Lloyd Creek Rural Village

Engineering Services Report

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1 INTRODUCTION

1.1 Background

ADG Engineers (Aust.) Pty Ltd (herein ADG) have been commissioned by Intrapac Noonamah Pty Ltd (herein Intrapac) to prepare an Infrastructure Plan for the proposed Lloyd Creek Rural Village development. The project is located in the suburb of Lloyd Creek within the Greater Darwin Region, approximately 36km south-east of the Darwin CBD. The project is also identified in the NT Infrastructure Plan and Pipeline report (2022) commissioned by the NT Government under the enabling infrastructure plan as a proposal which responds to economic and population growth.

The project aims to provide a high-quality, Rural Village and lifestyle community, with a land product which enables serviceable rural village lots, something that is not currently available in the Greater Darwin market. An earlier concept for the site previously proposed for the site under the name "Noonamah Ridge," and was rejected at a planning / Ministerial level for several reasons, including concerns surrounding possible impacts on ground water and infrastructure servicing. This report aims to address the servicing concerns raised during the previous planning assessment, while leveraging new information and projects in the regional planning matrix for rural Darwin to demonstrate the serviceability of the proposed development and provide commentary on timing of enabling infrastructure opportunities. The main points to be discussed within this report are:

- Water Servicing
- Wastewater Servicing / Treatment
- Stormwater Impacts
- Transportation Networks
- Power & Telecommunications

The report presents high-level design considerations and calculations to demonstrate servicing viability of the development, acknowledging that, upon approval of the development through planning, a detailed Masterplan addressing all of the above elements will be prepared and submitted to the relevant authorities for review and approval.

1.2 Property Detail

The details of the property for the proposed development can be seen in **Table 1**.

Table 1 – Property Detail

Title	Sections 5827, 507, 5758 & 5761 Hundred of Strangways
Street Address	Monaghan Road, Lloyd Creek, NT 800 Freds Pass Road, Lloyd Creek, NT 905 Redcliffe Road, Lloyd Creek, NT 580 Alverly Road, Lloyd Creek, NT
Site Area	2,641.4 Ha

The location of the proposed development is demonstrated in **Figure 1.**

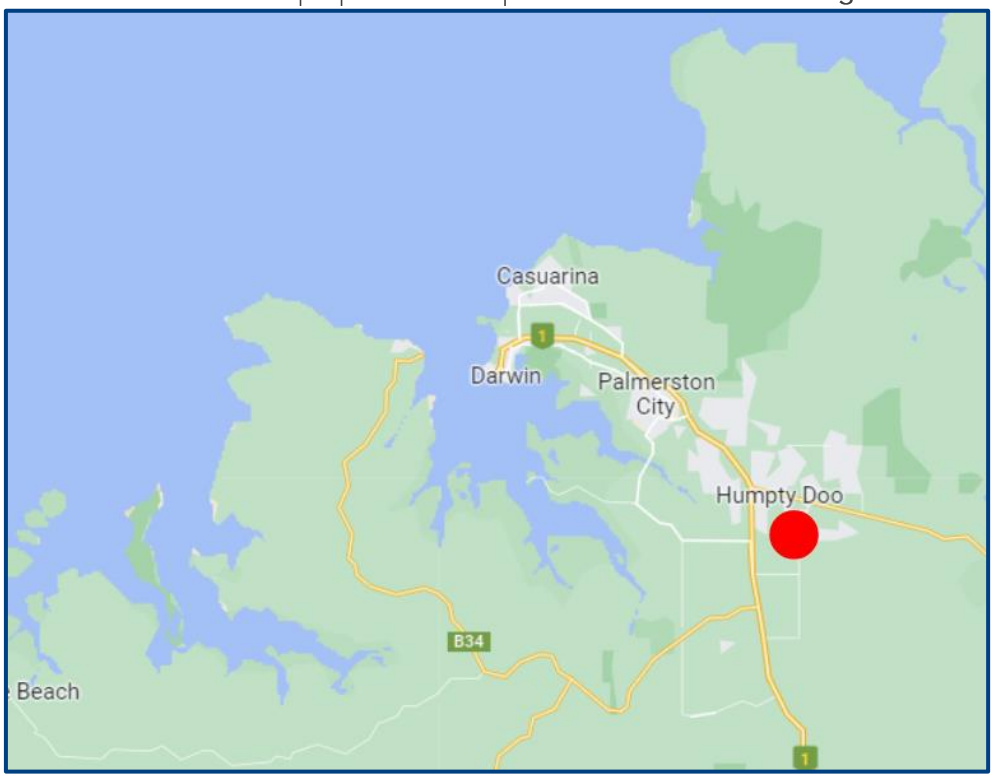


Figure 1 – Location of the Proposed Development

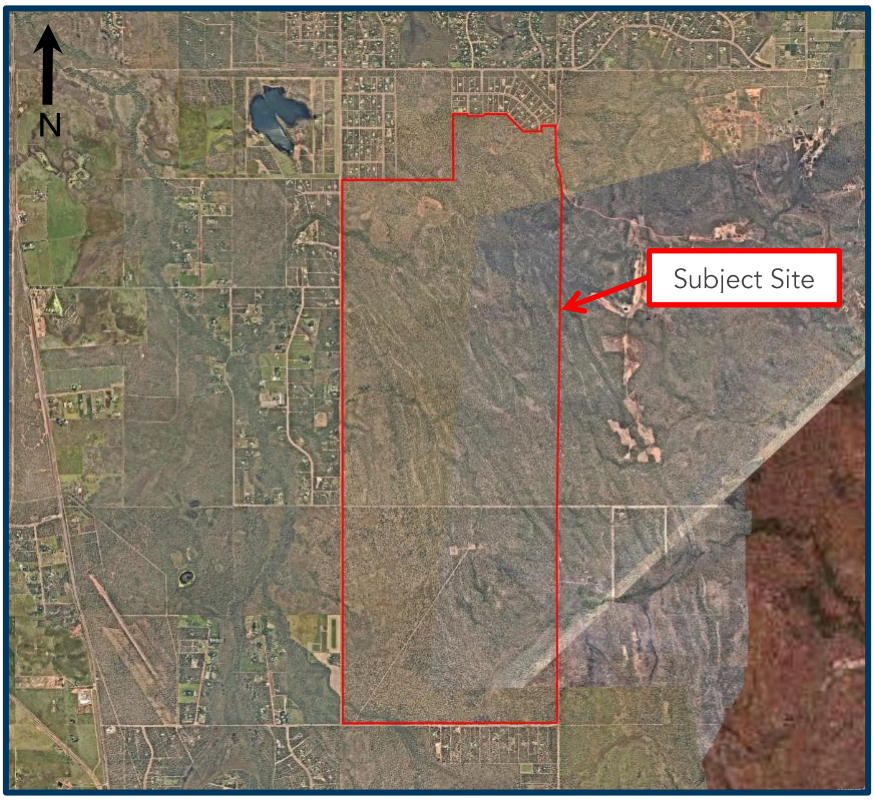


Figure 2 – Site Location (as accessed from NearMaps 19.06.2022)

2 EXISTING SITE

The existing site is private freehold land, currently held by Koolpinyah Station Pty Ltd and Norama Enterprises Incorporated. The proposed area is largely undeveloped pastoral land with an existing telecommunications tower and transponder site in the south and associated access easement and track from the south-west corner. There are several mining tenements that exist over the land and a network of existing watercourses through the site. This site is bound by Redcliff Road to the west, Townend Road to the south and Mocatto Road to the east.

Cadastral information for the site is shown in **Figure 3**. Lot 5759 is owned by the NT Government and is proposed as a future road and services corridor extending Alverly Road to meet with an extension of Goode Road. This corridor is a section of a proposed link between the possible future industrial port areas in Cox Peninsula and Glyde Point and does not constitute part of the project area.

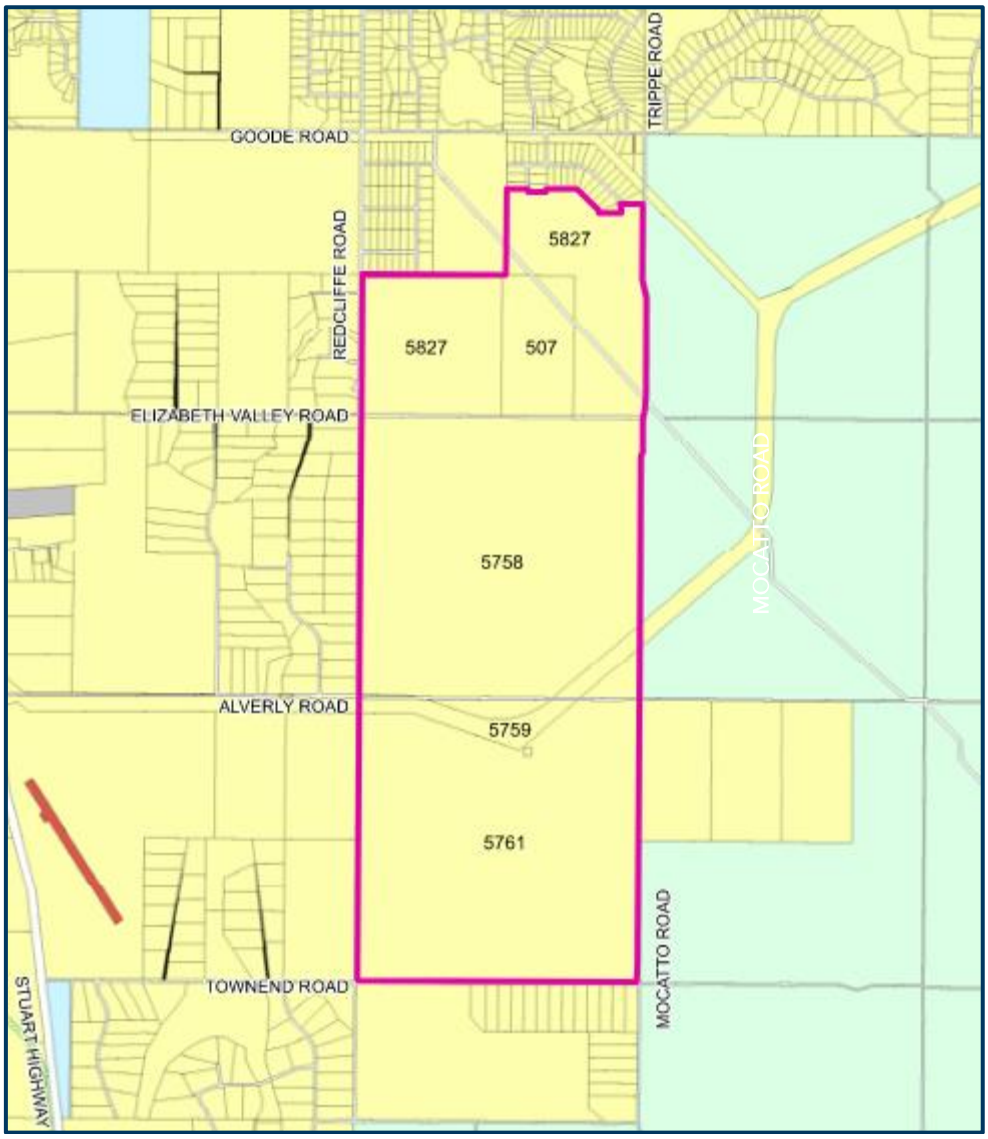


Figure 3 – Cadastre and Tenure Map of the Project Area and Surrounds (extracted from Intrapac's EIS report)

3 PROPOSED DEVELOPMENT

3.1 Development Yield

A draft Lloyd Creek Rural Village Area Plan has been developed by Cunnington Rosse Town Planning Consultants and informs the general area intent for the development. The Lloyd Creek Rural Village expects to achieve 4,200 new allotments on its completion and is proposed to include:

- Two rural activity centres
- Approximately 1,000 Rural Activity Centre Residential lots with an average area of approximately 800m^2
- Approximately 3,200 lots within the Rural Village area (being Rural Village typology lots, Rural Residential and Rural Living) lots between 1,000m^2 and 20,000m^2
- Approximately 321 Ha of natural area (12% of the site area), including 235 Ha of passive and active open space (nominally 10% of the developable area).

Refer to the Draft Lloyd Creek Rural Village Area Plan available in **Appendix B** for further information.

3.2 Development Timing

The development proposes to enact the development designation for the site as per the NT Planning scheme strategic framework which will logically take place over a long period of time and be governed by regional demand. It is acknowledged that there are several Crown Lease developments in the Greater Darwin Area and noted that the proposed Lloyd Creek offers a different style of development appealing to a different style of landholder. The Northern Territory Government is proposing a growth strategy that is centric to a $40 billion economy by 2030 and with the current shortage for housing nationwide, the development will provide support to regional development.

As an estimate, **Figure 4** provides an indicative timeline for the development. It is important to note that the first stages of the development (including master planning, detailed design and construction) will take place within the rural fringes of the site, and as discussed later in this report, will not rely on services reticulation. Planning and design works for the rural activity centres will be dependent on planning and demand for the product, as well as attainment of a critical mass within the area to support commercial & educational facilities.

Figure 4 – Indicative Development Timeline

4 ACID SULFATE SOILS

Acid sulphate soils are soils which contain iron sulphides, and are generally found in low-lying, coastal areas below 20m AHD. A review of the Northern Territory Government's Natural Resources Maps (NR Maps) Acid Sulphate Soils Risk map overlay has indicated that the subject site is outside of an area that possesses a probability of acid sulphate soil occurrence.

5 EARTHWORKS

5.1 General Intent

Existing topography and contour data was obtained from Cross Solutions and can be found in **Appendix E.** Based on the existing contour data and information obtained from the Environmental Impact Statement prepared by Intrapac, there is a substantial series of quartzite and sandstone hilly ridges running diagonally from the north-west to south-east of the Lloyd Creek development area. The highest point of the site is approximately 80m above sea level (ASL) and located in the south of the site near the existing telecommunications tower. The lower areas – largely on the eastern and western boundaries of the site – are approximately 30m ASL.

Over 50% of the project site, mainly the centre area, is occupied by hilly ridges, which grade into low rises, then to flat, gently undulating upland areas towards the project boundaries. Some of the steepest slopes – approximately 18 – 20% – within the hilly areas occur as localised hill slopes up to 110m in width and 400m or more in length. These areas also feature some broad hill crests (over 350m in width) with a slope of approximately 5 – 6%. Generally, the rugged hills exhibit a pattern of undulating rises separated by open drainage depressions, with a slope of up to 20%. Within the lowlands, the drainage areas are generally broad depressions with occasional incised or gully-like systems.

An earthworks design shall be developed wholistically for the Lloyd Creek Rural Village as part of the masterplan and shall be refined during the detailed design of each stage of the development. The earthworks strategy for the development is to follow the natural contours of the land with the intention of minimising the extent of significant cut to avoid rock while aiming to achieve a cut and fill balance for the overall development. The earthworks design shall be developed in accordance with the Northern Territory Subdivision Development Guidelines. All disturbed areas shall be stabilised upon completion of the bulk earthworks activities.

5.2 Acts, Regulations and Guidelines

Earthworks design and construction will need to comply with (including but not limited to):

- AS3798 Guidelines on Earthworks for Commercial and Residential Developments
- NT Subdivision Guidelines (as a final point of reference where guidance on matters is not provided by the above).

5.3 Extents of Works

The earthworks design shall generally ensure that the limits of cut and fill are contained wholly within the boundaries of the stage under design. The exception to this is where precinct boundaries adjoin buffer zones which are alongside high and low order watercourses and other zones. Earthworks activities could be undertaken in these buffer zones where necessary provided the following conditions are complied with:

1) Earthworks in these zones shall be permitted for the formation of stormwater management features/facilities as well as cut and fill batters beyond allotments and road reserve. Roads, buildings and other structures shall not be located in the buffer zone unless otherwise approved by the relevant authority.
2) The batters shall comply with a detailed slope stability assessment prepared by a Geotechnical Engineering. As the buffer zone will also be potentially utilised for linear parks, the design of earthworks including batter slopes within the buffer zones will need to consider the requirements of the NT Subdivision Guidelines.

3) Batters shall be stabilised and finished in accordance with approved landscaping plans to maintain a seamless transition within the buffer zone.

5.4 Excavation

Excavation shall be in accordance with AS3798-2007 *'Guidelines on Earthworks for Commercial and Residential Developments'*. Grass and topsoil shall be stripped over the extent of the works to a depth as a recommended by the Geotechnical Engineer. The exposed subgrade shall be compacted to the required minimum relative compaction values (standard maximum dry density ratio or minimum density index) as nominated in Table 5.1 of AS3798-2007. Following compaction of the subgrade the surface shall be proof rolled in accordance with section 5.5 of AS3798.

Trenching for in-ground utilities shall be undertaken in safe manner as legislated by the *Workplace Health and Safety Act 2011*. Safety measures shall include but not be limited to: trench shoring measures, horizontal benching and fencing. In addition to these requirements, the stability of the surrounding land, roads and structural foundations shall not be compromised. Trenches shall be adequately drained.

5.5 Filling

The placement of all fill shall be inspected and tested by a Geotechnical Engineer to a minimum 'Level 2' requirement during earthworks operations to ensure that all fill is placed in a *'controlled manner'*, in accordance with AS3798-2007 *'Guidelines on Earthworks for Commercial and Residential Developments'*.

