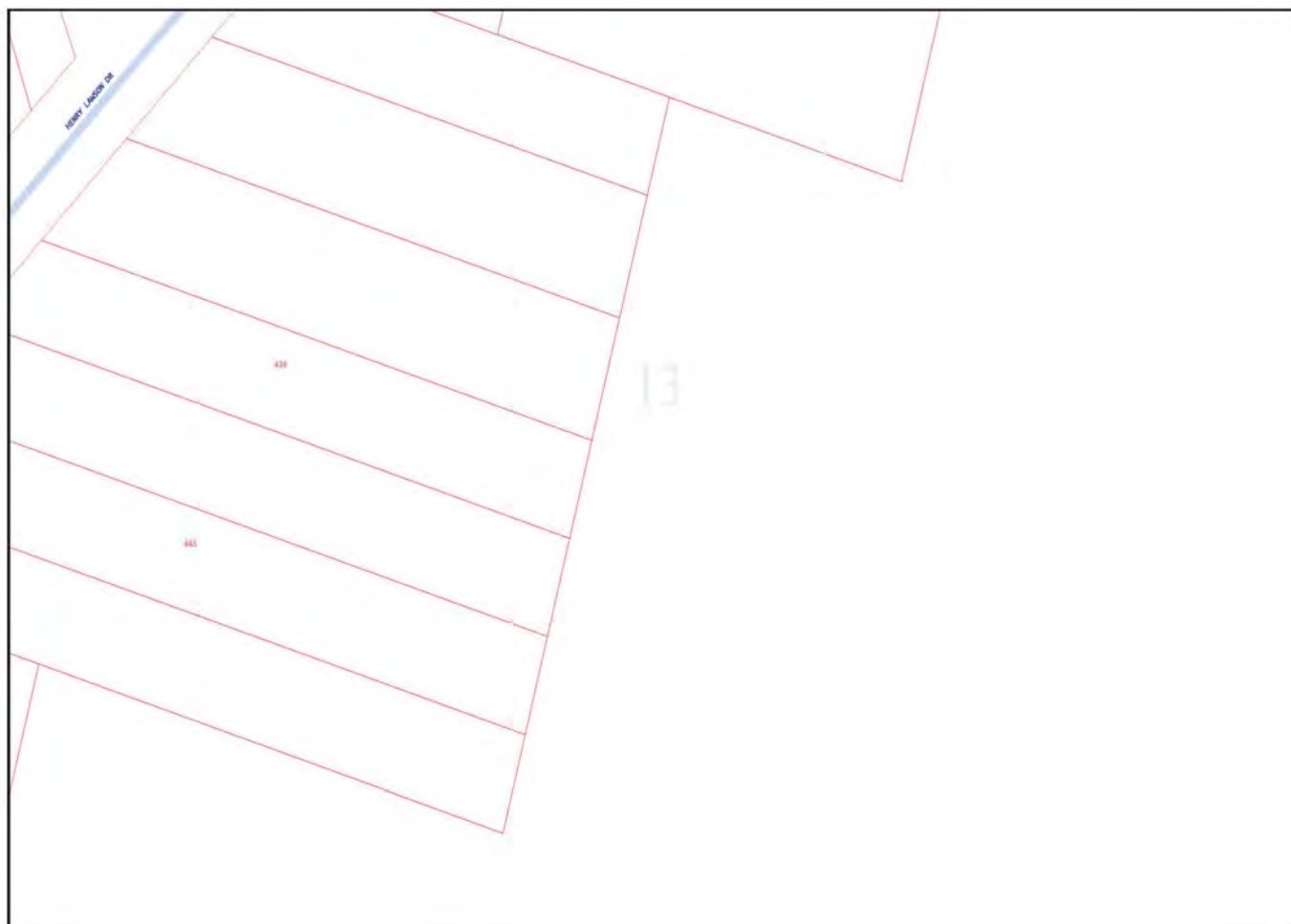


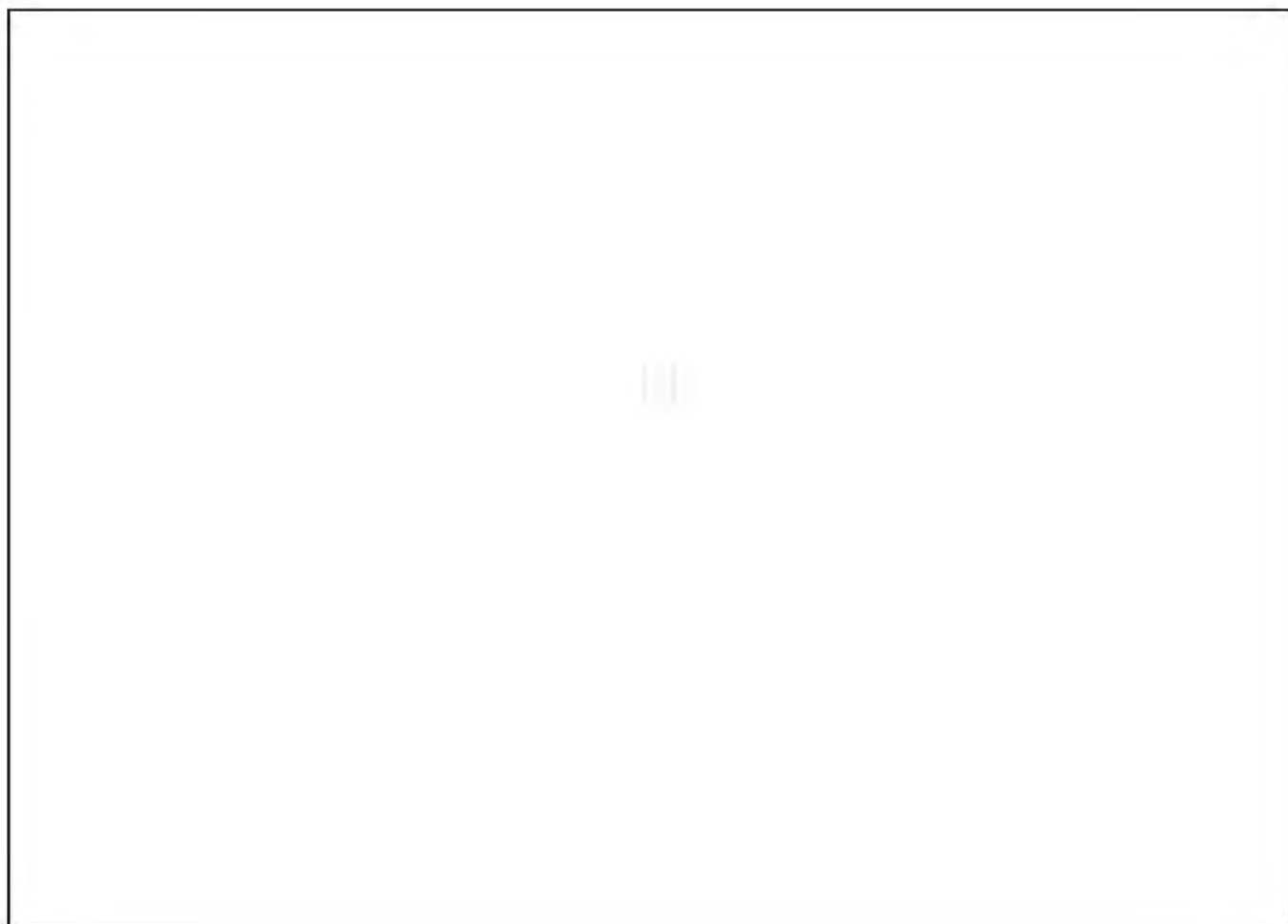






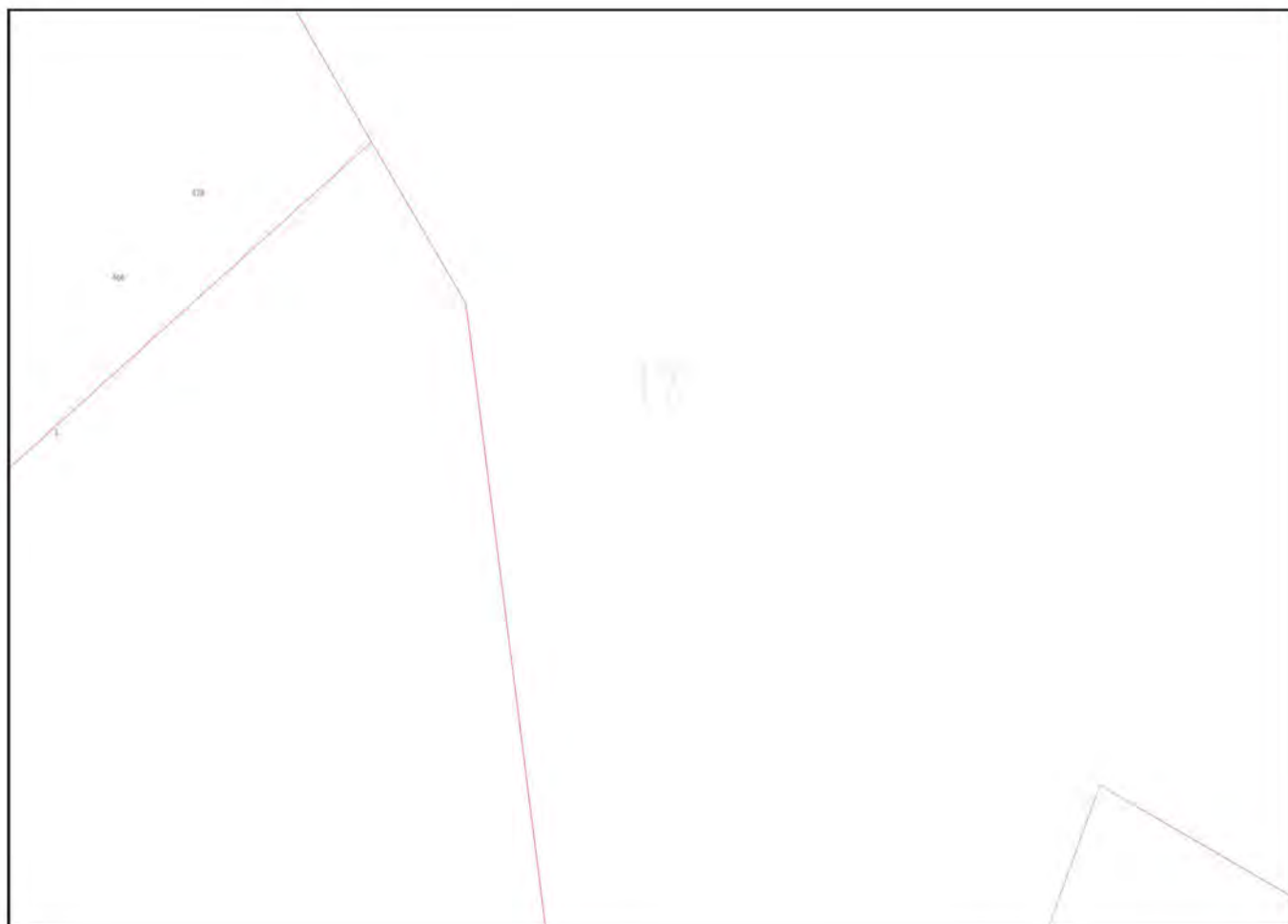


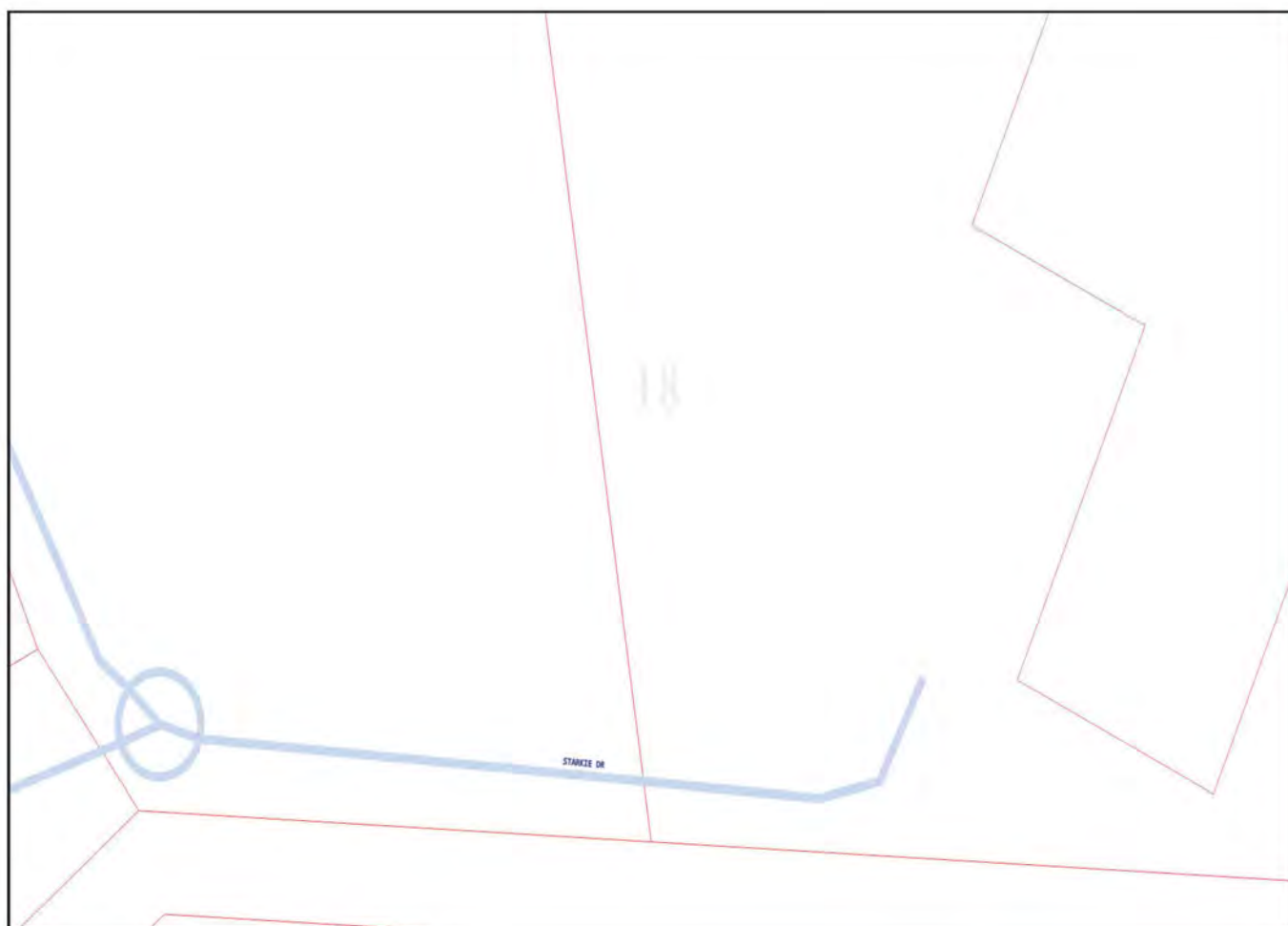


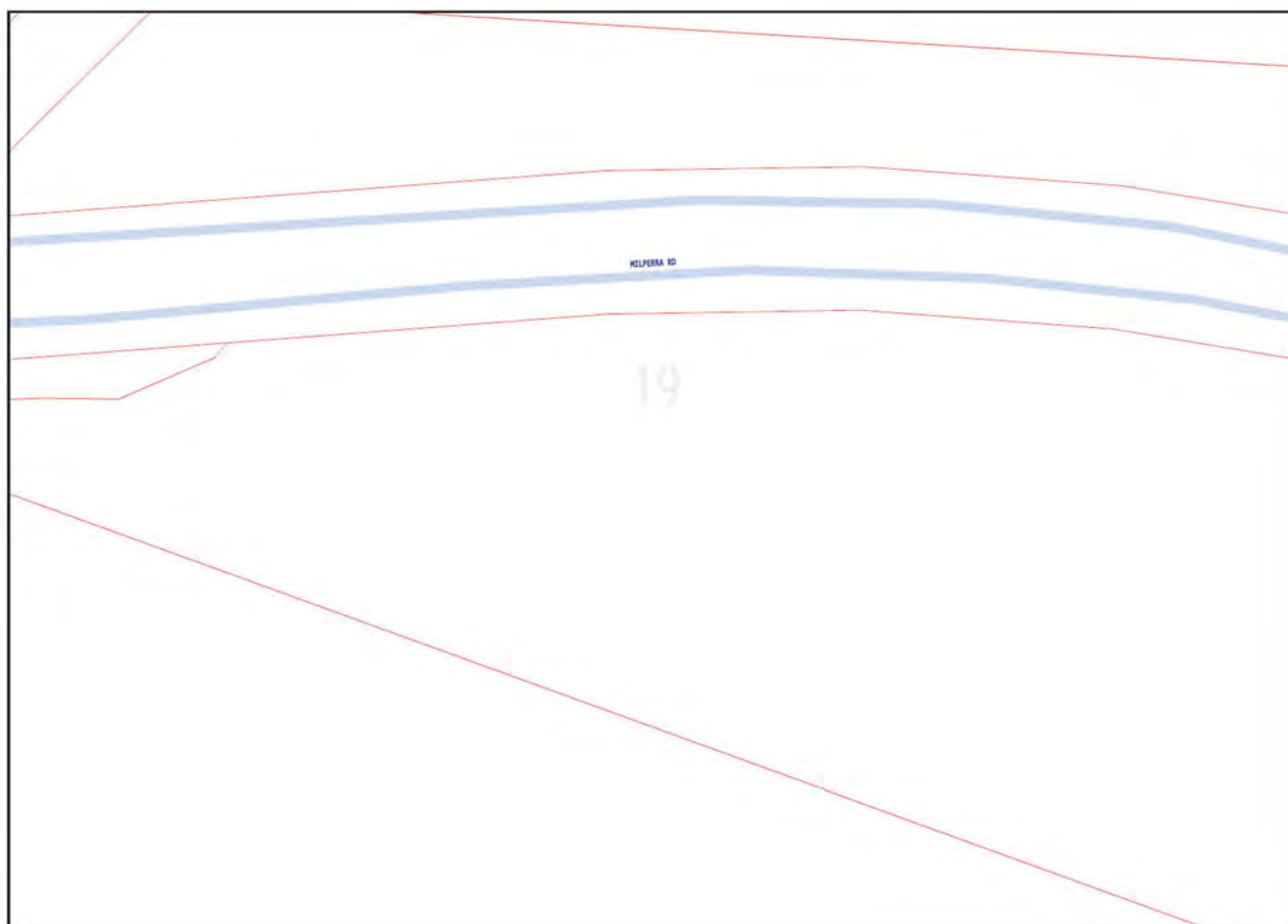


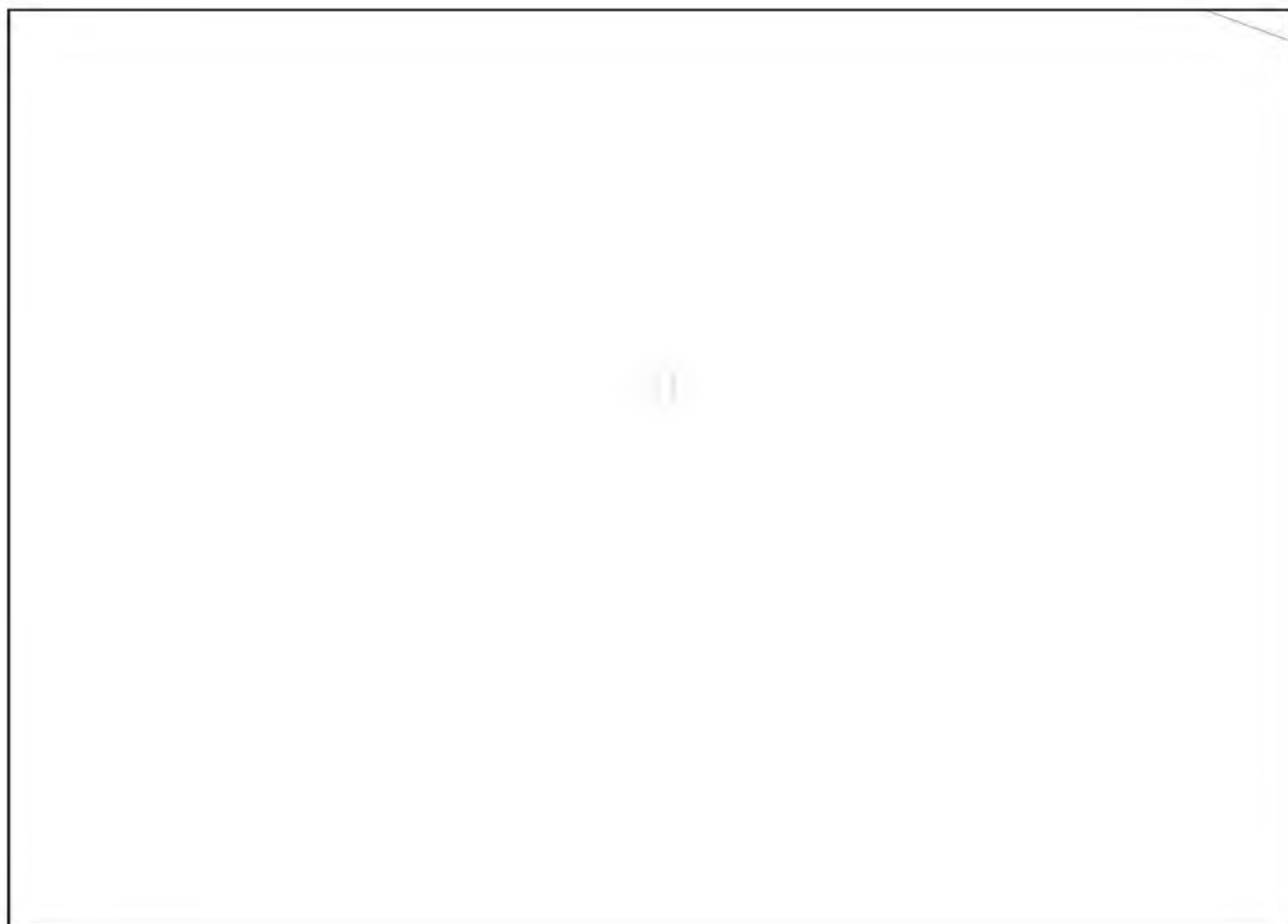


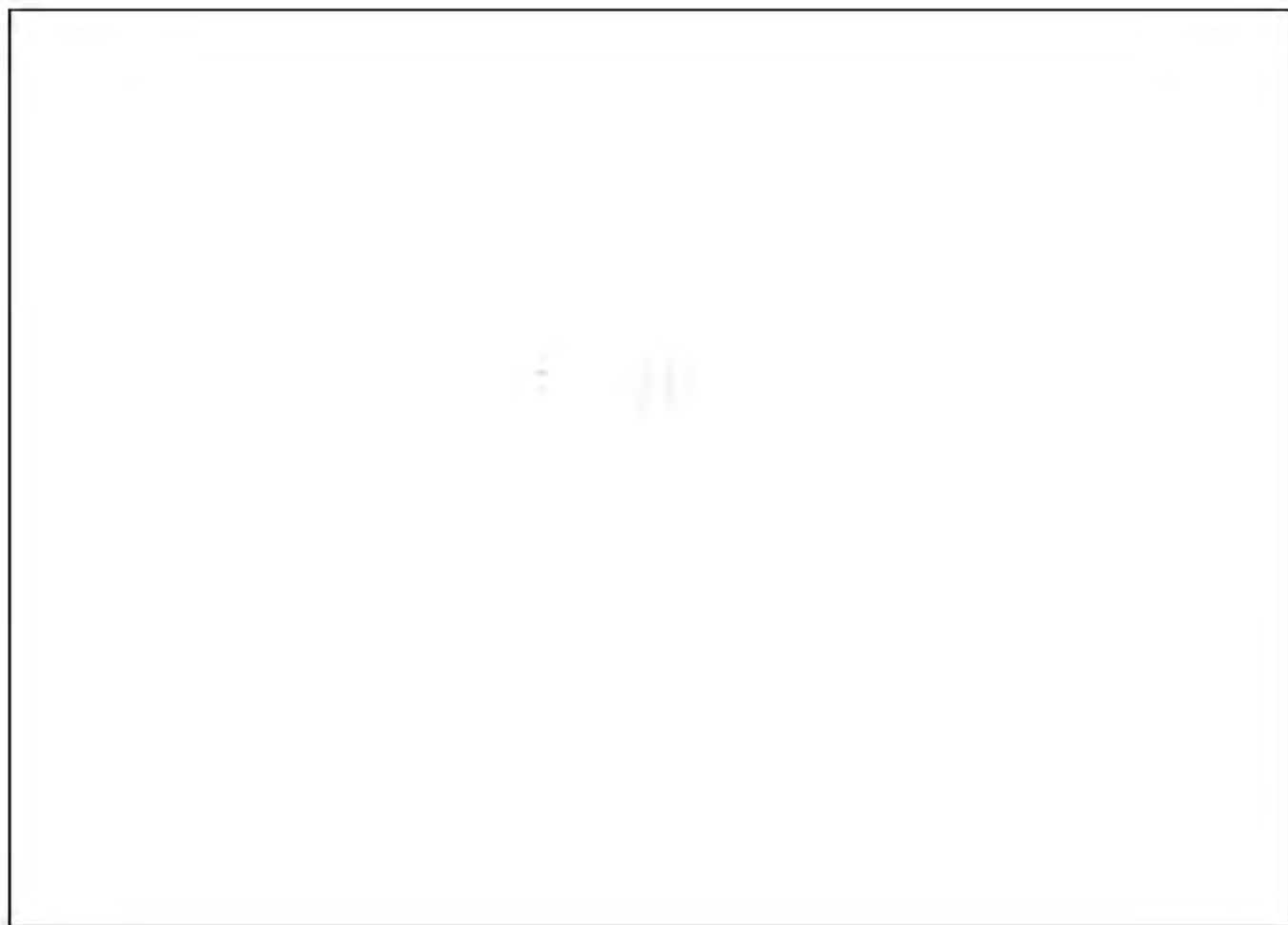












Emergency Contacts

You must immediately report any damage to **nbn™** network that you are/become aware of. Notification may be by telephone - 1800 626 329.

If further information is required, please contact:
Ausgrid DBYD
Phone: (02) 4951 0899
Fax: (02) 4951 0729



Emergency Phone Number 131388

Underground Cable Location Search Advice -- Ausgrid Assets Affected --

| | | | |
|-----|--|-------------|------------|
| To: | Mr Raghav Rana Aurecon 552 Boronia Road Wantirna VIC 3152 | | |
| | | Phone No: | 0401448946 |
| | | Issue Date: | 24/09/2020 |
| | | | |

In response to your enquiry, Sequence No: 102165063 the records of Ausgrid disclose that there **are** Ausgrid underground cables in the defined search location and relevant Ausgrid plans have been provided.