Material won from any excavation on site would be required to meet the minimum requirements for general or select fill material as defined in the project specification.

5.6 Retaining Walls

The incorporation of retaining walls within the proposed development is likely to be an infrequent occurrence in the future detailed design applications due to the natural topography and the desire to provide affordable near flat lots. Retaining wall structures may be in the form of:

- Gravity retaining walls;
- Cantilever retaining walls;
- Crib walls; and
- Sleeper walls (timber retaining structures are not desirable).

Where retaining structures exceed 1.0 meter in height, these shall be covered by a Structural Engineer's design certification (Section 40). The earthworks design may consider nominating temporary batters in lieu of retaining walls as part of the subdivision civil works provided that batter stability requirements are complied with.

5.7 Erosion and Sediment Control

The design and incorporation of erosion and sediment control measures for both the temporary (construction phase) and operational phase will be imperative for the proposed development. Erosion and sediment control measures including water quality management will require thorough assessment in conjunction with advice from a suitably qualified geotechnical engineer to ensure that the control measures are appropriately devised.

Detailed earthworks designs for the proposed development will be accompanied by erosion and sediment control management plans and associated drawings demonstrating the anticipated control measures to be implemented. The design will be carried out in accordance with International Erosion Control Association Best Practice Erosion & Sediment Control books.

Proactive erosion prevention measures shall be prioritised over reactive control measures. Examples of erosion prevention measures include:

- Limiting the area and duration of exposed earth (i.e. following earthworks procedures, cover with geotextiles or stabilise with turf/planting as soon as practically possible)
- Diverting runoff in a controlled manner away from the exposed earth during earthworks
- Rock check dams
- Geo-synthetic reinforcing and / or and turf/planting stabilisation of batters and embankments

6 ROADWORKS

6.1 Existing Road Network

The subject site is bound by:

- Redcliffe Road to the west – Rural cross section catering for two-way movement and two-way crossfall with table drainage within either verge. The road pavement features centreline and edge line linemarking for the full extent of the subject site.
- Townend Road to the south – Rural cross section catering for two-way movement and two-way crossfall with table drainage within either verge. The road pavement features centreline and edge line linemarking for the full extent of the subject site.
- Cockatiel Road to the north – Rural cross section catering for two-way movement and two-way crossfall with table drainage within either verge. The road pavement currently terminates with a pavement stub at the intersection of Cockatiel Road and Malachite Road. The road pavement does not feature linemarking.
- Monaghan Road to the north – Rural cross section catering for two-way movement and two-way crossfall with table drainage within either verge. The road pavement currently terminates with a cul-de-sac head at the interface to the subject site. The road pavement features centreline linemarking for its full extent.
- Ward Road to the north – Rural cross section catering for two-way movement and two-way crossfall with table drainage within either verge. The road pavement currently terminates with a cul-de-sac head at the interface to the subject site. The road pavement features centreline linemarking for its full extent.

All of the above-mentioned road pavements appear to currently be in excellent operational condition. Redcliffe, Townend and Mocatto Roads have all been recently resealed circa October 2021 as part of the 2020/21 Local Roads and Community Infrastructure Grant – Road Reseal. **Figure 5** indicates the location of each of the existing road corridors explored above.

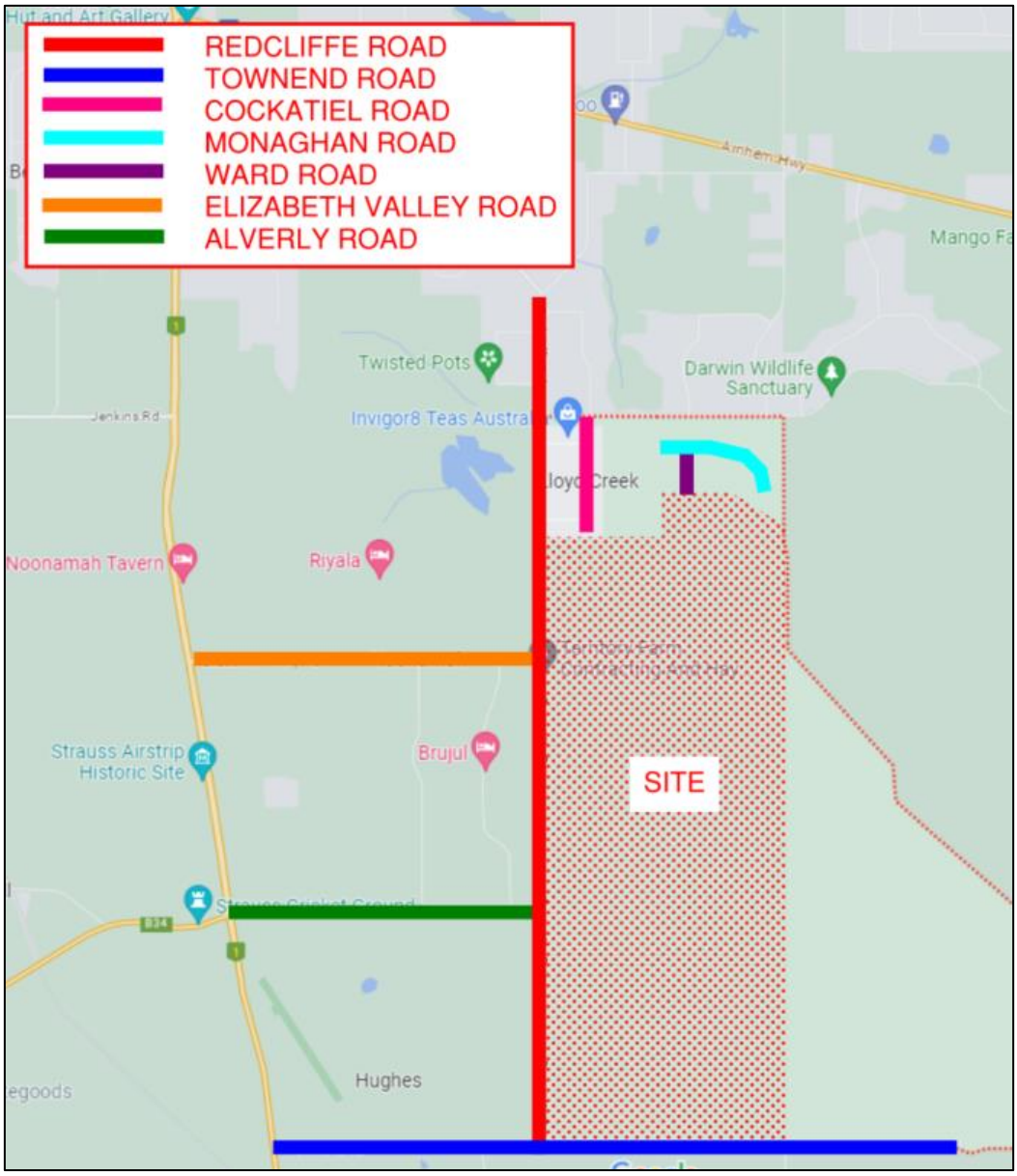


Figure 5 – Existing Road Corridors

6.2 Proposed Road Network

The proposed development will require a road network to provide access to residential lots, rural activity centres and thoroughfare for access to adjacent future development of the region. A detailed Traffic Impact Assessment (TIA) has been undertaken as part of the previous development application which highlights key private, public and active transport strategies for the previously proposed urban focuses development. The primary difference between the Lloyd Creek Rural Village and the previous application will be the shift from a proposed urban footprint to that of a rural village. Considering the transport strategies outlined in the previous TIA established that proposed and existing transport infrastructure could cater for an urban population, it is expected that the Lloyd Creek Rural Village will also be readily able to cater for proposed and existing transport infrastructure. Notwithstanding this, any future development application will be supported by reporting in regard to transport whether this may be in the form of a new Traffic Impact Assessment or amendment to the existing.

It is expected that the proposed transport infrastructure throughout the Llyod Creek Rural Village will:

- Consist of rural road cross sections consistent with the regional road networks & the requirements of the NT Subdivision Development Guidelines (SDG).
- Allow for the collection of stormwater via table drains in the verge & discharge into existing waterways (subject to a detailed design of quantity and quality control to the NT SDG)
- Allow a provision of lighting minimum at intersections, and as required for safety (to be developed during detailed design)
- Consider a road hierarchy to be assessed and adopted based on the outcomes and recommendation of the TIA / network study and the NT SDG.

The internal road network will be developed as part of the development master plan and the recommendations of the TIA / Network Study however based on the Rural Village theme; it is expected that rural pavement cross sections will be proposed throughout the development. **Figure 6** indicates the anticipated rural road cross-section for the Llyod Creek Rural Village noting the road reserve width will vary between 20m to 30m depending on the road hierarchy classification as shown in **Table 2.**

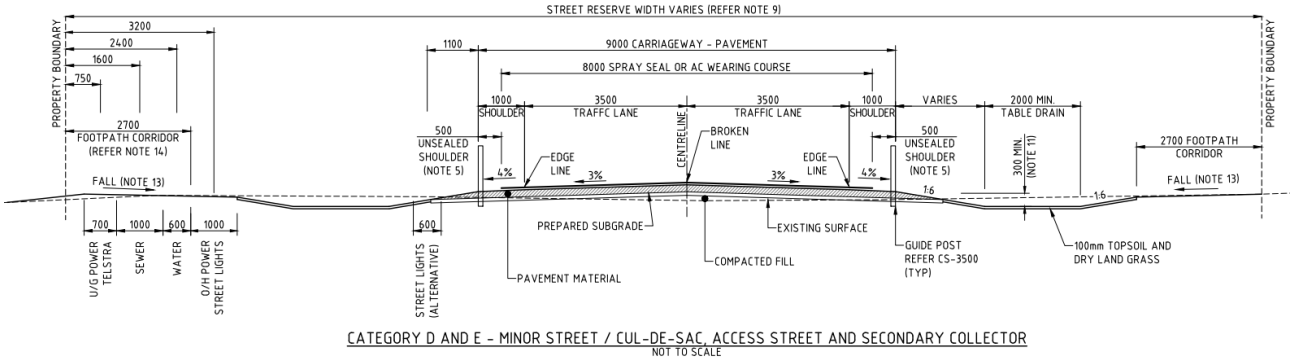


Figure 6 – Typical Rural Road Cross Section as indicated by NTG standard drawing SS1005

Table 2 – Minimum Street Reserve Width as indicated by NTG standard drawing SS1005

Street Hierarchy	Minimum Street Reserve Width (m)
Minor Street / Cul-de-sac	20
Access Street	22
Secondary Collector	25
Primary Collector	30

At the detailed design phase it may be proven appropriate to construct an urban cross section within the rural activities centres depending on spatial restrictions.

6.3 Site Access

The existing site is bound by Redcliff Road to the west, Townend Road to the south and Mocatto Road to the east. The existing Redcliff Road is a rural cross section and provides ample access to the site throughout. There are currently several points along the extent of Redcliffe Road which will be suitable for access to the development. Acknowledging the requirement for further analysis, the access intersections will be assessed during the detailed design for safety and location suitability in the context of the existing roads and property accesses along the road. As the development commences, access will be provided, at a minimum, at the extension of Alverly Road through the site, and additional accesses to the west of the development will be provided as deemed appropriate and necessary.

7 STORMWATER INFRASTRUCTURE

As part of future stage applications, site-based stormwater management plans will be prepared to assess the proposed development with relation to both stormwater quantity and quality and in accordance with the requirements of the NT Subdivision Guidelines. The quantity assessment will be undertaken to confirm a 'non-worsening' of peak flow discharges from the site and the quality assessment will be undertaken to determine the required stormwater treatment measures to be implemented on site.

Stormwater management plans will be required to comply with the NT Subdivision Guidelines and Local Authority requirements, which stipulates requirements regarding the removal of gross pollutants, suspended solids, nitrogen and phosphorus to target reduction levels.

7.1 Existing Infrastructure

It is understood that there is no existing formalised drainage infrastructure within the proposed Lloyd Creek Rural Village development, noting the previous discussion within this report of the existing site conditions. Noting the lack of stormwater infrastructure, it is noted that there are several existing watercourses that run throughout the site. A review on the Northern Territory Government's NR Maps interactive mapping indicates that there are no major or minor drainage courses throughout the site, only a series of ephemeral 'streams' which convey overland flow through to the site boundaries and beyond the outer edges discharging into major drainage courses. As part of the future masterplan application a 2D hydraulic analysis will be undertaken to determine the existing flow regime of the ephemeral streams.

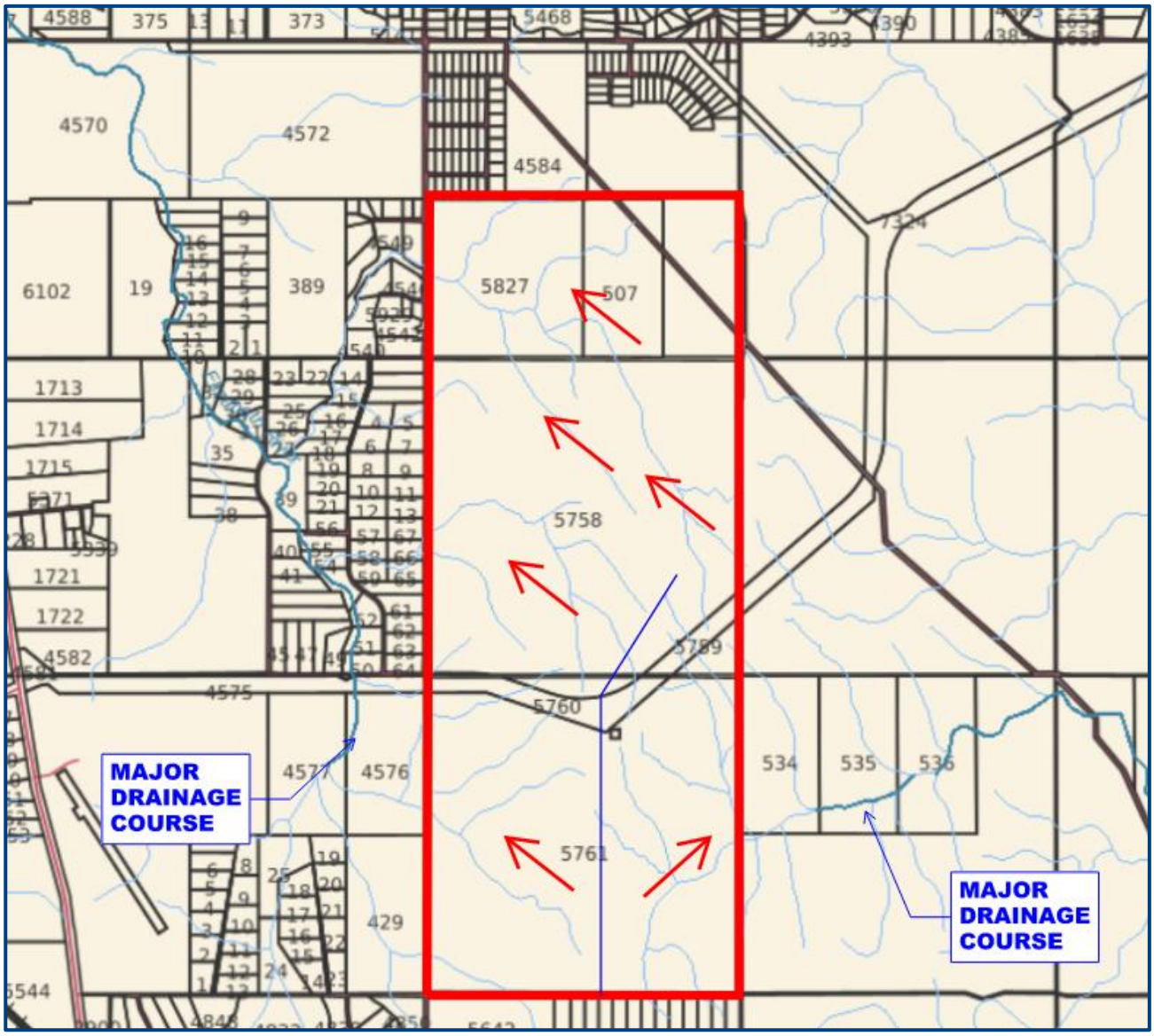


Figure 7 – Existing Stormwater Regime

There is an existing table drain running along the entire length of the boundary between Redcliffe Road on the development side with culverts to facilitate transverse drainage beneath driveways and the road pavement at several locations.

7.2 Upstream Catchments

Based on the available contour data, no upstream external catchments have been identified to convey runoff onto the subject site.

7.3 Point of Discharge

The NT Subdivision Guidelines indicate that all stormwater infrastructure constructed as part of Subdivision developments require a Point of Discharge into downstream drainage Public Infrastructure. In the pre-development case, the Point of Discharge for a large majority of the site may be considered as the existing table drain and associated infrastructure within the Redcliffe Road corridor ultimately discharging beneath Redcliffe Road via the existing ephemeral streams mentioned above. A secondary point of discharge may

also be observed at the site's eastern extent discharging across the site boundary to existing rural allotments. The existing points of discharge will be maintained in the post-development case.

7.4 Stormwater Quantity Management

7.4.1 Flow Objectives

Increasing the impervious surface area of the development site will have the effect of increasing stormwater runoff from the site. To mitigate any increase in peak flow rates, it is proposed to provide stormwater detention measures within each developed neighbourhood. Peak stormwater runoff discharge rates at downstream property point of discharge are to remain at or below pre-development levels for all ARI's up to the Q100 storm event.

7.4.2 Hydrologic Methodology

To analyse the hydrological characteristics of the existing and post-development catchments and produce runoff hydrographs, a suitable hydraulic model will be utilised in future stage applications. These hydrographs will form the basis of the calculation of the detention volumes required to achieve non-worsening of peak flows. Pre-development catchment boundaries will be delineated based on existing topography derived from LiDAR data supplied by the Department of Infrastructure, Planning and Logistics while post-development catchment delineation will be based on the natural topography and expected earthworks extents.

The Queensland Urban Drainage Manual (QUDM) provides advice as to the typical fraction impervious figures for varying development categories. See **Figure 8** below for the expected fraction impervious for Urban Residential and Rural Residential development zones.

Development category	Fraction impervious (f_i)
Central business district	1.00
Commercial, local business, neighbouring facilities, service industry, general industry, home industry	0.90
Significant paved areas e.g. roads and car parks	0.90
Urban residential – high density	0.70 to 0.90
Urban residential – low density (including roads)	0.45 to 0.85
Urban residential – low density (excluding roads)	0.40 to 0.75
Rural residential	0.10 to 0.20
Open space and parks etc.	0.00

Figure 8 – Fraction Impervious

7.4.3 Hydraulic Methodology

A suitable hydraulic model will be created to represent each sub-catchment for both pre-and post-development conditions in the future stage applications. Land uses and development yield from a preliminary layout prepared of the proposed development will be used as the basis for calculation of impervious areas for the entire site. Catchment inflows will be calculated as per Section 7.4.2 and applied at proposed detention basin or detention lake locations.

The proposed detention basins / lakes will be modelled in accordance with Section 7.9.14 of the NT Subdivision Guidelines. Depth-area relationships will be created for each proposed basin / lake to represent the available storage volume at each node. Low flow pipes and a high flow weir will be incorporated into each design to simulate a typical detention basin outlet arrangement. Each basin / lake will undergo detailed design and verification as part of a Site Based Stormwater Management Plan for each relevant stage.

The proposed basins / lake will be provided with suitable outlet arrangements that throttle flows back to pre-development flows. Emergency overflows shall be provided to discharge flows in excess of the major design storm. It is anticipated that the major design storm will be the 100 year storm in accordance with the NT SDG.

7.5 Stormwater Quality Management

7.5.1 Water Quality Objectives

The NT Subdivision Guidelines requires stormwater runoff from a development site to be collected and treated prior to discharge to maintain environmental values of the receiving waters. In future stage applications, this will be achieved through the use of a stormwater treatment train to remove sediments and nutrients from runoff. Any proposed Stormwater Quality Treatment devices shall ensure the minimum percentage reduction targets as identified in **Figure 9** are achieved prior to discharging the stormwater from the site to the lawful points of discharge.

Table 28 — Stormwater Pollutant Reduction Targets

Stormwater Pollutants	Pollutant Reduction Targets (%)
Gross Pollutants (GP)	90%
Total Suspended Solids (TSS)	75%
Total Phosphorous (TP)	60%
Total Nitrogen (TN)	35%

Figure 9 – Stormwater Quality Reduction Targets

7.5.2 Methodology – Modelling MUSIC

The Model for Urban Stormwater Improvement Conceptualisation (MUSIC) will be utilised to simulate pollutant generation and treatment for each stage within the development site. The MUSIC model will be prepared in accordance with the current version at the time of *Water by Design Music Modelling Guidelines* with appropriate rainfall-runoff parameters and recommended pollution generation rates. The proposed treatment method will be designed in accordance with the above document. Land uses and development yield from preliminary layout of the proposed development will be used as the basis for calculation of treatment areas for the entire site.

Rainfall data will be sourced from the closest available station to the site for a 10-year period at six-minute intervals as per the *Water by Design Music Modelling Guidelines.*

7.6 Proposed Infrastructure

The drainage management for the area will be designed to maintain pre-development flows at the sites various points of discharge and reduce the discharge of pollutants into receiving waterways by utilising suitable applications of Water-Sensitive Urban Design (WSUD) principals. The greenfield nature of the development, along with well-defined catchments can accommodate a wide range of available WSUD drainage solutions that are suitable to the tropical climate of the area, e.g. detention basins, lakes, swamps/wetlands, grassed swales, gross pollutant traps and porous pavements. An internal hydraulic network housed within the proposed road network will be required to convey stormwater runoff to any proposed stormwater management system. The Major and Minor storm events will match the criteria as identified in **Figure 10** from as per the NT Subdivision Guidelines.

7.7 Regional Flooding

A review of the Northern Territory Government's Elizabeth and Blackmore River Catchments Flood Extent map has indicated that the subject site is outside of an area that possesses a riverine flood risk.

Table 20 — Design Storm Events for Residential/Mixed Use and Industrial Zones		
Application	**Annual Exceedance Probability (AEP)**	
	Minor Storm	**Major Storm**
Residential Zones (excl. HR)	50%	1%
Commercial and HR Zones	10%	
Industrial Zones	20%	
All Other Land Use Zones	50%	
Areas of Significance (See Definitions)	1%	0.2%

Table 21 — Design Storm Events for Rural Zones		
Application	**Annual Exceedance Probability (AEP)**	
	Minor Storm	**Major Storm**
Rural Zones (RR, RL, R)		1%
- Table Drains	50%	
- Culverts under Driveway Crossovers	50%	
- Cross Road Culverts	5%	
- Floodways	Refer Section 7.9.13 for details.	

Figure 10 – Minor and Major Stormwater Design Storm Criteria

Due to the predominantly rural nature of the proposed development, it is expected that stormwater runoff will be conveyed via aboveground infrastructure such as roadside table drains. At the detailed design phase it may be proven appropriate to construct below ground infrastructure within the rural activities centres depending on spatial restrictions.

8 WASTEWATER & WATER DEMAND

The number of equivalent persons (EP) was used to calculate an approximate wastewater and water demand that will be generate by the proposed development. For the Lloyd Creek Rural Village development, the EP was calculated by applying a demand rate per dwelling and defined area as outlined in the PWC Supplement to the Water and Sewerage Supply Code of Australia. **Table 3** provides a summary of the EP calculations.

Table 3 – Approximate Water and Wastewater Demand

Land Classification		Units	Criteria	Equivalent Persons
Residential	Single Dwelling Unit Area = 800 m^2	1,000 lots	3.5 EP / Dwelling Unit (Assumes 1 dwelling per lot)	3,500
	Rural Residential Unit Area = 2 ha	50 lots	4.5 EP / Dwelling Unit (Assumes 1 dwelling per lot)	225
	Rural Residential Unit Area = less than 2 ha	3,150 lots	3.5 EP / Dwelling Unit (Assumes 1 dwelling per lot)	11,025
Non-residential	Shopping	8 ha*	20 EP / ha	160
	Commercial	5 ha	35 EP / ha	175
	Schools	3.5 ha*	45 EP / ha	157.5
	Public Open Space (POS)	235 ha	20 EP / ha (Sewer) 80 EP / ha (Water) – N/A as POS will be irrigated from bore water	4,700 (Sewer)
Total Sewer EP				19,942.5
Total Water EP				15,242.5

* Note – Quantity adopted from Groundwater Headworks Option report by Byrne Consultants (Ref: 19074_R001_RevA). Actual quantity to be reviewed on advancement of area plan.

9 WATER SUPPLY

9.1 Existing Infrastructure

It is understood that there is no existing reticulated water infrastructure within the project area. Residential allotments near the site are serviced with on-lot groundwater bores, and provision of water storage tanks which are replenished through rainfall during the wet season and re-stocked through trucked water from regional water treatment plants during the dry season.

There is an existing DN300 and DN375 potable reticulation pipework running along the Stuart Highway 3 km west of the development. PWC have previously advised that the closest existing pump station located on Stuart Highway does not currently have sufficient capacity to service the entire Lloyd Creek Rural Village development and will therefore need to be upgraded if connection to this reticulated water source is required.

The Groundwater Headworks Option report prepared by Byrne Consultants (Ref: 19074_R001_RevA dated March 2020) available in **Appendix C** has confirmed that exploratory bore drilling at the Lloyd Creek Rural Village site indicates there is a viable but limited groundwater supply immediately under the site area. To achieve the required demand it was previously proposed to draw from the existing aquifer to supply the fringe rural allotments only and to then secure a separate source of reticulation for the activity centres.

9.2 Future Planned Priority Infrastructure Projects

There are several planned priority infrastructure projects within the region by the Northern Territory Government which will provide options to supply the development with a secure water supply. These projects are the Manton Dam Return to Service project and the Adelaide River Off-Stream Water Storage Project (AROWS).

9.2.1 Manton Dam RTS / Strauss Water Treatment Facility

The Strauss Water Treatment Plant is a key component of the Manton Dam Return to Service (Manton Dam RTS) project. The project aims to secure an additional water source to boost Greater Darwin's short term water supply and is scheduled to be delivered by 2026 at the time of writing this report. The water treatment plant located at Strauss provides a potential point of connection to supply the Lloyd Creek Rural Village with potable water. To facilitate this connection, a pipeline would need to be constructed from the Strauss water treatment plan to the proposed development. This pipeline would follow existing services corridors and would be approximately 3km in length. **Figure 11** indicates the proposed location of the Strauss Water Treatment Plant on the corner of Cox Peninsula Road and Stuart Highway. Refer also to the Llyod Creek Rural Village Area Plan in **Appendix B** for an indication of the intended water reticulation alignment from the Strauss Water Treatment Plant to the site.

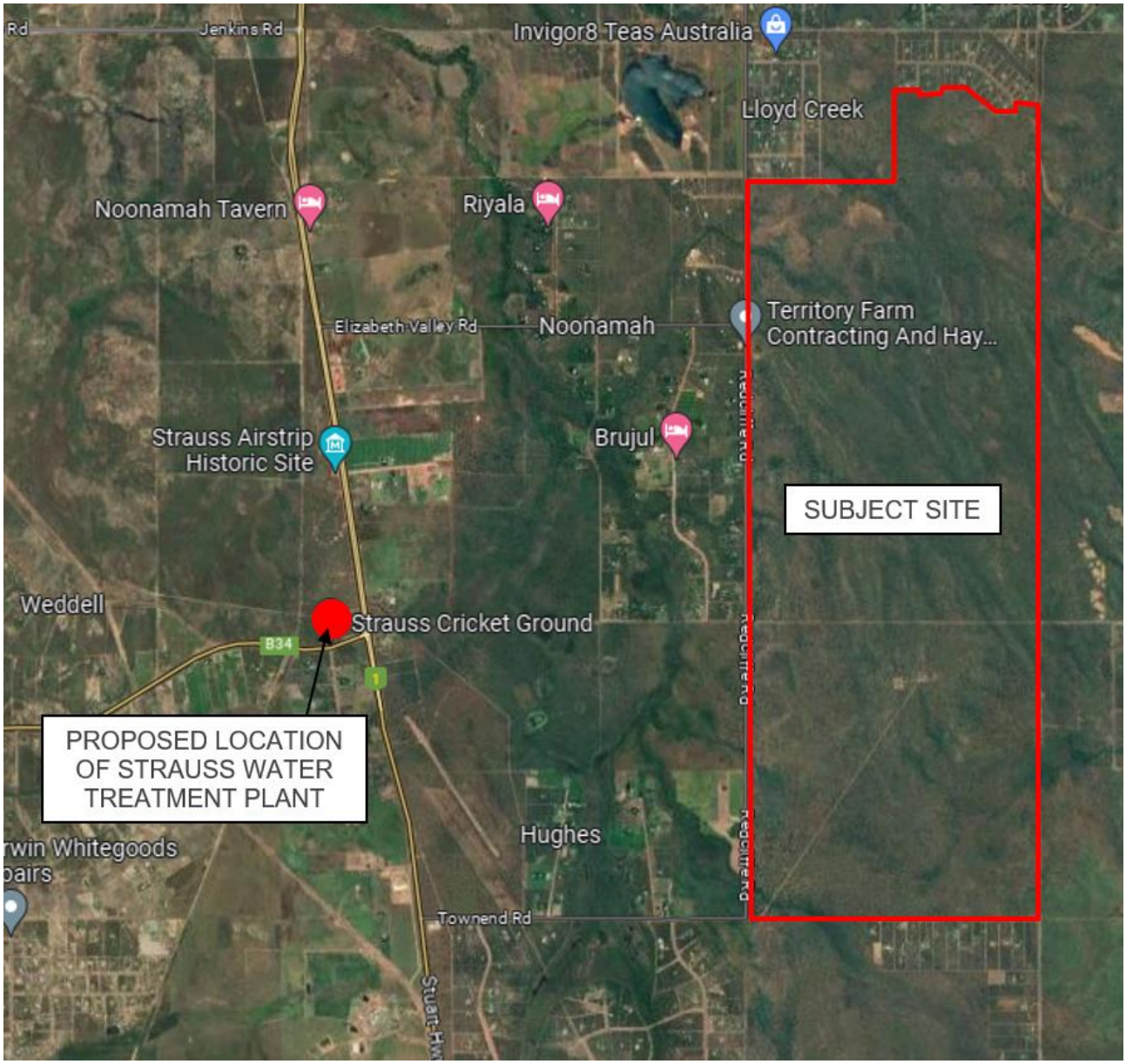
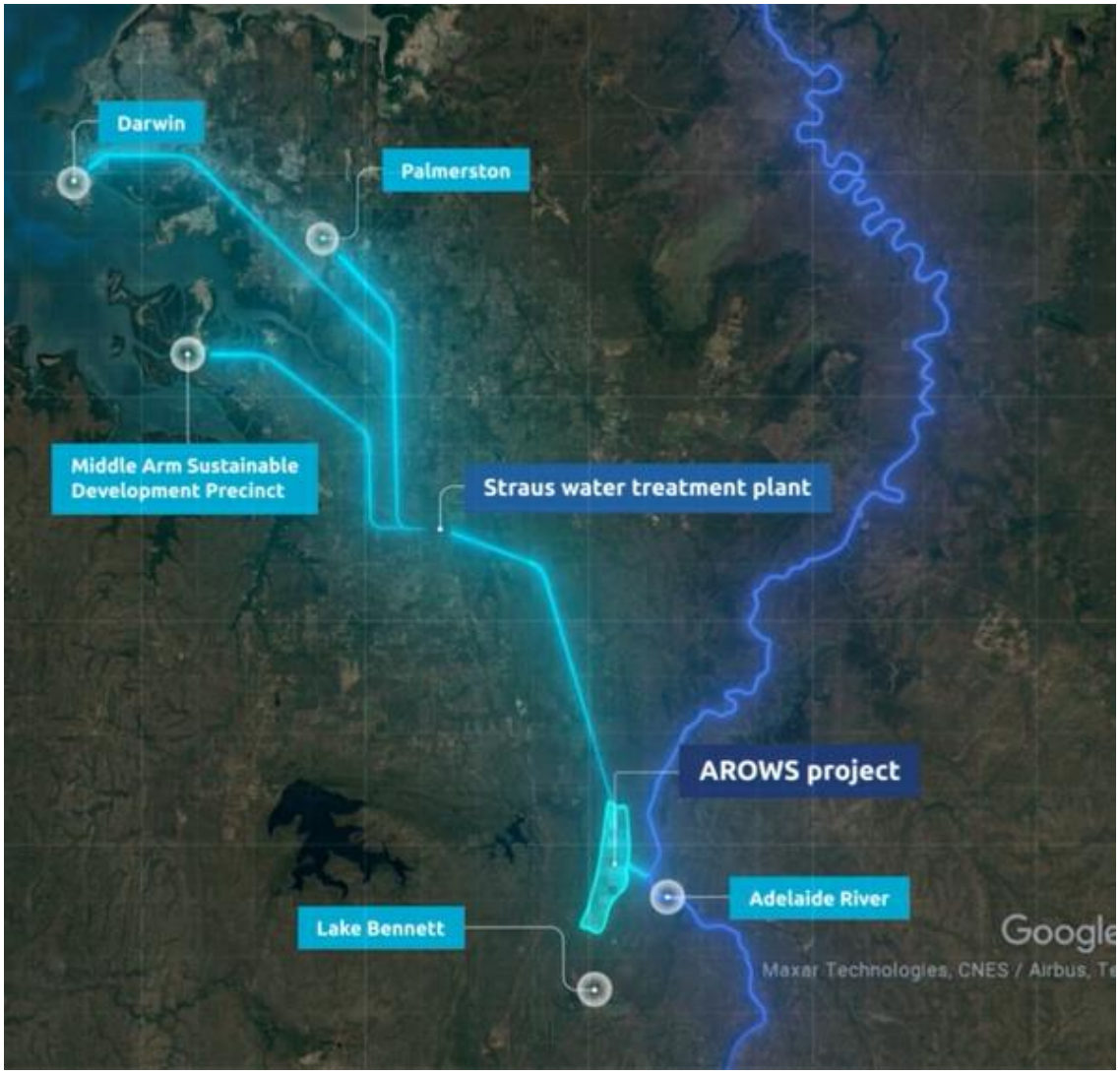


Figure 11 – Location of Strauss WTP in relation to Subject Site

9.2.2 Adelaide River Off-Stream Water Storage (AROWS) Project

The Adelaide River Off-stream Water Storage (AROWS) project is a long-term solution to supply additional water to the Darwin region by harnessing perennial runoff from the Adelaide River to be stored and distributed for reticulated use. The proposed infrastructure necessary to facility the AROWS is proposed to be constructed though the Lloyd Creek Rural Village area along the Alverly Road corridor discussed earlier in this report.