This search is based on the geographical position of the dig site as denoted in the Dial Before You Dig caller confirmation sheet and an overview is provided:

| | |
|----------|---|
| Address: | Henry Lawson Drive Milperra NSW 2214 |
| Job #: | 20310876 |



****Important****

- All information provided to you is **ONLY VALID FOR 30 DAYS** from the date of issue
- You must keep Ausgrid plans on site during excavation works. If the people actually performing the excavation works do not know how to read and interpret Ausgrid's plans, then the work must be directed by a person who knows how to read and interpret plans.
- If you require a full size print of A0 plans and don't have the resources to do so please contact our office on 49510899 to request a hard copy to be posted. **Please allow 3 working days for delivery.**
- Please note you will ONLY receive portions of your search area that contain Ausgrid Underground Assets

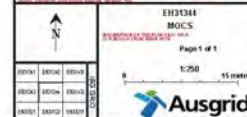
YOU MUST READ AND UNDERSTAND THE SUPPLEMENTARY MATERIAL CONTAINED IN THIS ADVICE BEFORE PROCEEDING WITH ANY WORKS.

Summary of Supplementary Information:

| Material | Purpose | Location |
|--|--|---------------------------------------|
| Important Information.pdf | Details important information | Attached |
| Working near Ausgrid Cables.pdf | Summary of NS156 | Attached |
| COMN0119 How to Read Ausgrid Plans.pdf | Details how to read Ausgrid plans | Attached |
| SafeWork NSW "Work near underground assets: Guide" | To assist you in deciding appropriate measures to eliminate or control risks when working near underground assets. | Web Link [Click Here] |
| Ausgrid's Network Standard NS156 | For important information for work near or around underground cables | Web Link [Click Here] |
| Ausgrid's Network Standard NS199 | This Network Standard applies to specific work on Ausgrid Low Voltage Underground Assets and associated Hazards | Web Link [Click Here] |
| Working in Confined Spaces | For important information when working in confined spaces | Web Link [Click Here] |

[illegible][illegible]

Ref: F10

[illegible]



| | |
|-------------|-------------|
| EH314 - AI1 | EH314 - BI1 |
| | |
| Ref: B10 | Ref: D9 |
| EH314 - BL1 | EH314 - BN1 |
| | |
| Ref: D9 | Ref: D10 |
| EH314 - BO1 | EH314 - BP1 |
| | |
| Ref: C10 | Ref: B10 |
| EH314 - BO1 | |
| | |
| Ref: B10 | |

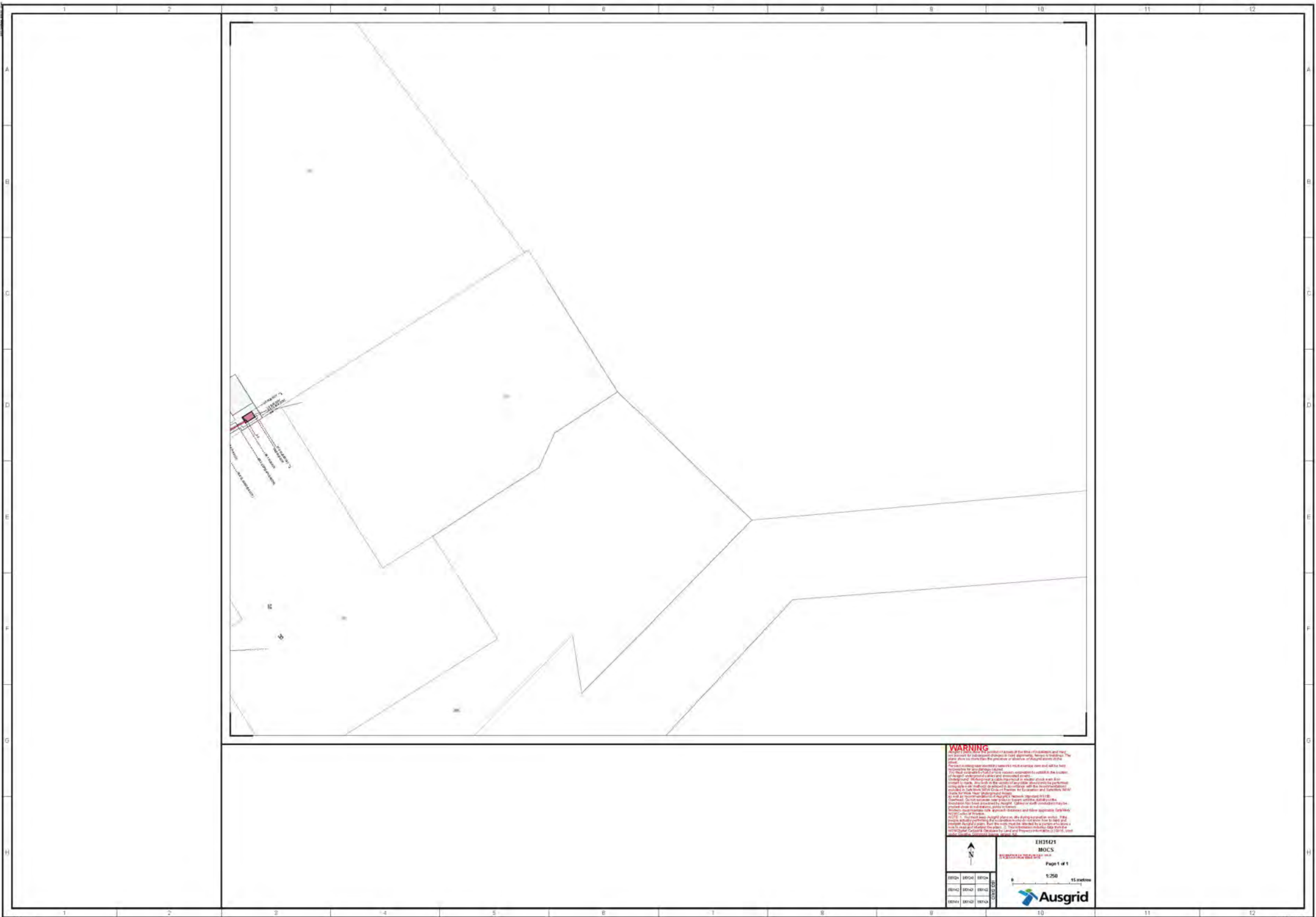
| NO. | REV. | DATE | DESCRIPTION |
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| 2 | 002 | 10/10/2019 | REVISED TO INCLUDE COMMENTS |
| 3 | 003 | 10/10/2019 | REVISED TO INCLUDE COMMENTS |
| 4 | 004 | 10/10/2019 | REVISED TO INCLUDE COMMENTS |
| 5 | 005 | 10/10/2019 | REVISED TO INCLUDE COMMENTS |
| 6 | 006 | 10/10/2019 | REVISED TO INCLUDE COMMENTS |
| 7 | 007 | 10/10/2019 | REVISED TO INCLUDE COMMENTS |
| 8 | 008 | 10/10/2019 | REVISED TO INCLUDE COMMENTS |
| 9 | 009 | 10/10/2019 | REVISED TO INCLUDE COMMENTS |
| 10 | 010 | 10/10/2019 | REVISED TO INCLUDE COMMENTS |

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EH314
MOCS
Page 1 of 1
1:250
15 meters

Ausgrid



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EHS1271
MOCS
"PROPOSED" 2018