The Northern Territory Government has identified that construction and commissioning of AROWS to secure a long term water supply is expected to be undertaken within the next 7 to 10 years with an approximate completion around 2032. The water supply from the AROWS project is understood to be untreated (raw) water. If the AROWS project was to be adopted as a supply source for the proposed development, a water treatment plant would be required to treat the raw water to potable water before reticulating it through the development as a supply. **Figure 12** indicates the location of the proposed AROWS project.



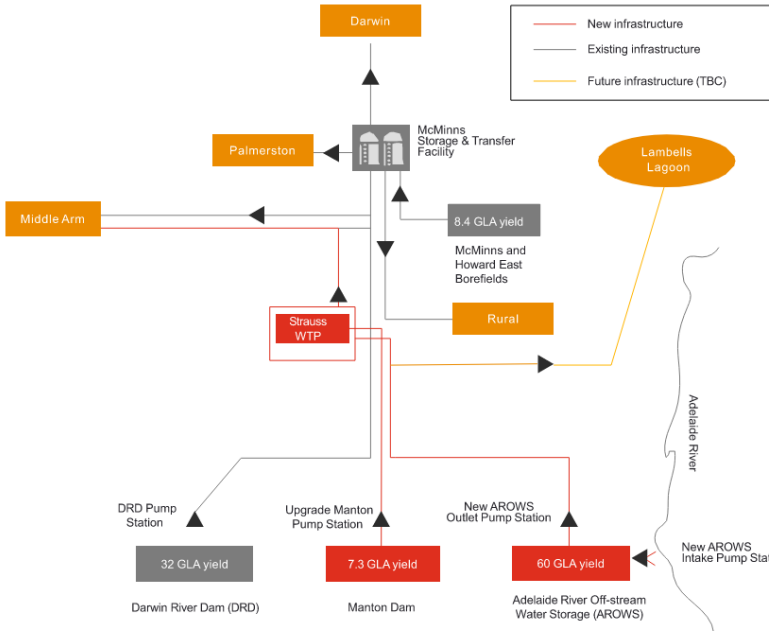


Figure 12 – Location of AROWS project (as obtained from NT Government)

9.3 Proposed Infrastructure

The reticulated water solution for the Lloyd Creek Rural Village will be dependent on timing of the above-mentioned Priority Infrastructure Projects and as such the following servicing proposal has been developed:

- All Rural Residential and Residential allotments as well as the rural activity centres will require connection to a reticulated, potable water supply. This water supply shall be obtained from either the Strauss Water Treatment Plant or AROWS pipeline. Construction and titling of these allotments will be driven by market demand and regional development and is expected to align with the completion of AROWS project. Water storage reservoirs will be required to be located at a suitable elevation to provide minimum required pressure to the service the proposed lots.

The intended water supply for the site not serviced by bores / water storage tanks will be the AROWS project, noting the timing alignment with the development and the NTG anticipated delivery. Noting that the AROWS project is not currently a committed project, and the options management of the Wydell Region currently being undertaken by the Northern Territory Government, the locality and timing of the committed Strauss water treatment facility provides a secure back up supply for the development if AROWS does not proceed, or timing does not align with current expectations.

A timeline of the key milestones for the Lloyd Creek Rural Village, as well as the NTG water infrastructure plans is noted in **Figure 13**. Noting the timing in the Figure, it is concluded that secure water supply can be provided to the site from 2026, should the developer adjust development plans to suit the market demand.

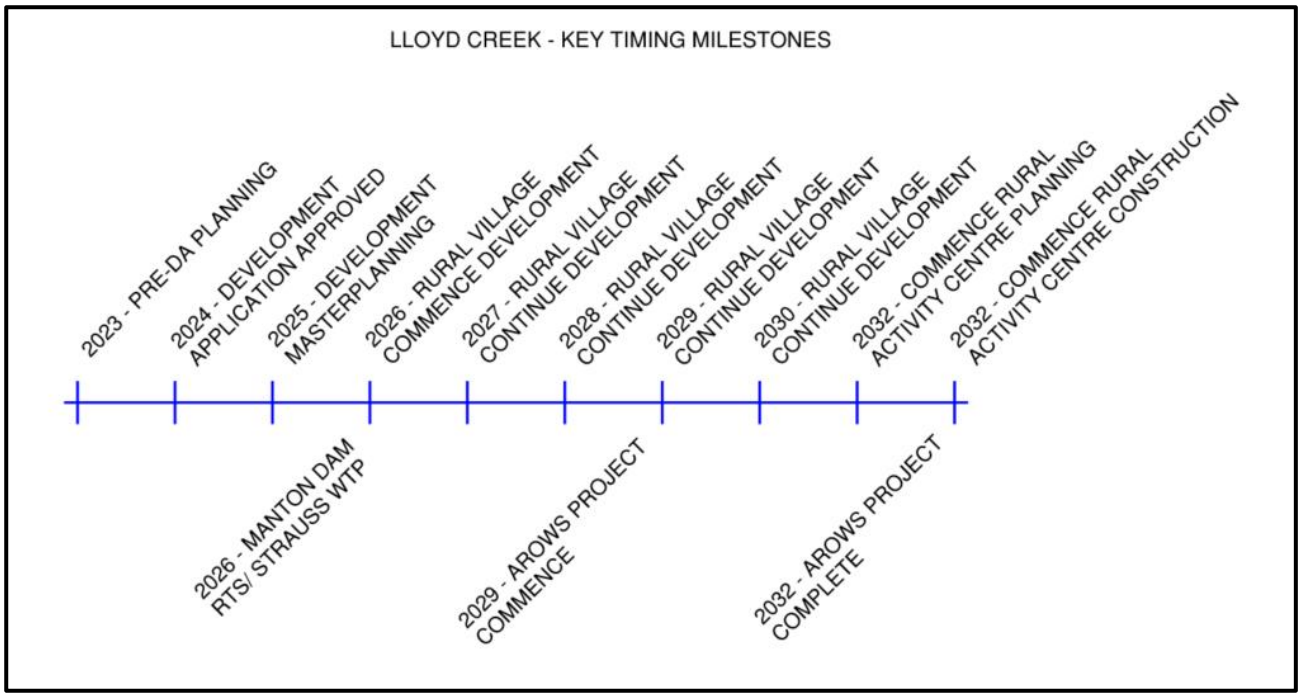


Figure 13 – Anticipated Water Supply Key Timing Milestone

10 WASTEWATER TREATMENT

10.1 Existing Infrastructure

There is currently no public sewerage infrastructure within the vicinity of the proposed development. The closest wastewater treatment facility is located in Humpty Doo, and previous engagement with PWC has indicated that this facility does not have the capacity to service the proposed development. Existing residential properties surrounding the development are generally serviced via on-lot septic tanks and effluent disposal systems.

10.2 Proposed Infrastructure

PWC have previously advised that reticulated municipal sewer treatment services are not proposed for the area in the near future. Previous soil / environmental investigations for the site indicate that the soil conductivity is suitable for on-site wastewater disposal subject to meeting the Code of Practice for Wastewater Management 2020 (NTG). It is also acknowledged that this is a typical wastewater management strategy for rural lots where reticulated sewer is not available. It is thus proposed that the rural lots within the development are serviced via on-site wastewater treatment and effluent disposal and managed by the landholder.

Noting the timeline of the development in **Figure 13,** it is not anticipated for lots in the rural activity centre to be developed until approximately 2032, and it is expected based on population growth forecasts to achieve the $40 billion economy goal, that reticulated sewer may be a viable option for the activity centre's in consultation with PWC. If reticulated sewer is not available, the developer will be required to install an approved alternative wastewater treatment strategy, which will comply with the requirements of the relevant authorities.

- All Rural Residential allotments located outside of the Rural Activity Centres of the Lloyd Creek Rural Village will utilise a traditional means of on-site wastewater treatment subject to meeting the Code of Practice for Wastewater Management 2020 (NTG). Construction and titling of these allotments can begin immediately (subject to planning & authority approvals) as the wastewater treatment solution will not be reliant on public infrastructure. As per the requirements of the Cod eof Practise for Wastewater Management, a Site and Soil Evaluation will be undertaken over each proposed allotment during the detailed design phase to determine the most appropriate type of wastewater treatment solution. If the Site and Soil Evaluation indicates an area of existing strata material as unsuitable for effluent disposal, then an engineering solution will be proposed.

- Allotments and tenancies within Rural Activity Centres to be constructed with connection to a reticulated or as otherwise approved wastewater system to be determined closer to the construction date to the satisfaction of PWC or the relevant authority / agency. As above, construction / titling of these allotments will not be expected to begin for 7 to 10 years to coincide with the completion of the AROWS project and as such developments in the rural activity centre's. At this time, available technologies may have significantly changed. Potential options for consideration include:

  - Traditional gravity and pressure sewerage network to be dedicated to PWC. Note: lack of a suitable point of connection limits the viability of this option at this time.

  - A Community Effluent Disposal system consisting of individual primary treatment units to be installed to each allotment and to drain to a combined effluent treatment system. As this proposal is non-standard, it is expected that this option would be designed, constructed and maintained by a third-party authority to remove any responsibility to PWC. At the time of

compiling this report, Intrapac had thoroughly investigated the viability of engaging a Kubota Community Sewage Treatment solution to be designed, installed and maintained by True Water Australia. Should the means of a traditional gravity and pressure sewerage network be proven non-viable once the above timeframe has elapsed, the Kubota Community Sewage Treatment solution will be revisited as the preferred means of treatment for the remaining Rural Residential and Residential allotments and commercial activity centres.

- On-site wastewater treatment to each proposed allotment. This option would engage the individual lot owner to monitor and maintain their own on-site system and may be limited by required boundary setbacks as identified in the NTG On-Site Wastewater Management Code of Practice.

11 ELECTRICAL SUPPLY

11.1 Existing Infrastructure

A review of the PWC as-constructed mapping as obtained from a Before You Dig (BYDA) search has identified the below existing infrastructure with proximity to the site:

- An existing overhead HV conductor running along the western side of Redcliffe Road.

The Power and Communications Infrastructure EIA report compiled by Byrne Design (Ref: 14055_R01_B dated June 2015) was prepared as part of an earlier development application which confirms the presence of this infrastructure and indicates that there is minimal spare capacity in the existing adjacent PWC network and as such this infrastructure cannot be considered as an adequate source to service the proposed development.

Refer to the BYDA information in **Appendix A** and relevant extracts from the Power and Communications Infrastructure EIA report in **Appendix D** for further information.

11.2 Proposed Infrastructure

As indicated in the Power and Communications Infrastructure EIA report compiled by Byrne Design, the estimated load allocations across the site are classified as basic supply consisting of the load allocations as indicated in **Table 4** below.

Table 4 – Estimated Electrical Demand

Land Classification		Units	Criteria	kVA
Residential	Single Dwelling Unit Area = 800 m^2	1,000 lots	10 kVA Single Phase **	10,000
	Rural Residential Unit Area = 2 ha	50 lots	10 kVA Three Phase **	500
	Rural Residential Unit Area = less than 2 ha	3,150 lots	10 kVA Three Phase **	31,500
Non-residential	Shopping	8 ha*	Undefined **	2,500 (assumed)
	Commercial	5 ha		
	Schools	3.5 ha*		
	Public Open Space (POS)	235 ha		
Total Estimated Electrical Load				44,500

* Note – Quantity adopted from Groundwater Headworks Option report by Byrne Consultants (Ref: 19074_R001_RevA). Actual quantity to be reviewed on advancement of area plan.

** Note – Criteria adopted from Power and Communications Infrastructure EIA report by Byrne Design (Ref: 14055_R01_B dated June 2015). Actual criteria to be confirmed by qualified electrical consultant on advancement of area plan.

Refer to the relevant extracts from the Power and Communications Infrastructure EIA report in **Appendix D** for further information on the proposed electrical solutions available to this development. Noting the Power and Communications Infrastructure EIA report was commissioned in 2015, a qualified electrical consultant should be engaged to further explore the current potential electrical reticulation options.

12 COMMUNICATIONS

12.1 Existing Infrastructure

A review of the PWC as-constructed mapping as obtained from a Before You Dig (BYDA) search has identified there is no existing communications infrastructure within proximity to the site.

The Power and Communications Infrastructure EIA report compiled by Byrne Design (Ref: 14055_R01_B dated June 2015) indicates the presence of an existing Telstra cable running beneath Alverly Road to provide service to the Jorn Radar.

Refer to the BYDA information in **Appendix A** and the relevant extracts from the Power and Communications Infrastructure EIA report in **Appendix D** for further information.

12.2 Proposed Infrastructure

The Power and Communications Infrastructure EIA report compiled by Byrne indicates that the project will be serviced via the NBN fibre optic rollout. Noting the Power and Communications Infrastructure EIA report was commissioned in 2015, alternative communications options may provide a more suitable connection option. A qualified communications consultant should be engaged to further explore the current potential communication options including but not limited to Sky Muster and Star Link.

13 GAS

No gas infrastructure has been identified as part of a Before You Dig (BYDA) search.

14 CONCLUSION

ADG have been commissioned by Intrapac to prepare an Infrastructure Plan for the proposed Lloyd Creek Rural Village. The project is located in the suburb of Lloyd Creek within the Greater Darwin Region, approximately 36km south-east of the Darwin CBD. The development is proposed to consist of approximately 3,000 rural lots with a range of sizes (not more than 1.5 dwellings per Hectare) and 1,000 Residential lots accommodating approximately 11,000 people (approximately 10 lots per hectare). The Lloyd Creek Rural Village expects to achieve 4,200 new allotments on its completion.

The anticipated potable water supply for the site (subject to statutory requirements) will be the AROWS project, noting the timing alignment with the development and the NTG anticipated delivery. Noting that the AROWS project is not currently a committed project, and the options management of the Weddell Region currently being undertaken by the Northern Territory Government, the locality and timing of the committed Strauss water treatment facility provides a secure back up supply for the development if AROWS does not proceed, or timing does not align with current expectations.

An indicative timeline of the key milestones for the Lloyd Creek Rural Village is illustrated in **Figure 14**. Assuming the key milestones in this timeline are met, secure water supply can be provided to the site from 2026.

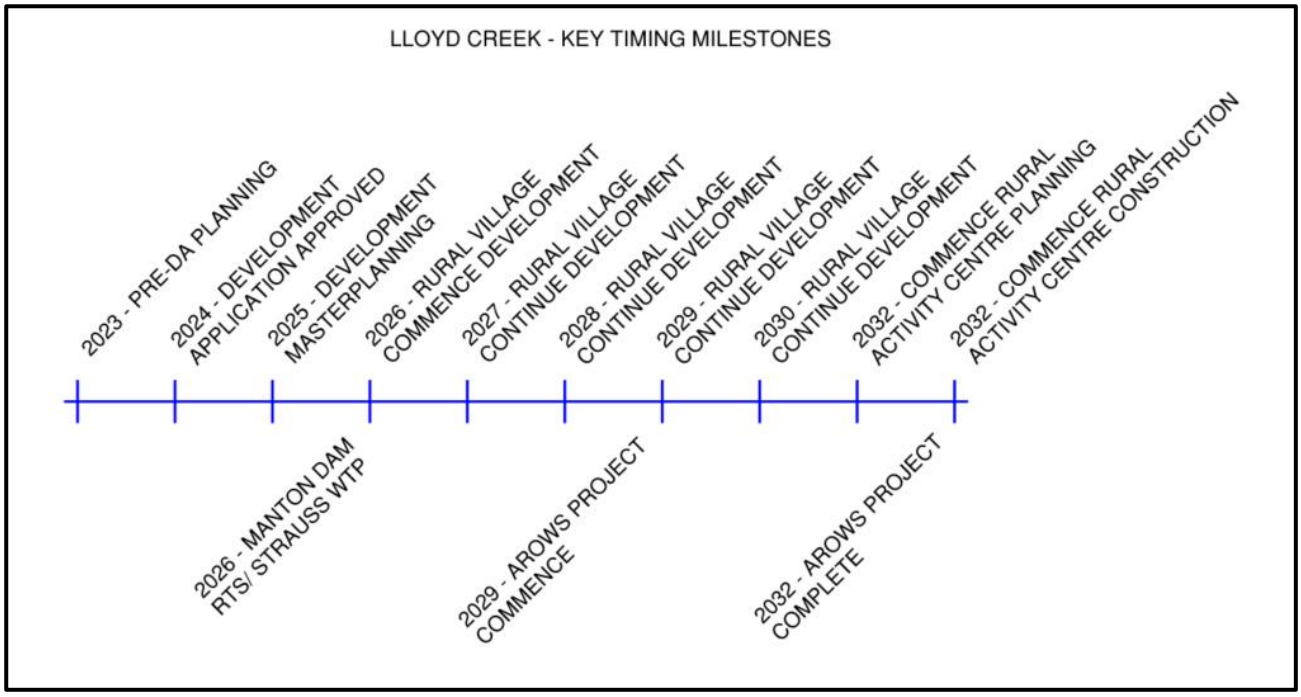


Figure 14 – Indicative Water Supply Key Timing Milestone

It is not anticipated for lots in the Rural activity centre to be developed until around 2032. Based on population growth forecasts to achieve the $40 billion economy goal by 2023, it is expected that reticulated sewer will be a viable option for the development in consultation with PWC. If reticulated sewer is not available, the developer will be required to install an approved wastewater treatment strategy, which will comply with the requirements of the relevant authorities.