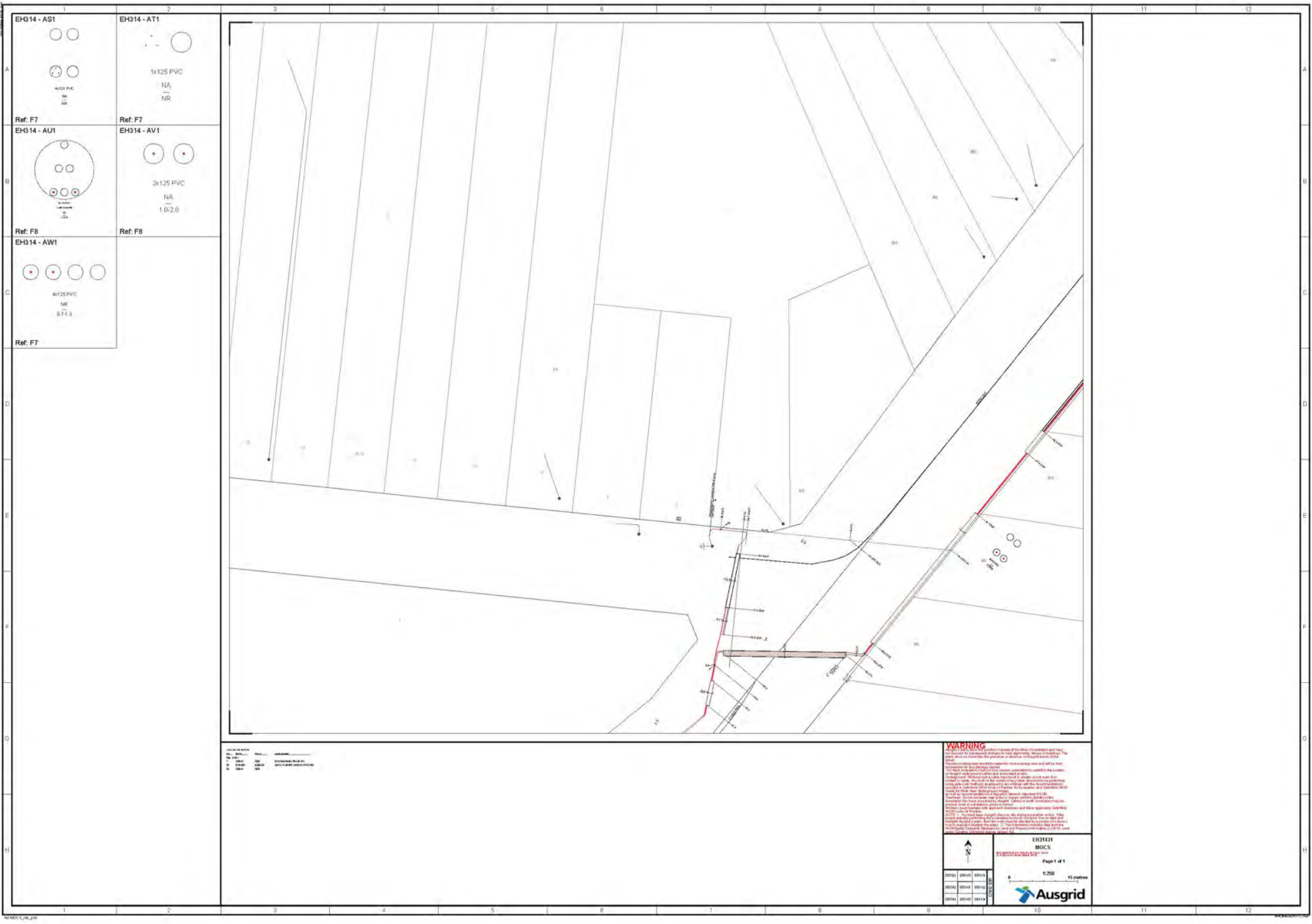
Page 1 of 1

1:250

0 15 meters

Ausgrid

| | | |
|------|------|------|
| 0001 | 0002 | 0003 |
| 0004 | 0005 | 0006 |
| 0007 | 0008 | 0009 |



EH314 - AS1

4x125 PVC
NR
0.74 0

Ref: F7

EH314 - AU1

4x125 PVC
NR
0.74 0

Ref: F6

EH314 - AW1

4x125 PVC
NR
0.74 0

Ref: F7

EH314 - AT1

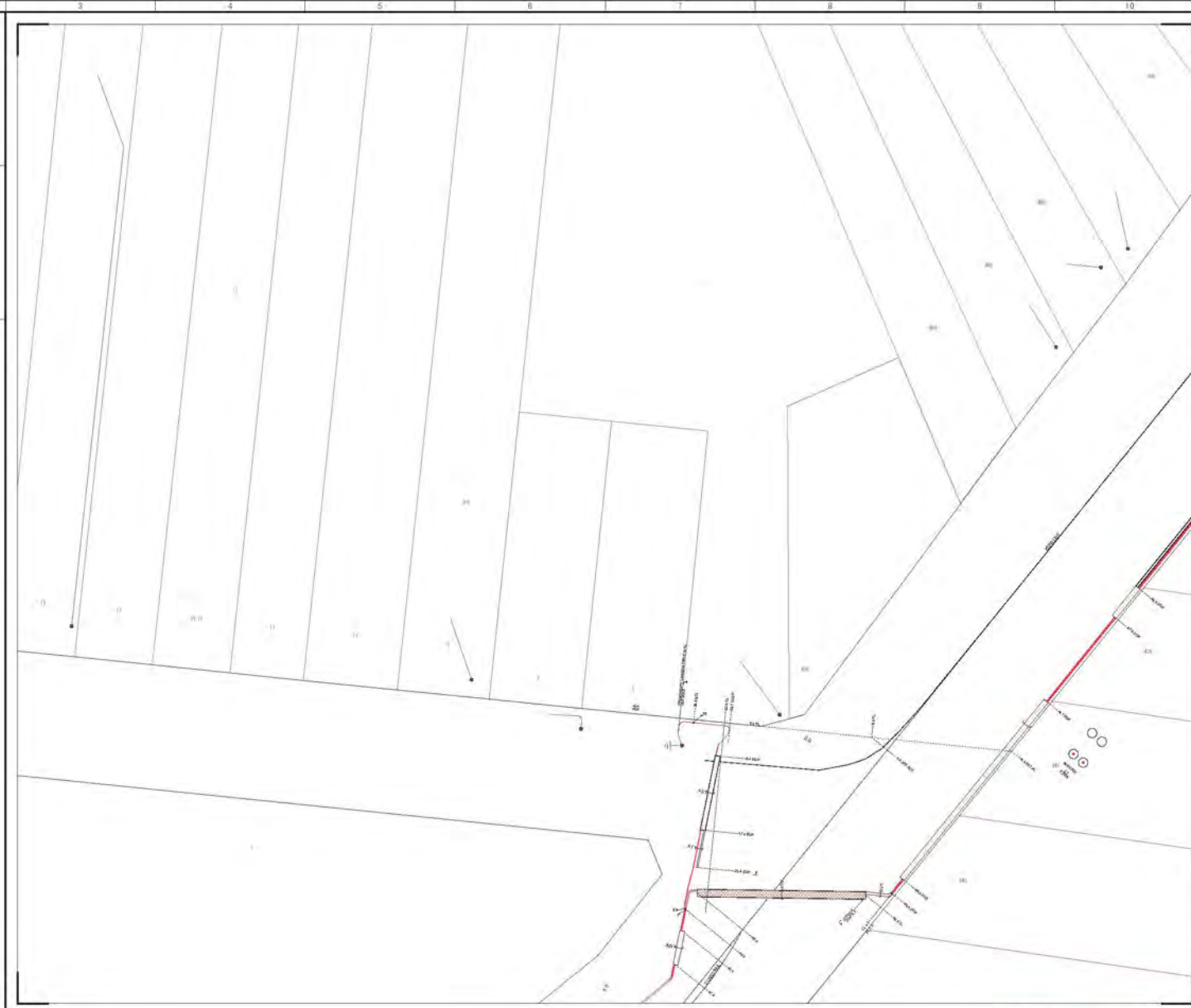
1x125 PVC
NA
NR

Ref: F7

EH314 - AV1

2x125 PVC
NA
1.0-2.0

Ref: F8



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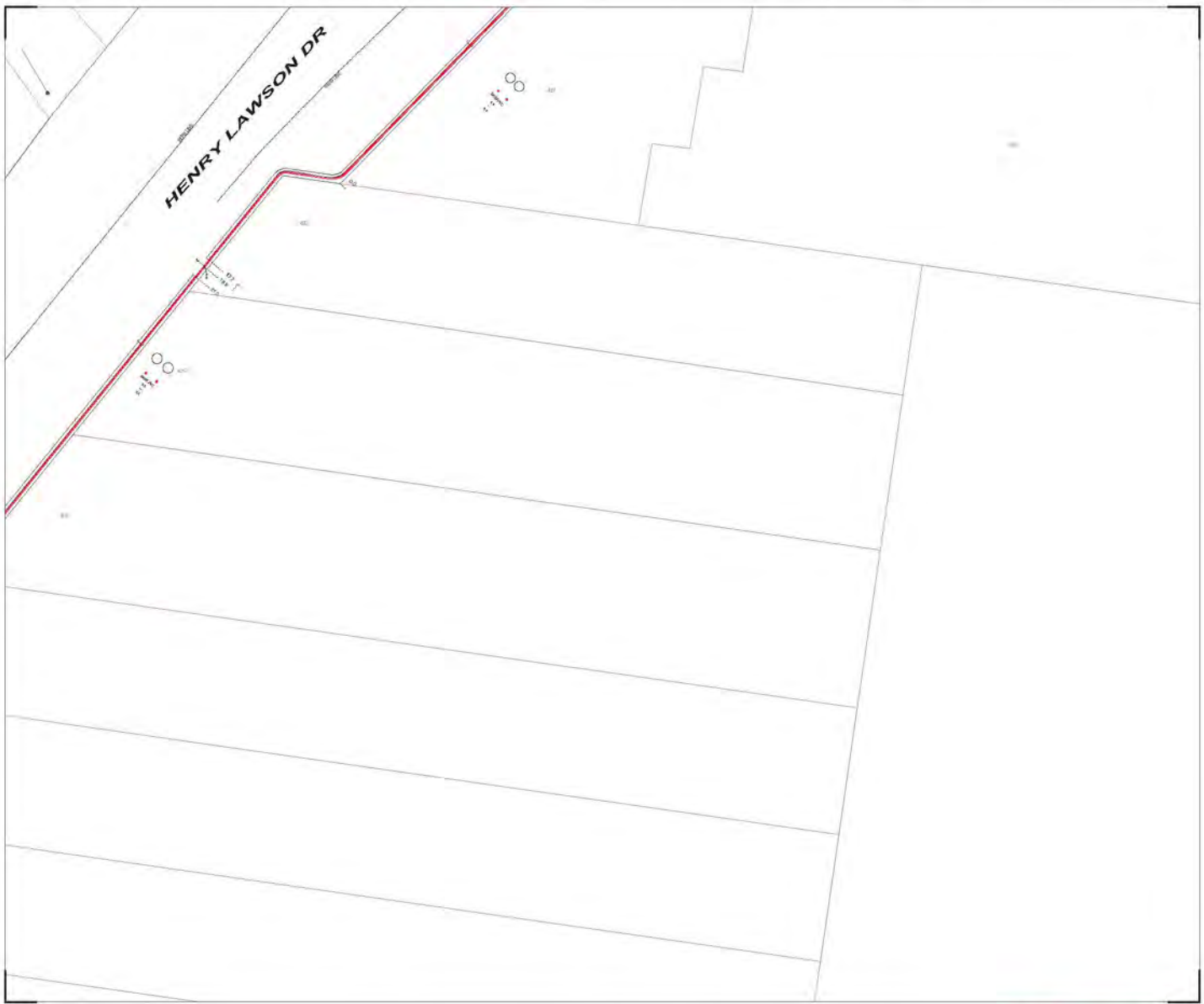
EH3143 MOCS