- All Rural Residential allotments located outside of the Rural Activity Centres of the Lloyd Creek Rural Village to be constructed utilising traditional means of on-site wastewater treatment) subject to compliance with relevant statutory requirements. Construction and titling of these

allotments can begin immediately (subject to planning & authority approvals) as the wastewater treatment solution will not be reliant on public infrastructure.

- Allotments and tenancies within Rural Activity Centres to be constructed with connection to a reticulated wastewater system to be determined closer to the construction date. As above, construction / titling of these allotments will not be expected to begin for 7 to 10 years to coincide with the completion of the AROWS project and as such developments in the point of connection and available technologies may have significantly changed. Potential options for consideration include:

  - Traditional gravity and pressure sewerage network to be gifted to PWC. Note a suitable point of connection limits the viability of this option at this time.

  - A Community Effluent Disposal system consisting of individual primary treatment units to be installed to each allotment and to drain to a combined secondary effluent treatment system. As this proposal is non-standard, it is expected that this option would be designed, constructed and maintained by a third-party authority to remove any responsibility to PWC.

  - On-site wastewater treatment to each proposed allotment. This option would engage the individual lot owner to monitor and maintain their own on-site system and may be limited by required boundary setbacks as identified in the NTG On-Site Wastewater Management Code of Practice.

This report demonstrates that there are options available to service the proposed Lloyd Creek Rural Village. Upon approval of the proposed development a detailed Masterplan addressing all infrastructure requirements (traffic, roads, stormwater, water, sewer, power and communications) shall be prepared and submitted to the relevant authorities for review and approval. The master planning of the development shall be approved by each relevant authority prior to the lodgement of development applications for individual stages and prior to works beginning on site.

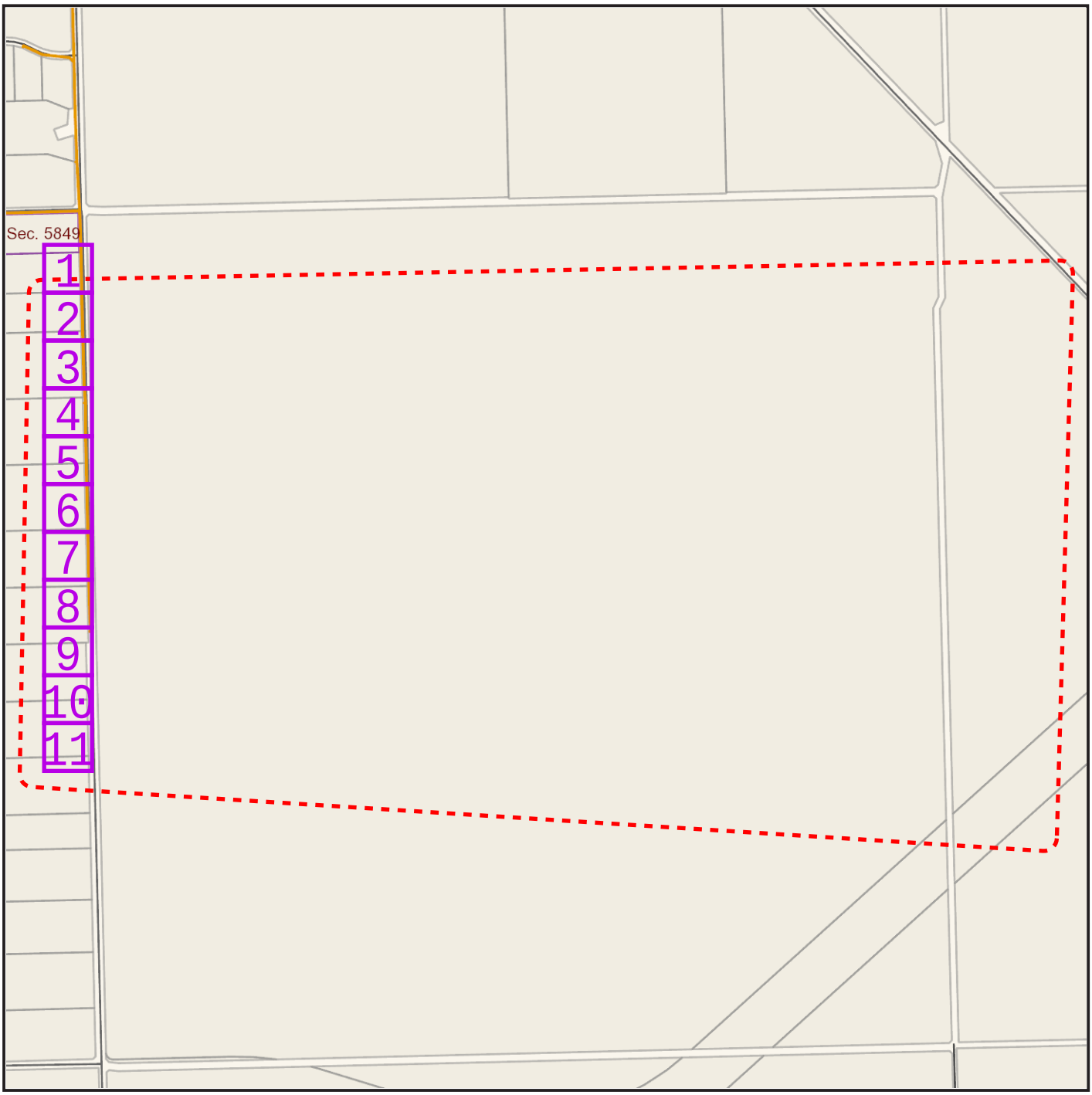
Appendix A
Dial Before You Dig Assessments

BYDA Infrastructure Location Advice

- **Activities within 3m of Power and Water Corporation assets may require a written authority from Power and Water Corporation prior to commencing work.**
- Do not assume depth or alignment of assets. Locations provided are approximate.
- You must read and understand all information supplied before undertaking any works.
- All information provided to you is valid for 30 days from the date of issue.

Not to scale

Power & Communications - OVERVIEW



Plans generated 06/07/2023

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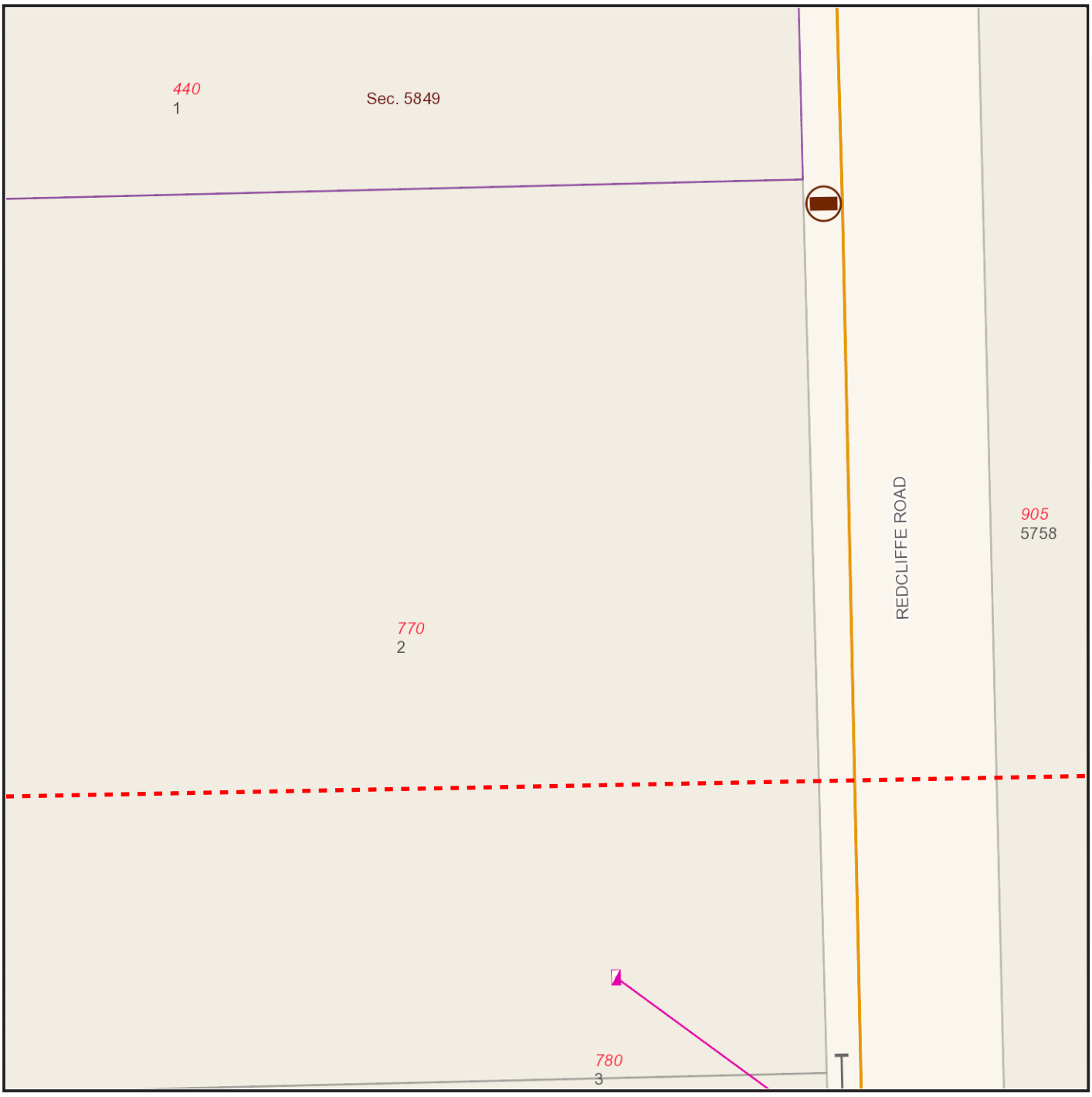

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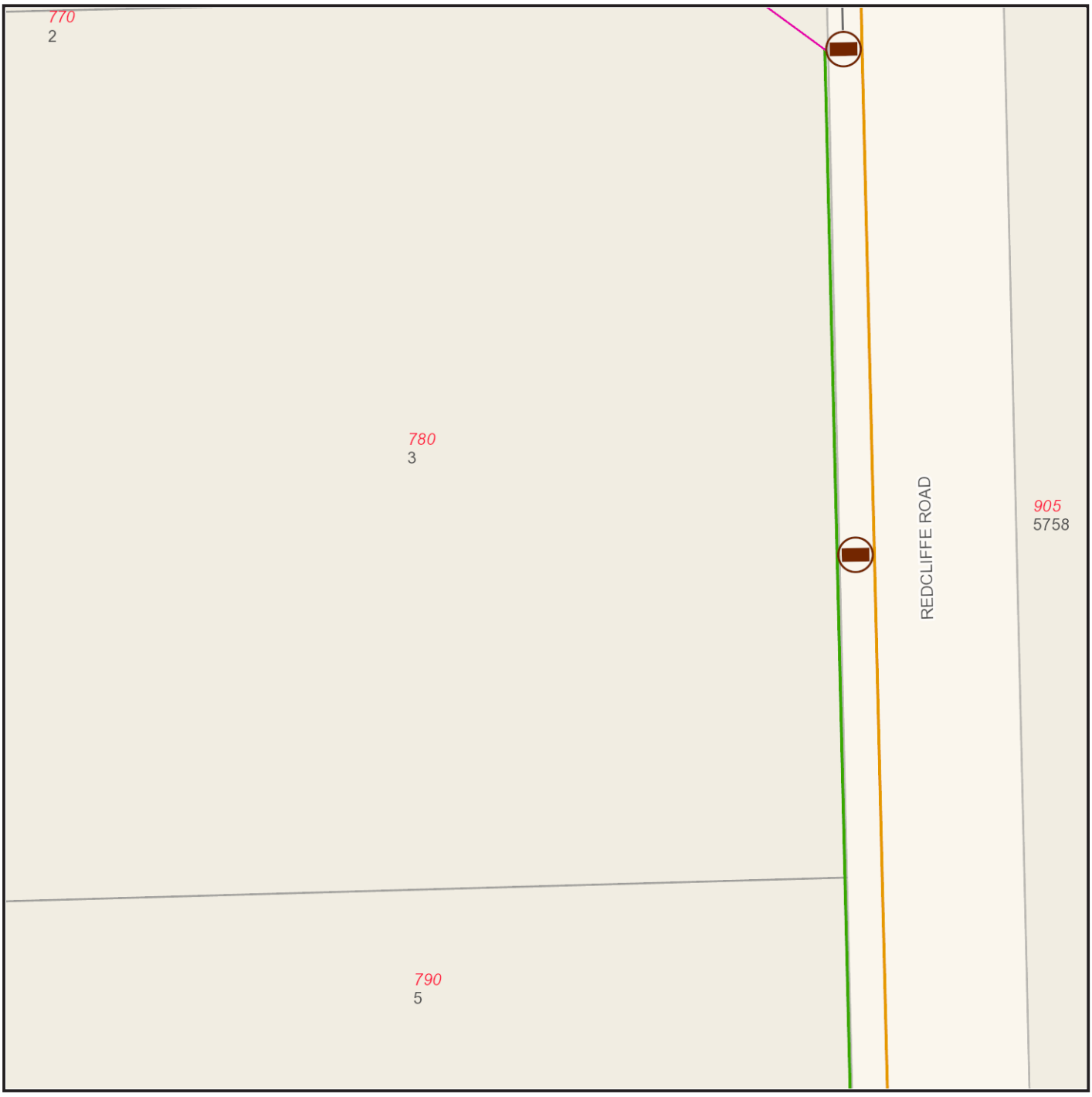

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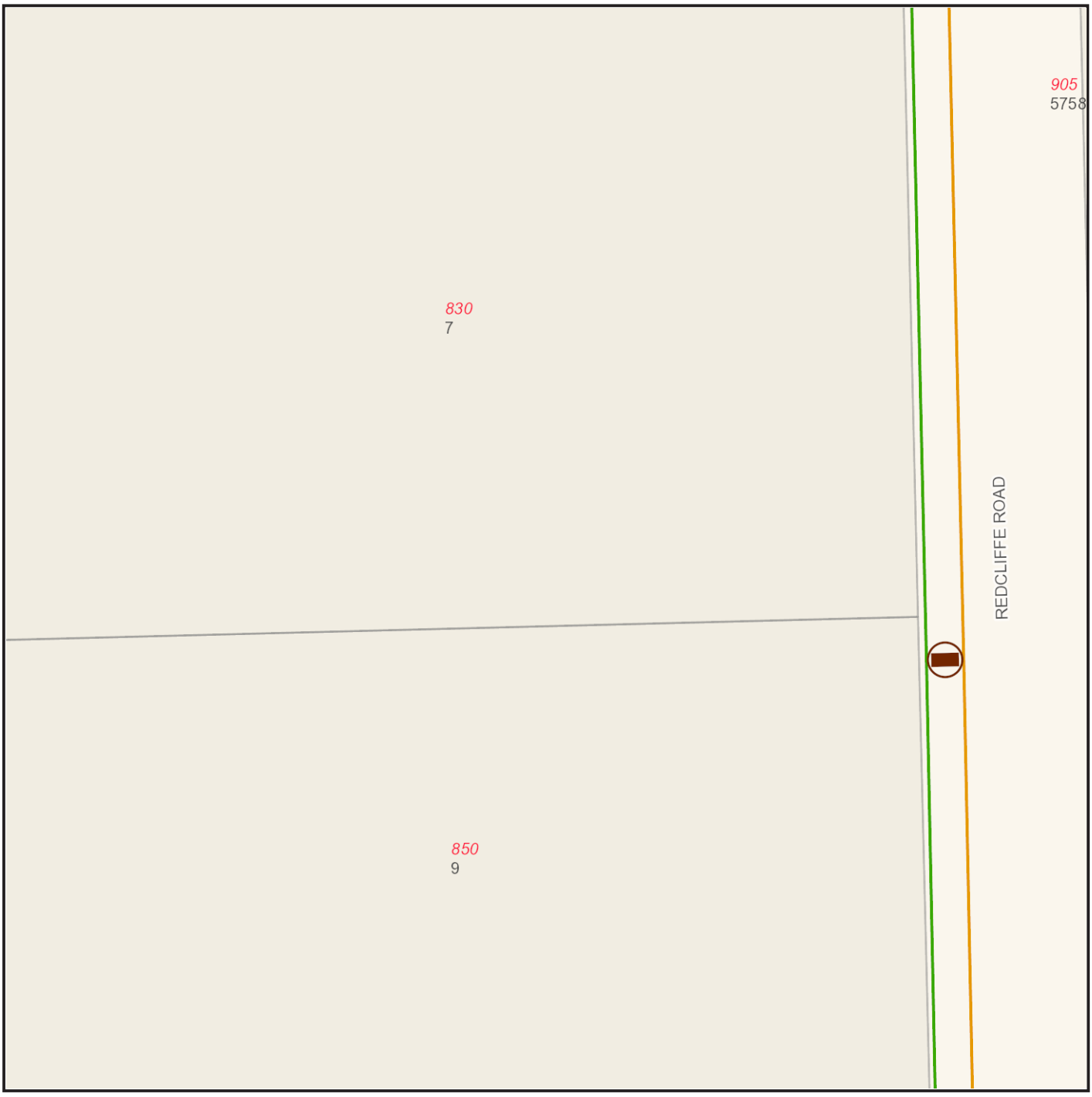