Page 1 of 1

1:250

15 metres

Ausgrid



Scale 1:1000
North Arrow
Date 10/04/2014
Author J. Smith

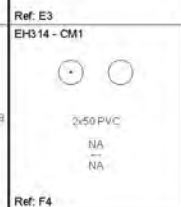
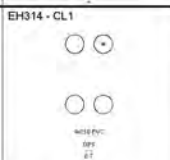
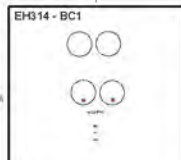
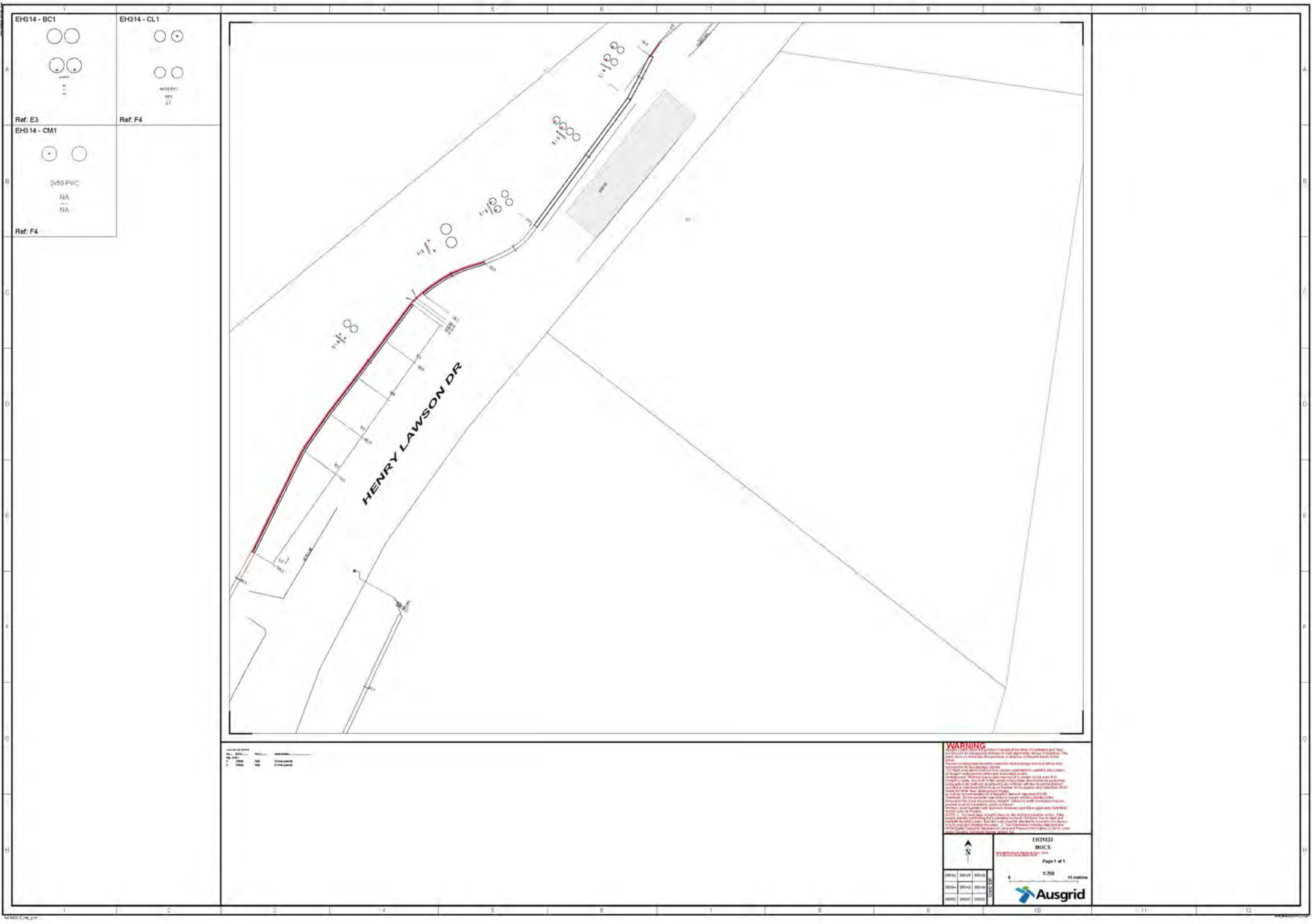
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EH3122
MOCS
Page 1 of 1
1:250
15 metres

Ausgrid

| | | |
|-------|-------|-------|
| ED001 | ED004 | ED002 |
| ED003 | ED005 | ED006 |
| ED007 | ED008 | ED009 |



Legend

1. 200mm

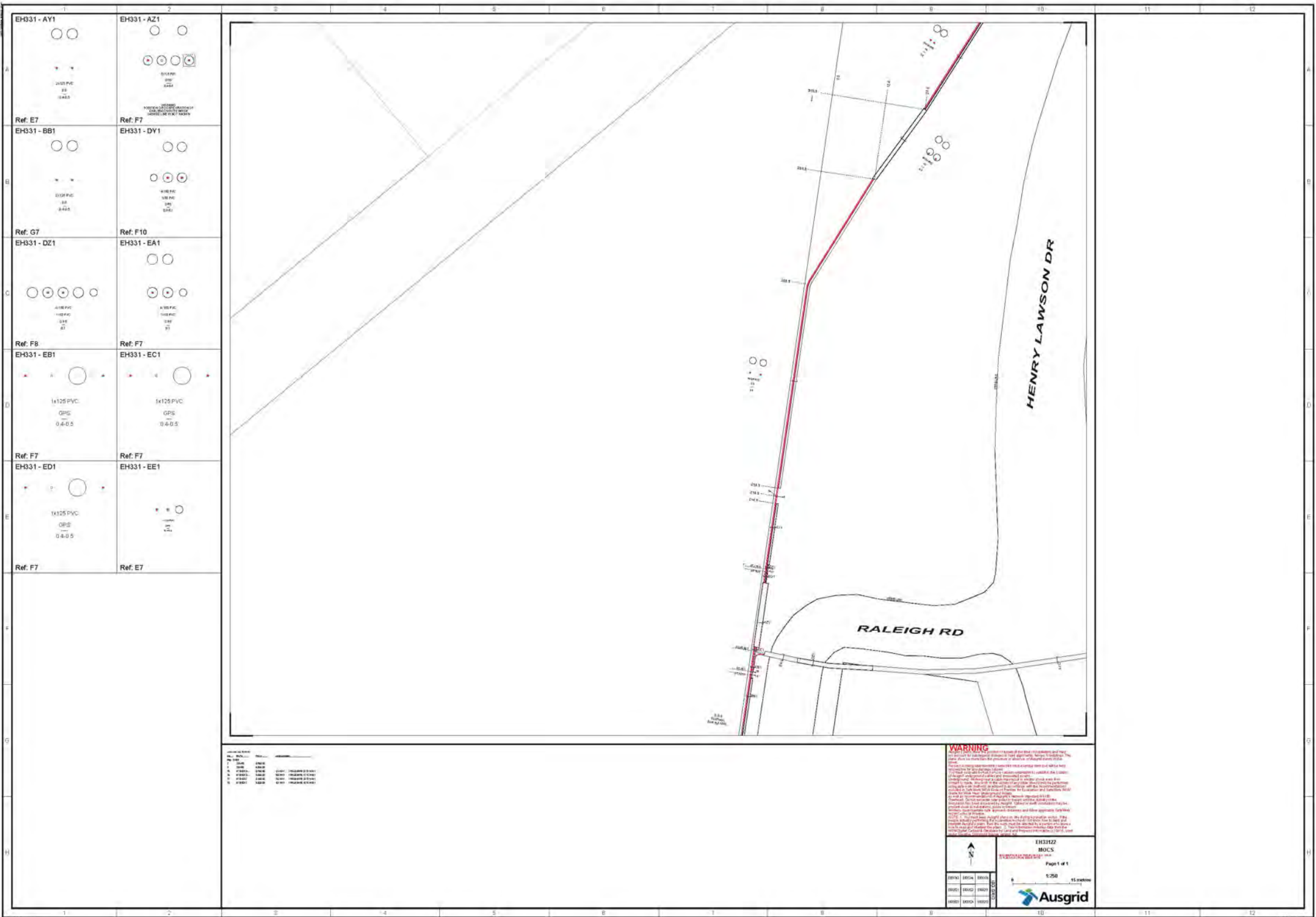
2. 150mm

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EH3143
MOCS
Page 1 of 1
1:250
15 meters

Ausgrid



| | |
|-------------|-------------|
| EH331 - AY1 | EH331 - AZ1 |
| | |
| Ref: E7 | Ref: F7 |
| EH331 - BB1 | EH331 - DY1 |
| | |
| Ref: G7 | Ref: F10 |
| EH331 - DZ1 | EH331 - EA1 |
| | |
| Ref: F8 | Ref: F7 |
| EH331 - EB1 | EH331 - EC1 |
| | |
| Ref: F7 | Ref: F7 |
| EH331 - ED1 | EH331 - EE1 |
| | |
| Ref: F7 | Ref: E7 |

| NO. | REV. | DATE | DESCRIPTION |
|-----|------|------|-------------|
| 1 | 1 | 2016 | ISSUED |
| 2 | 1 | 2016 | ISSUED |
| 3 | 1 | 2016 | ISSUED |
| 4 | 1 | 2016 | ISSUED |
| 5 | 1 | 2016 | ISSUED |
| 6 | 1 | 2016 | ISSUED |
| 7 | 1 | 2016 | ISSUED |
| 8 | 1 | 2016 | ISSUED |
| 9 | 1 | 2016 | ISSUED |
| 10 | 1 | 2016 | ISSUED |

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EH33122
MOCS
"PROPOSED" 1:250

Page 1 of 1

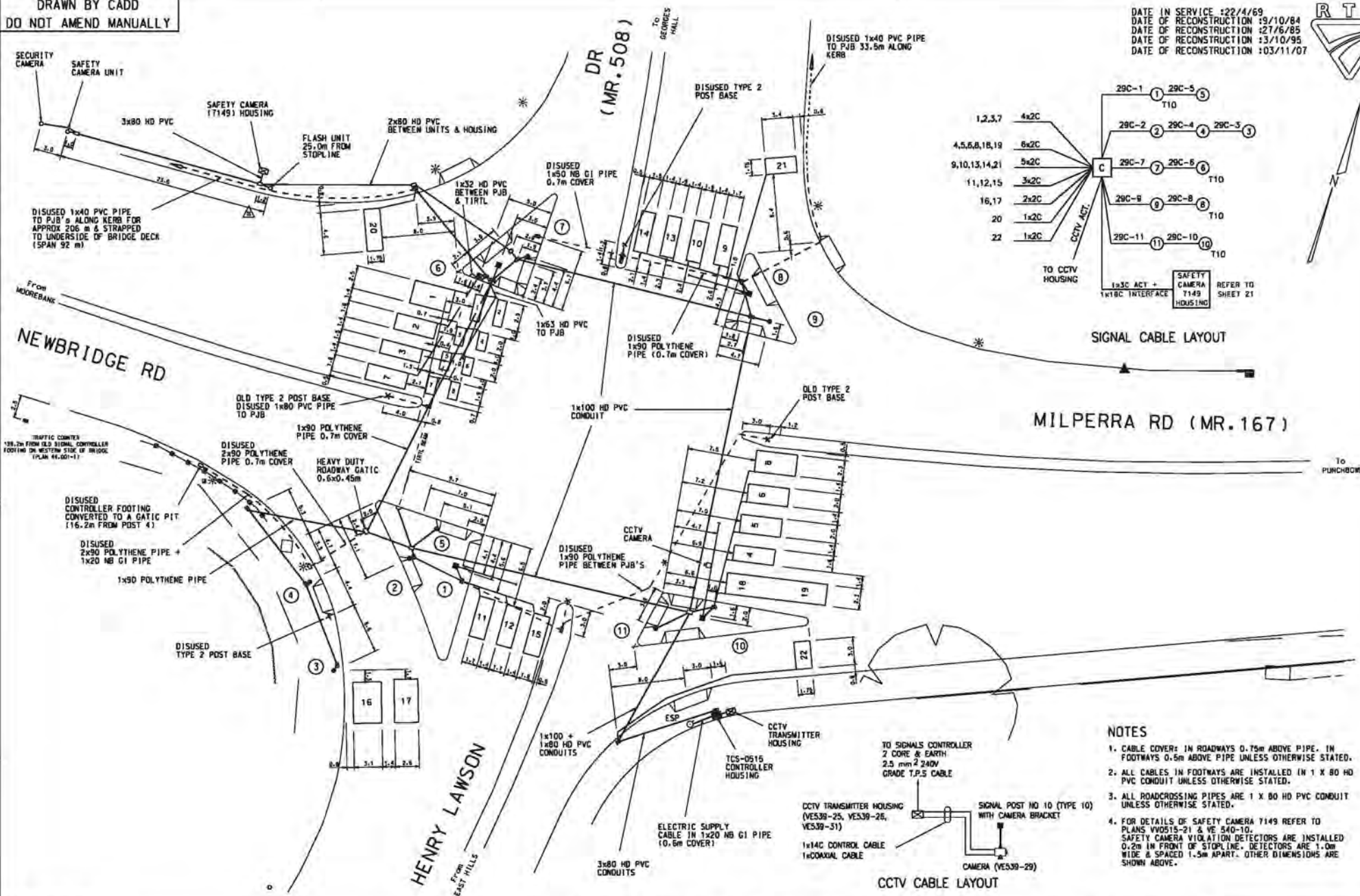
1:250

15 metres

Ausgrid

DRAWN BY CADD
DO NOT AMEND MANUALLY

DATE IN SERVICE :22/4/69
DATE OF RECONSTRUCTION :9/10/84
DATE OF RECONSTRUCTION :27/6/85
DATE OF RECONSTRUCTION :3/10/95
DATE OF RECONSTRUCTION :03/11/07

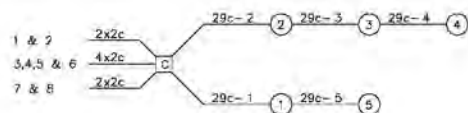


NOTES

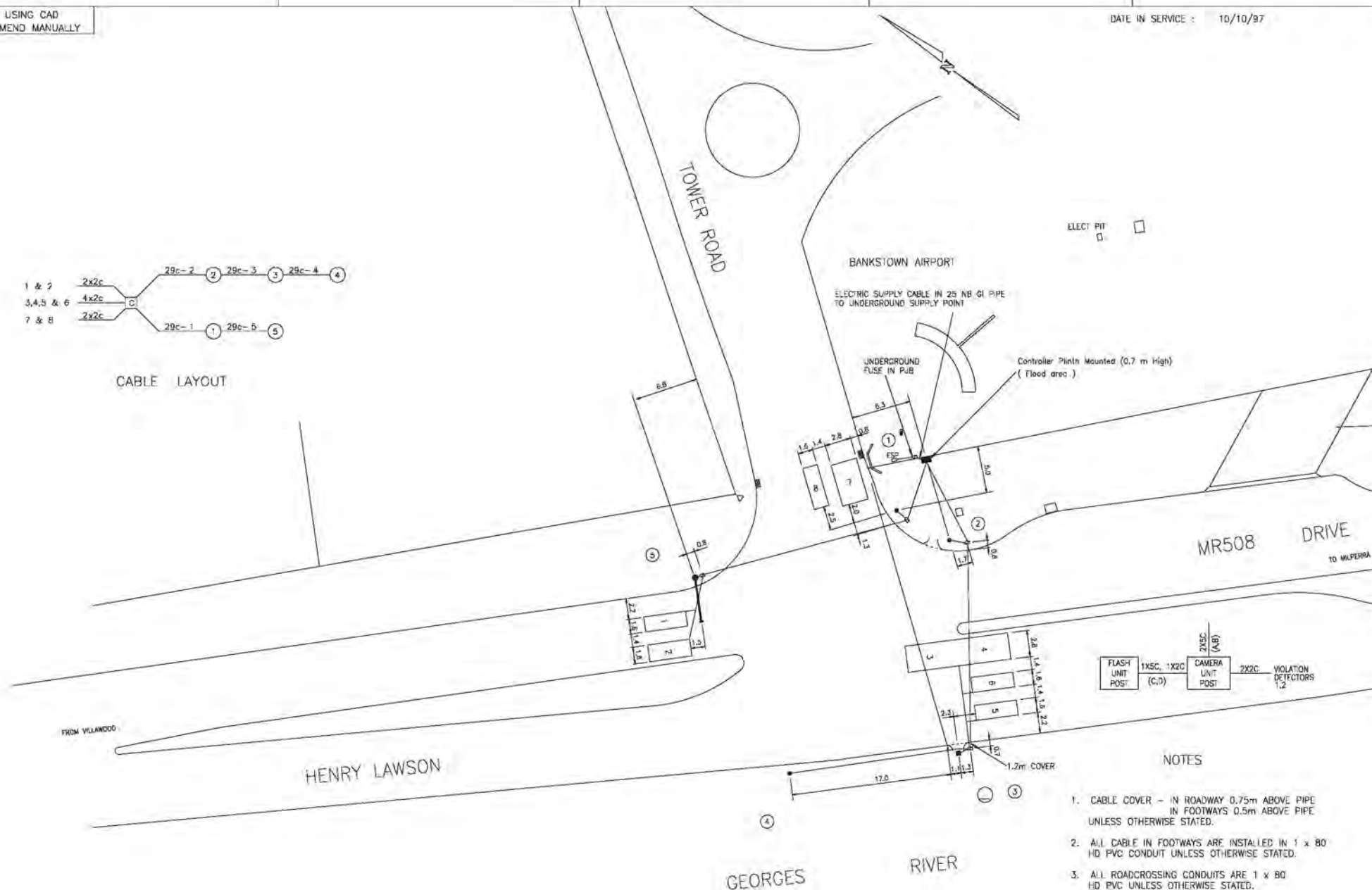
1. CABLE CORDS IN ROADWAYS 0.75m ABOVE PIPE. IN FOOTWAYS 0.5m ABOVE PIPE UNLESS OTHERWISE STATED.
2. ALL CABLES IN FOOTWAYS ARE INSTALLED IN 1 X 80 HD PVC CONDUIT UNLESS OTHERWISE STATED.
3. ALL ROADCROSSING PIPES ARE 1 X 80 HD PVC CONDUIT UNLESS OTHERWISE STATED.
4. FOR DETAILS OF SAFETY CAMERA 7149 REFER TO PLANS VV0515-21 & VE 540-10.
SAFETY CAMERA VIOLATION DETECTORS ARE INSTALLED 0.2m IN FRONT OF STOPLINE. DETECTORS ARE 1.0m WIDE & SPACED 1.5m APART. OTHER DIMENSIONS ARE SHOWN ABOVE.