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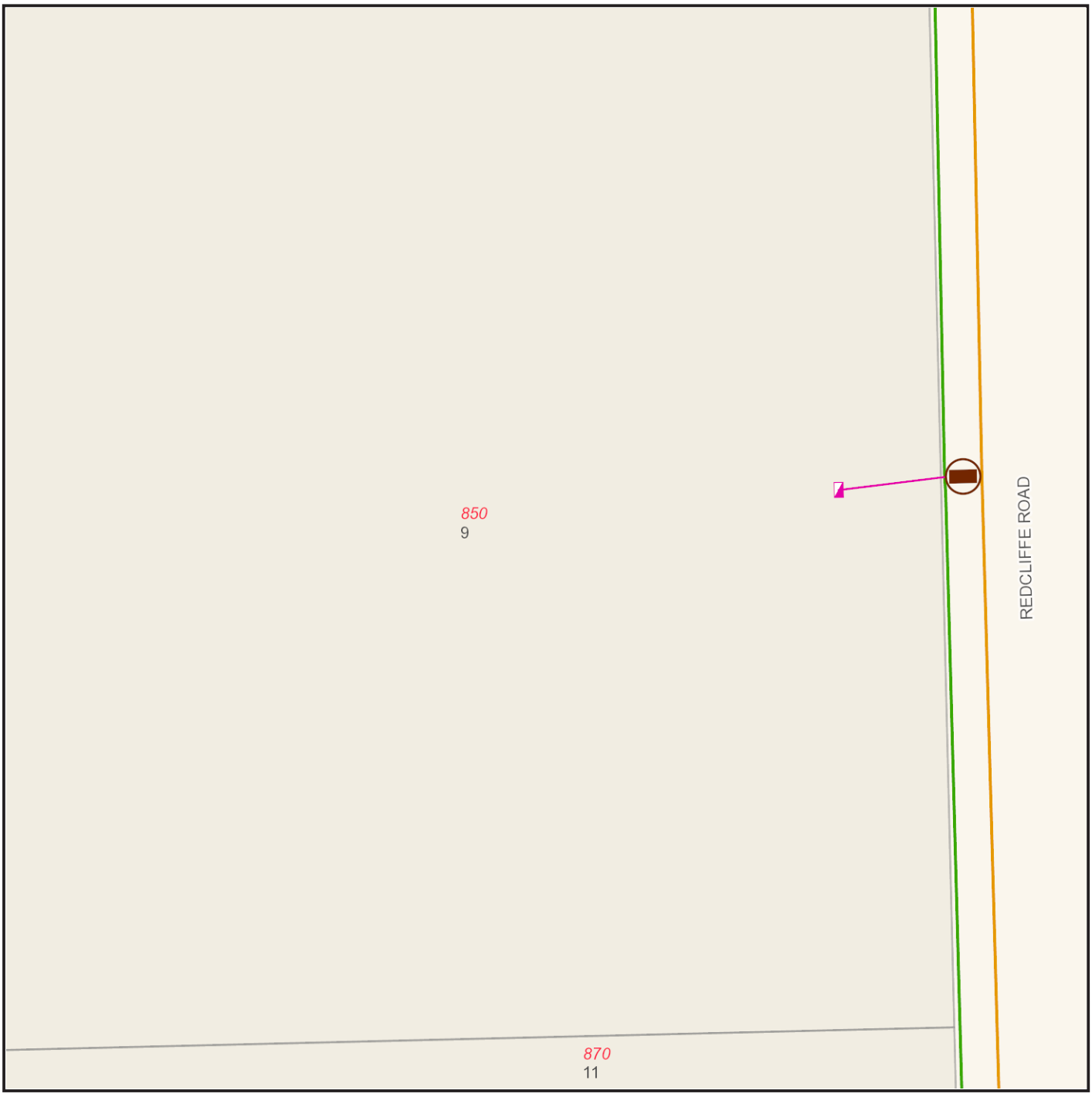

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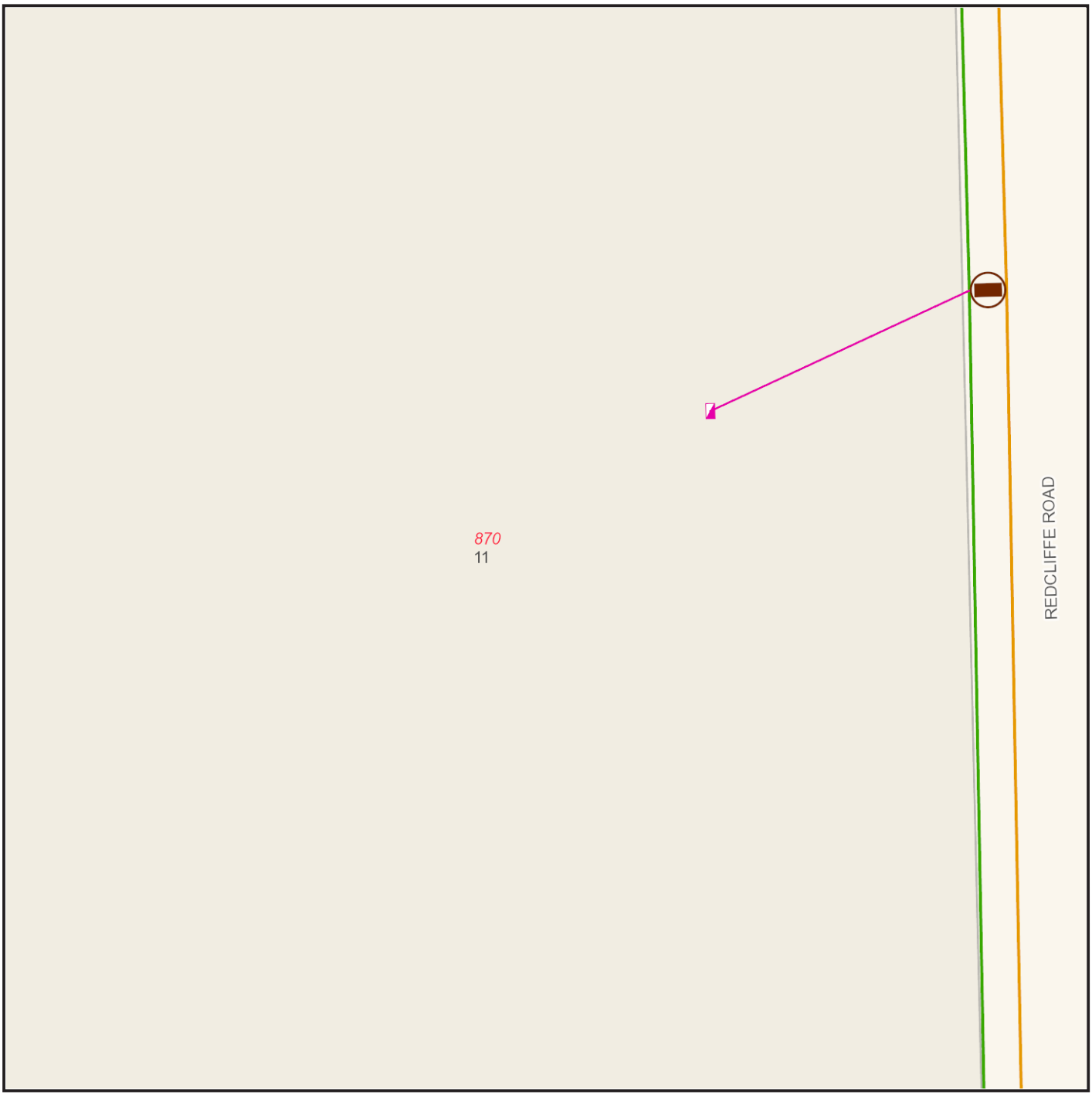

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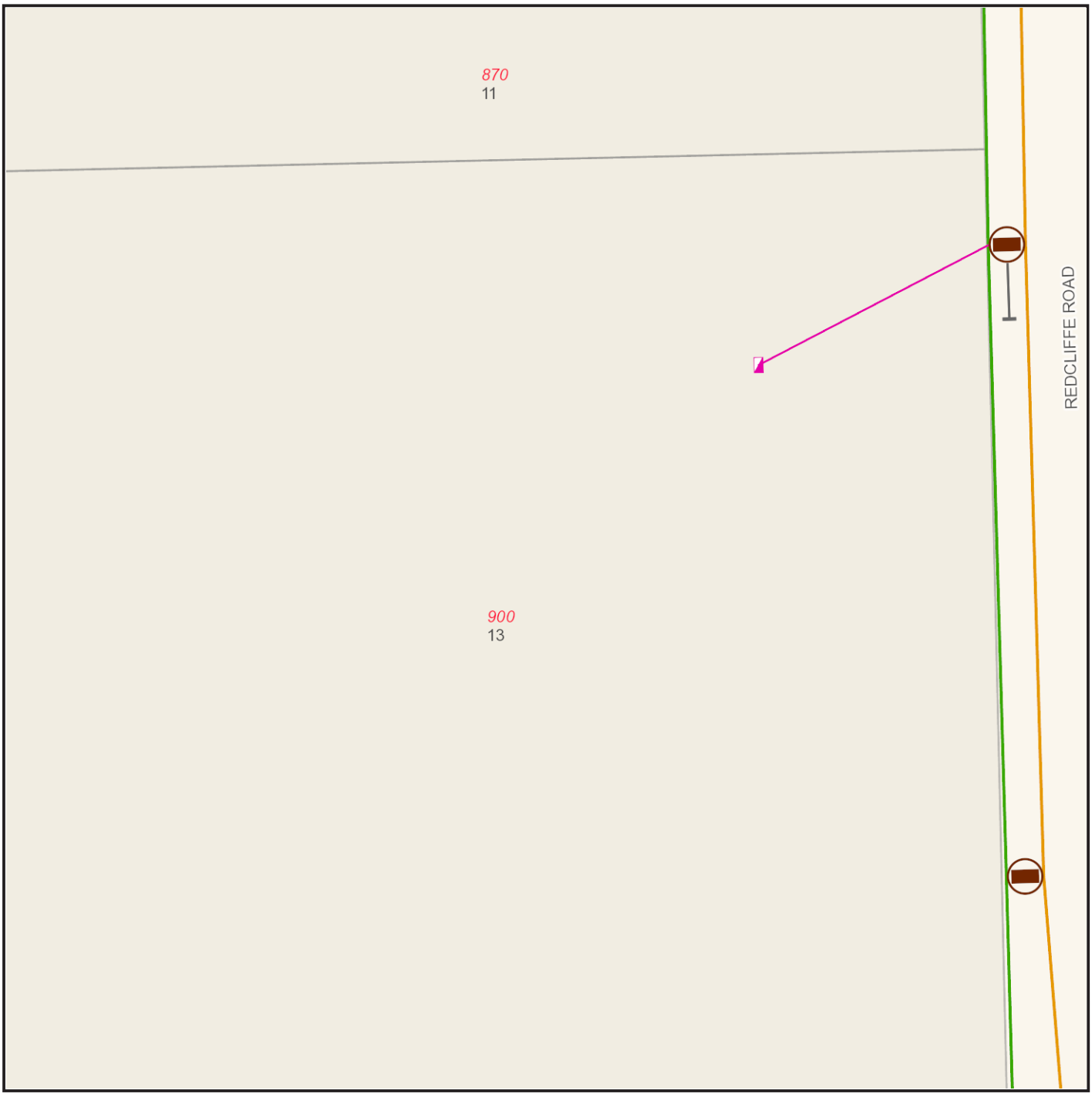

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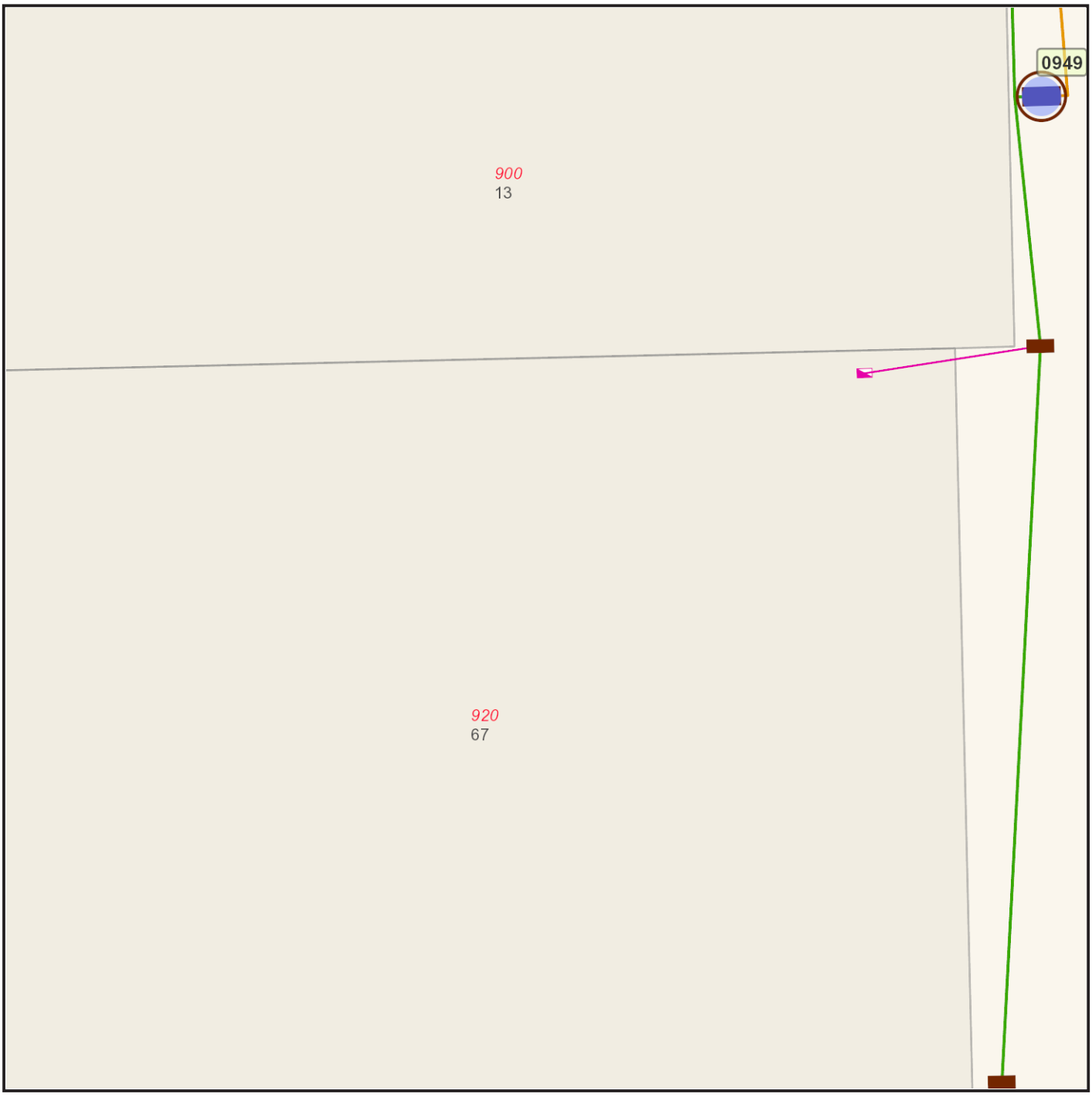