[illegible]

0508.026.W.3377



CABLE LAYOUT



NOTES

1. CABLE COVER - IN ROADWAY 0.75m ABOVE PIPE
IN FOOTWAYS 0.5m ABOVE PIPE
UNLESS OTHERWISE STATED.
2. ALL CABLE IN FOOTWAYS ARE INSTALLED IN 1 x 80
HD PVC CONDUIT UNLESS OTHERWISE STATED.
3. ALL ROADCROSSING CONDUITS ARE 1 x 80
HD PVC UNLESS OTHERWISE STATED.

| PUBLIC UTILITY LEGEND | | REFERENCE PLANS | | U.S.G. Ref. MAP 270 KS | |
|-----------------------|----|------------------|----------|------------------------|-------------|
| WYMAIN | 1 | SPRINKLER | W0003-8 | U.S.G. | CR. TRENCH |
| STOP VALVE | 2 | STD. SCHED. EXF. | W0001-8 | CO-DRYS | CR. LANSKAL |
| GAS VALVE | 3 | STD. SCHED. EXF. | W0018-10 | | |
| SPECIAL MAIN/CL | 4 | Pipes, ETC. | W0001-8 | | |
| TELECOM PIT | 5 | STD. DVS. SIG. | W0017-8 | | |
| TELECOM PIT | 6 | STD. DVS. SIG. | W0017-8 | | |
| TELECOM PIT | 7 | STD. DVS. SIG. | W0017-8 | | |
| TELECOM PIT | 8 | STD. DVS. SIG. | W0017-8 | | |
| TELECOM PIT | 9 | STD. DVS. SIG. | W0017-8 | | |
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| TELECOM PIT | 12 | STD. DVS. SIG. | W0017-8 | | |
| TELECOM PIT | 13 | STD. DVS. SIG. | W0017-8 | | |
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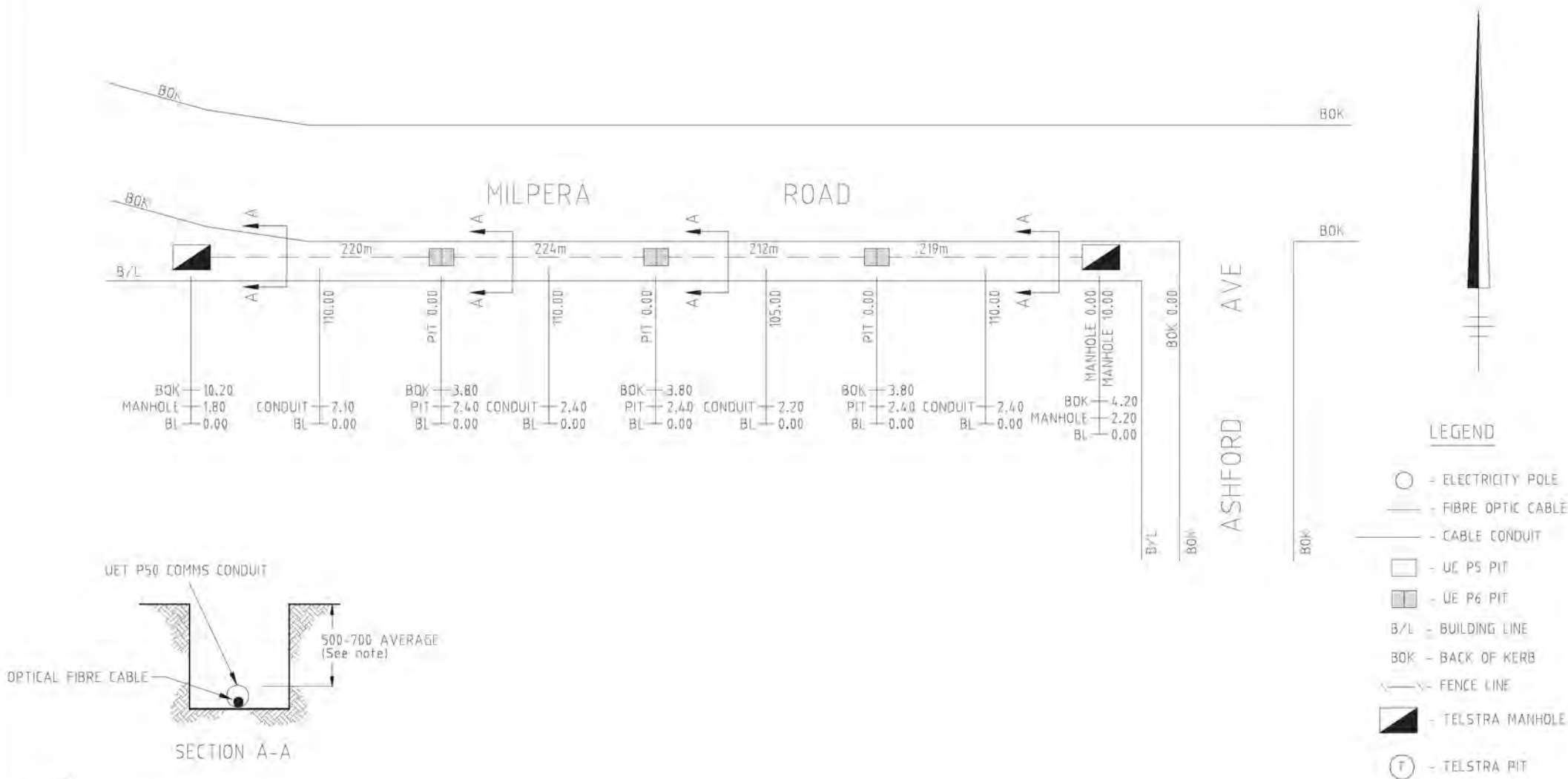
APPROVED
R. P. Bird
R.C.BIRD
ECT, DESIGN MANAGER
1.5.07.06
DATE

ROADS AND TRAFFIC AUTHORITY, N.S.W.
BANKSTOWN CITY COUNCIL
HENRY LAWSON DRIVE MR508
AND TOWER ROAD
MILPERRA

CABLE INSTALLATION

TCS No 3377

| | | | | |
|--|---|-----------------|-------------------------|---|
| DESIGN OFFICE PARRAMATTA — SYDNEY TECHNICAL SERVICES | | | | |
| CADD FILE: W3377_2A_INS.dgn | | | | |
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| 0508.026.W.3377 | | | | |



Note:
Conduit depths quoted are approximate only and may change due to unforeseen circumstances.
Excavate by hand until conduit depth is determined.

* DETAILED BY
RITEBORE

DRAWING NOT TO SCALE

| REV | DESCRIPTION | DATE | DRN | CHK |
|-----|-------------------------------|----------|-----|-----|
| A | CHAINAGES AND DWG No AMENDED. | 15-11-00 | TJK | GD |
| - | ISSUED FOR APPROVAL - UE.COMM | 8-11-00 | JP | TJK |

Civil Contractor
RITEBORE
PTY LTD.
ACN 079 783 903

| | |
|-----------------------------------|--|
| Drawn: J.PINO 8/11/00 | Design Checked: |
| Approved: R.Browne 15.11.00 | Melways Ref. 270 P6 (SYDNEY CBD) |
| Council: | |
| Shire: | |

Bayside
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Australia Pty. Ltd.
ABN 56 945 181 881
Telephone: (03) 9781 4011
Fax: (03) 9781 1653
Email: bdvic@baysidegrp.com.au

Uecomm
MAKING THE CONNECTION
ACN 079 083 195

UNDERGROUND OPTICAL FIBRE CABLE RUN
SUPPLY FROM MANHOLE TO MANHOLE
CNR MILPERA RD & ASHFORD AVE.
MILPERA - 2214

DRAWING NUMBER
QFN5/SYD/2040

REV.
A

Document prepared by

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to life*