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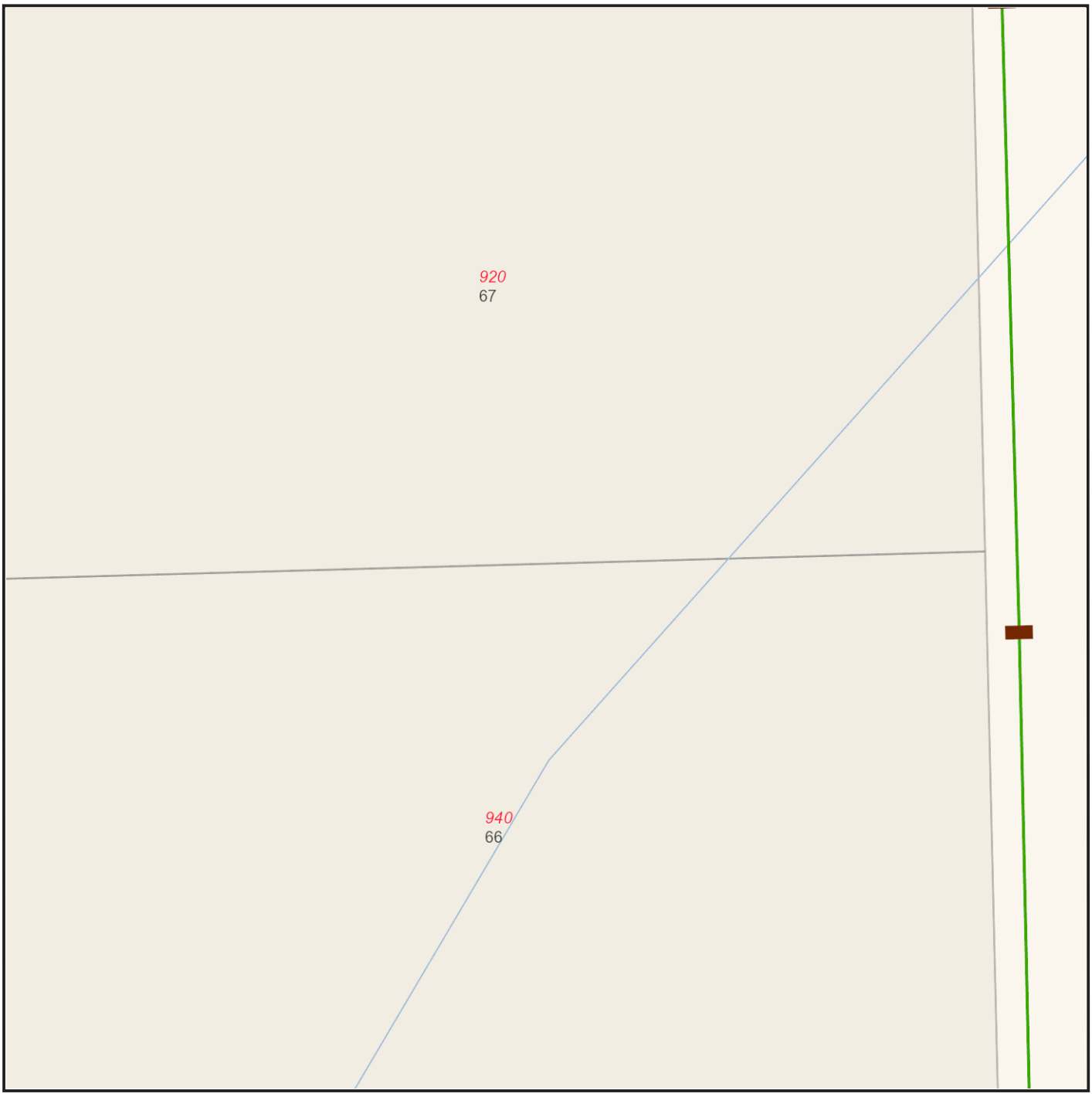

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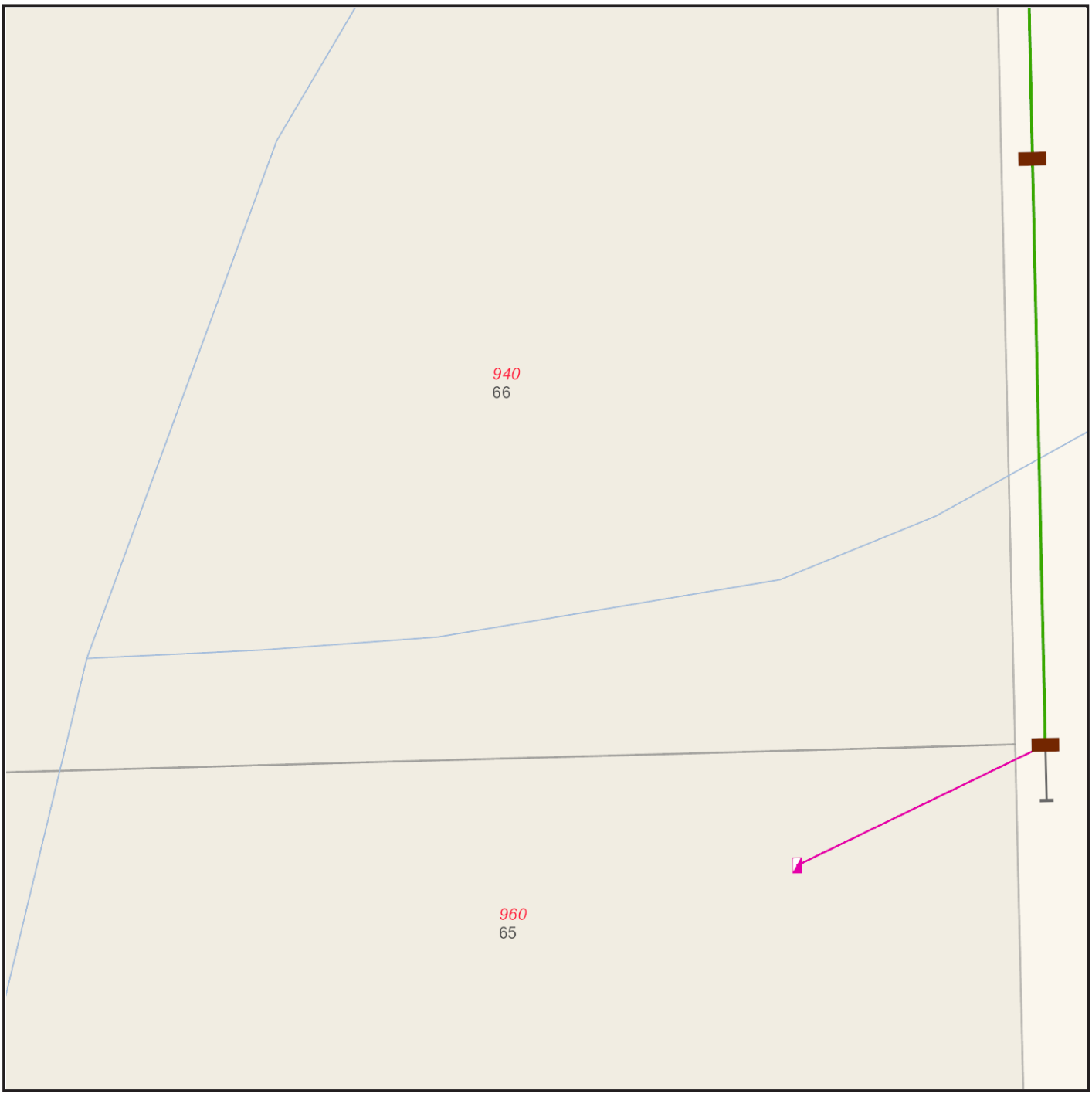

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Power & Communications - OVERVIEW

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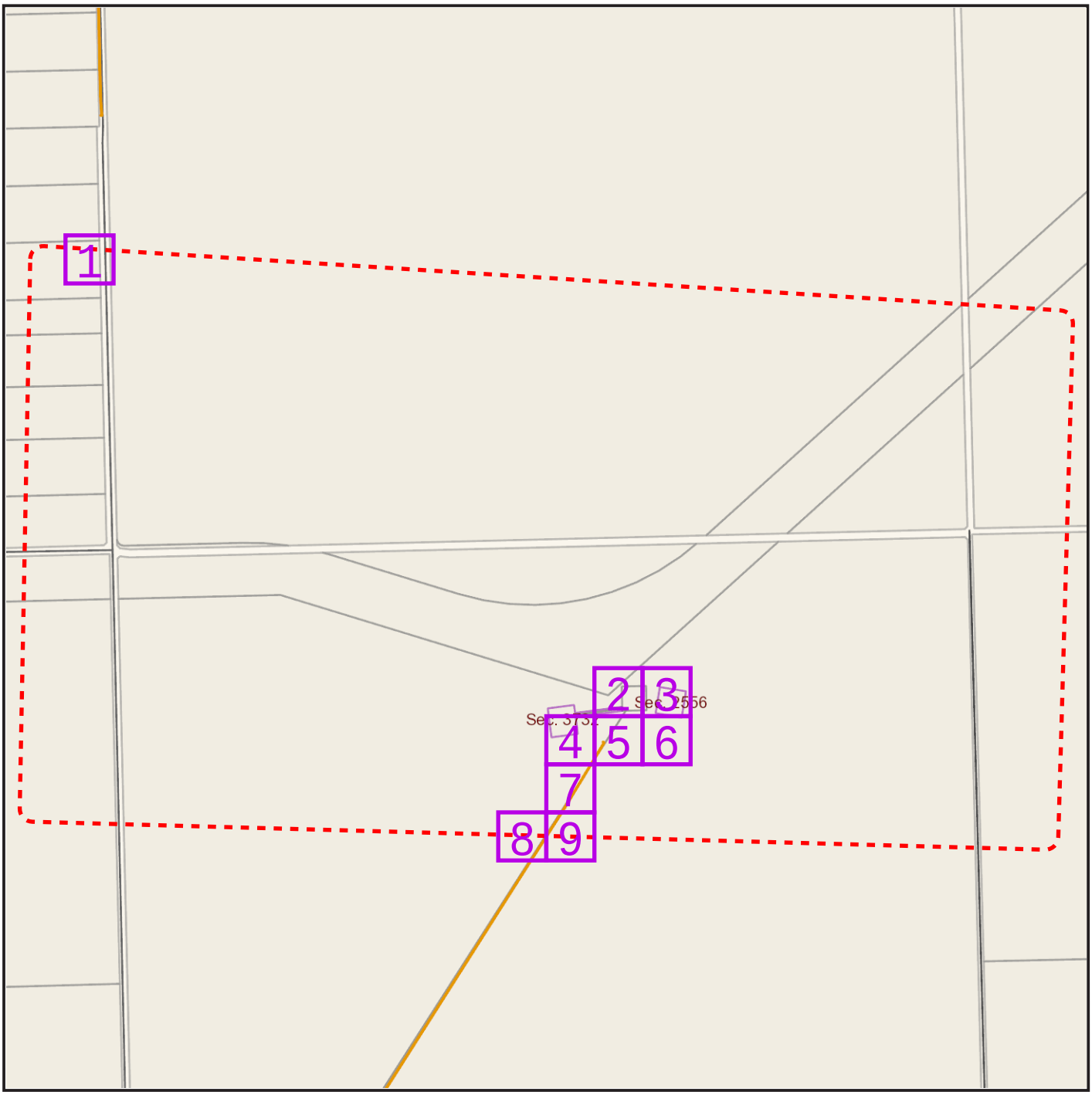

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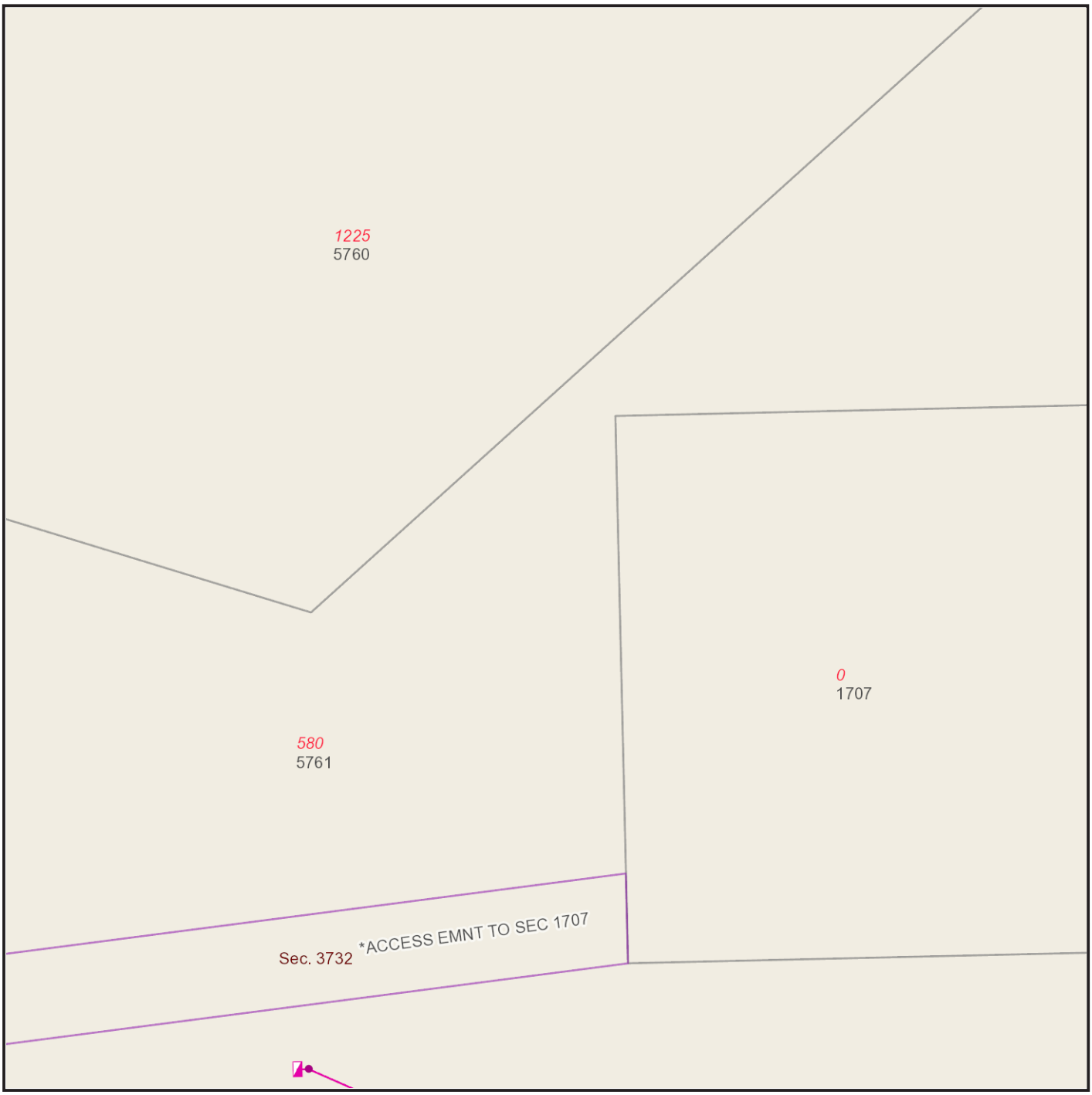

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Power & Communications - Tile No: 3

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Power & Communications - Tile No: 4

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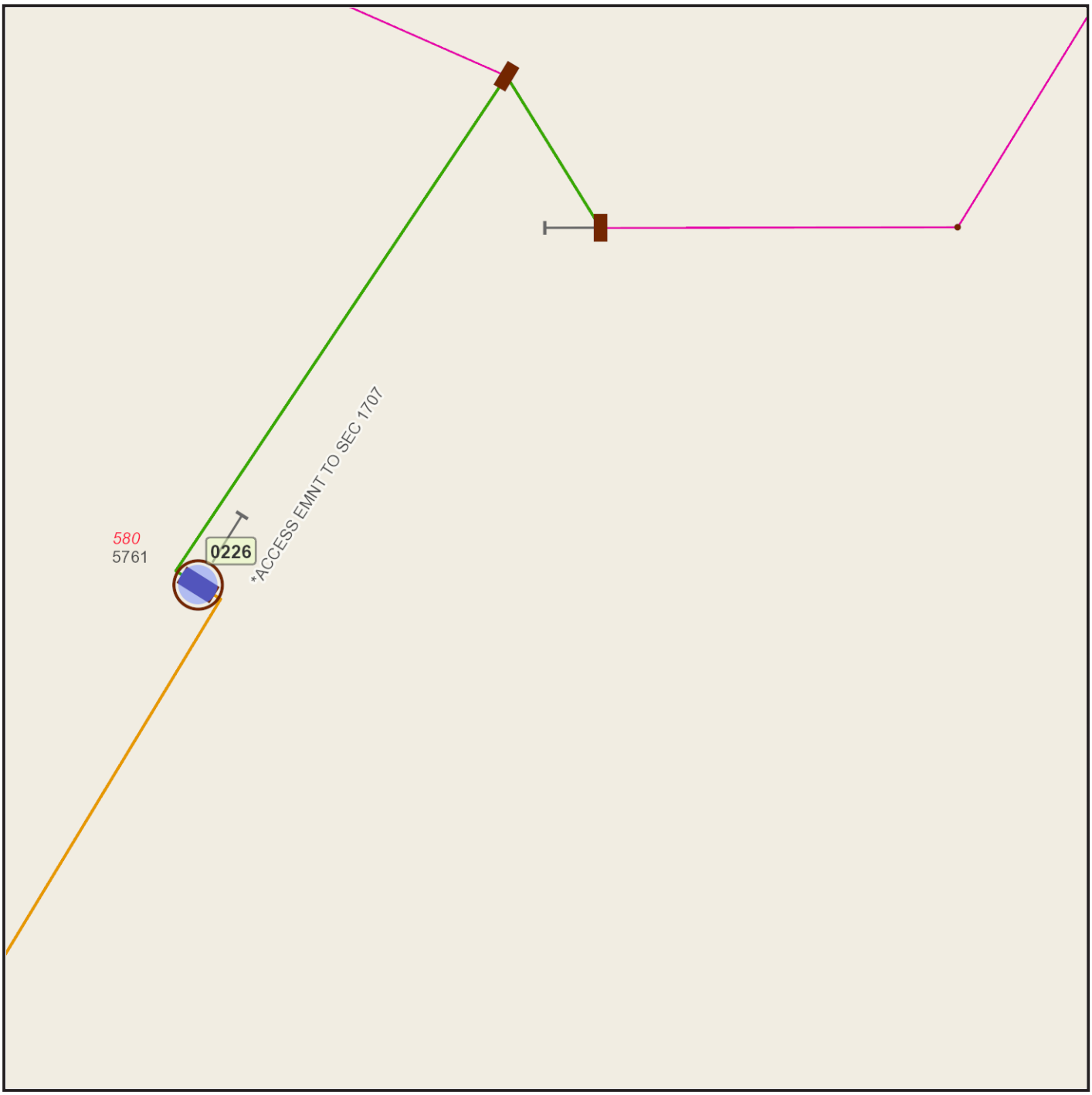

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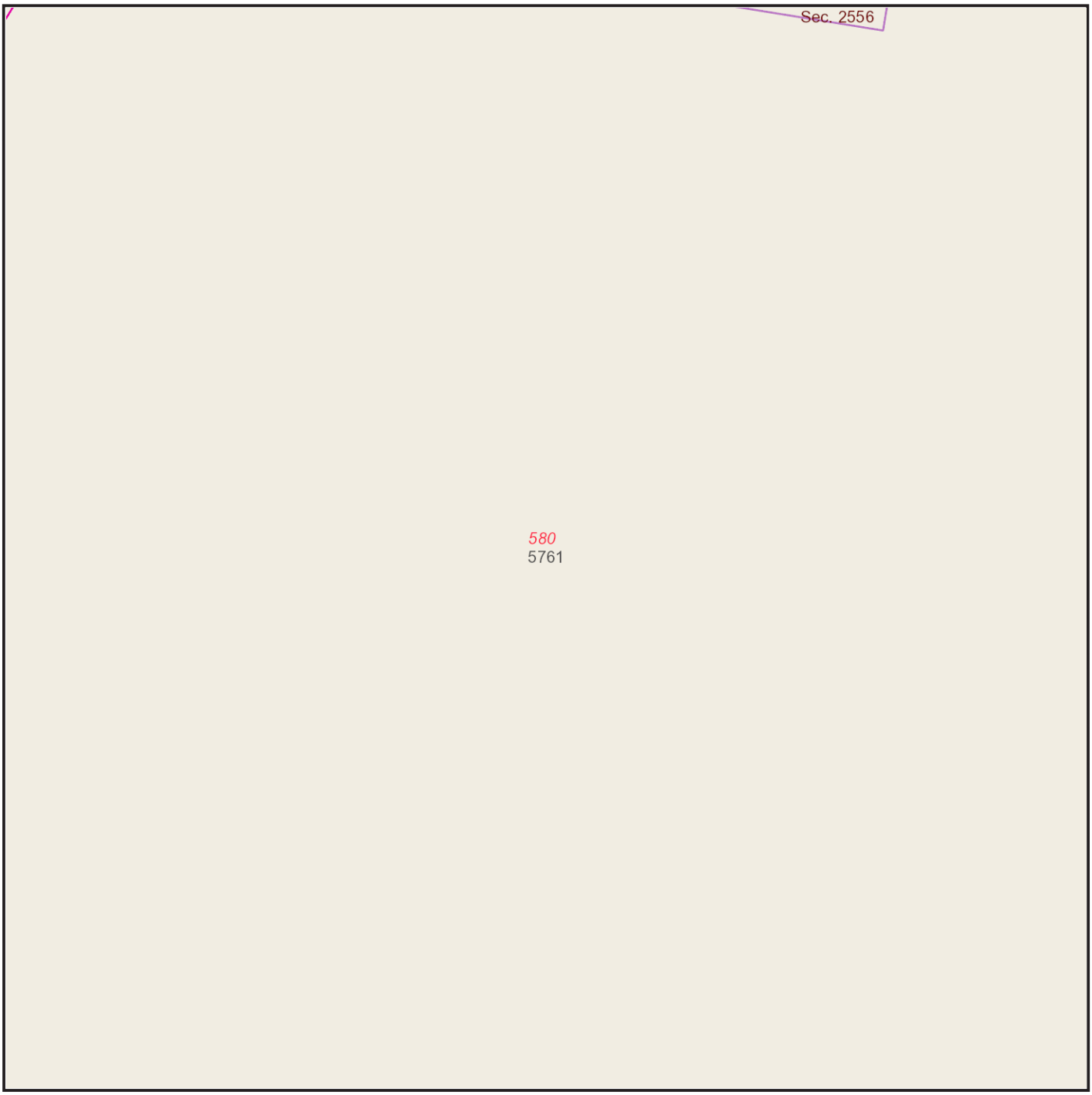

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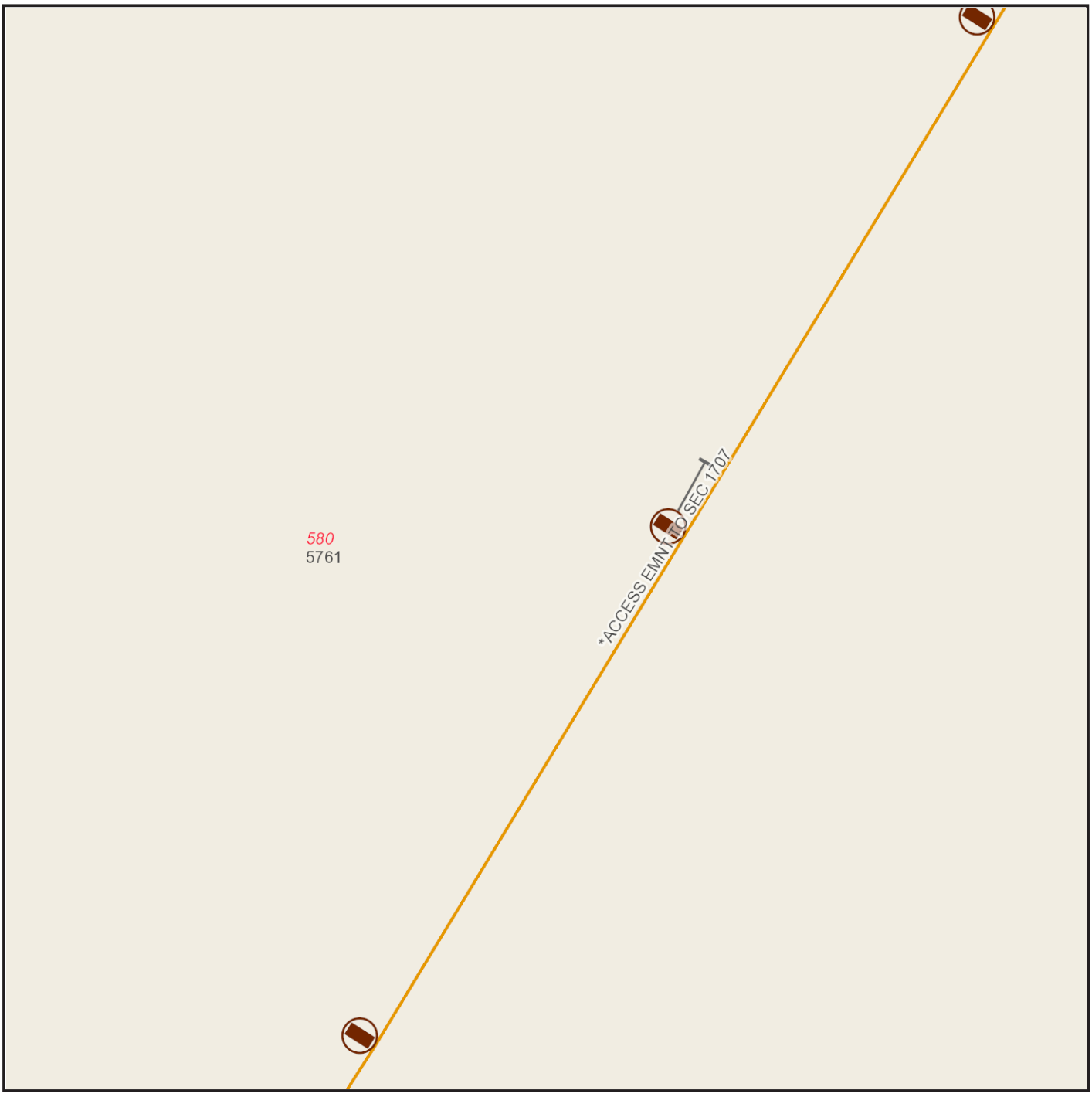
Not to scale

Power & Communications - Tile No: 7



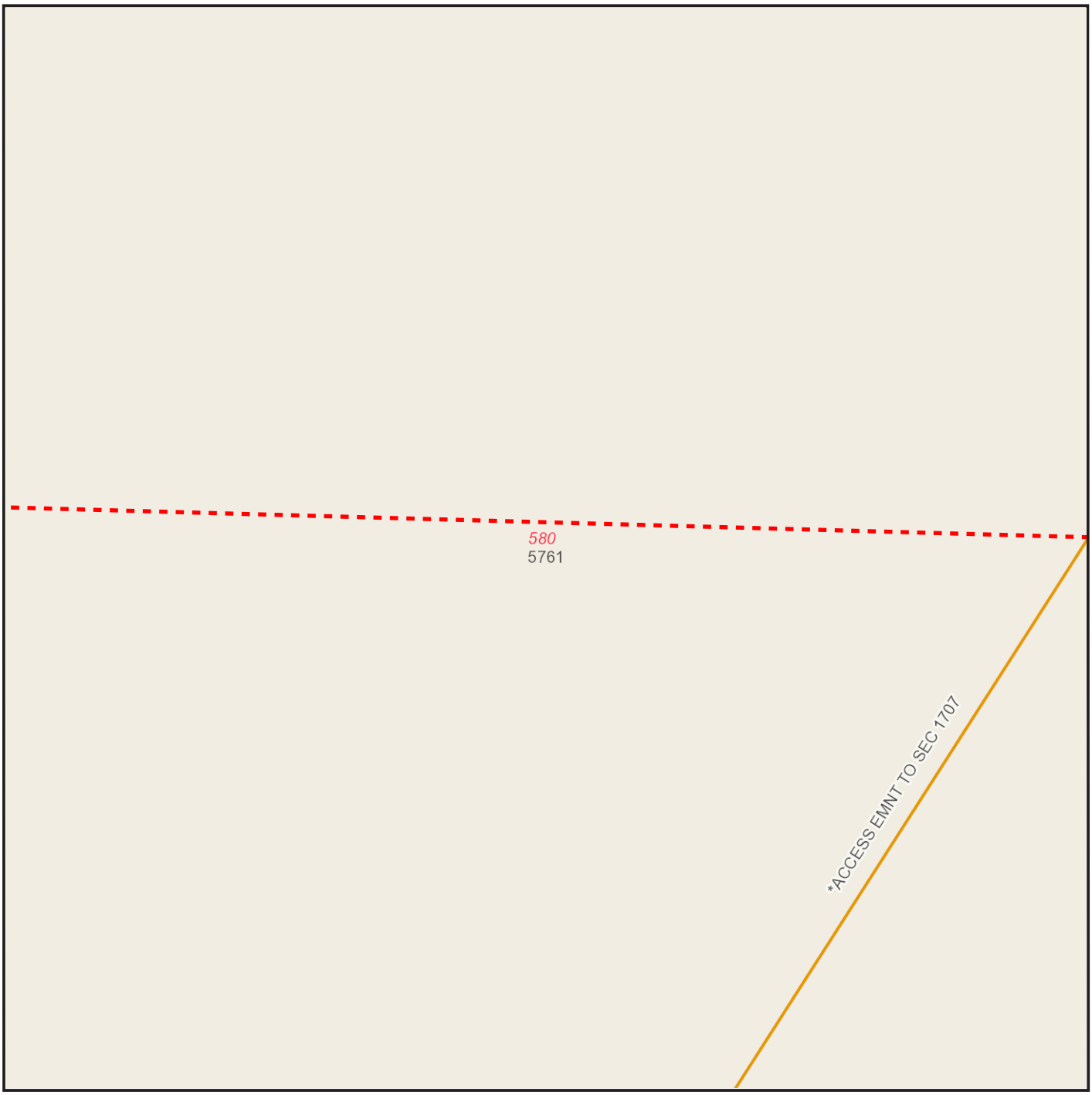
Plans generated 06/07/2023

BYDA Infrastructure Location Advice

- **Activities within 3m of Power and Water Corporation assets may require a written authority from Power and Water Corporation prior to commencing work.**
- Do not assume depth or alignment of assets. Locations provided are approximate.
- You must read and understand all information supplied before undertaking any works.
- All information provided to you is valid for 30 days from the date of issue.

Not to scale

Power & Communications - Tile No: 8



Plans generated 06/07/2023

BYDA Infrastructure Location Advice

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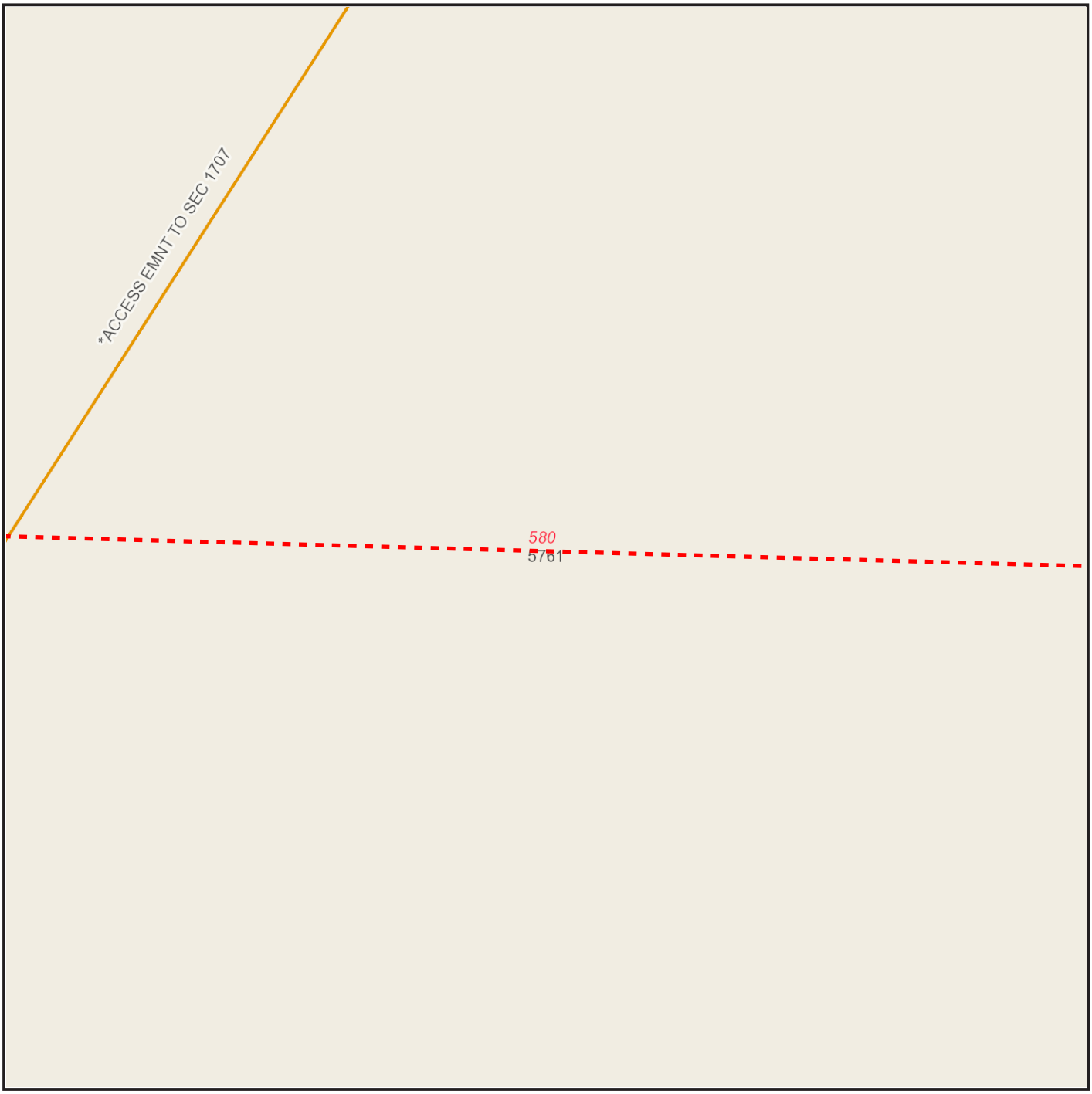
Not to scale

Power & Communications - Tile No: 9

N



Plans generated 06/07/2023

BYDA Infrastructure Location Advice

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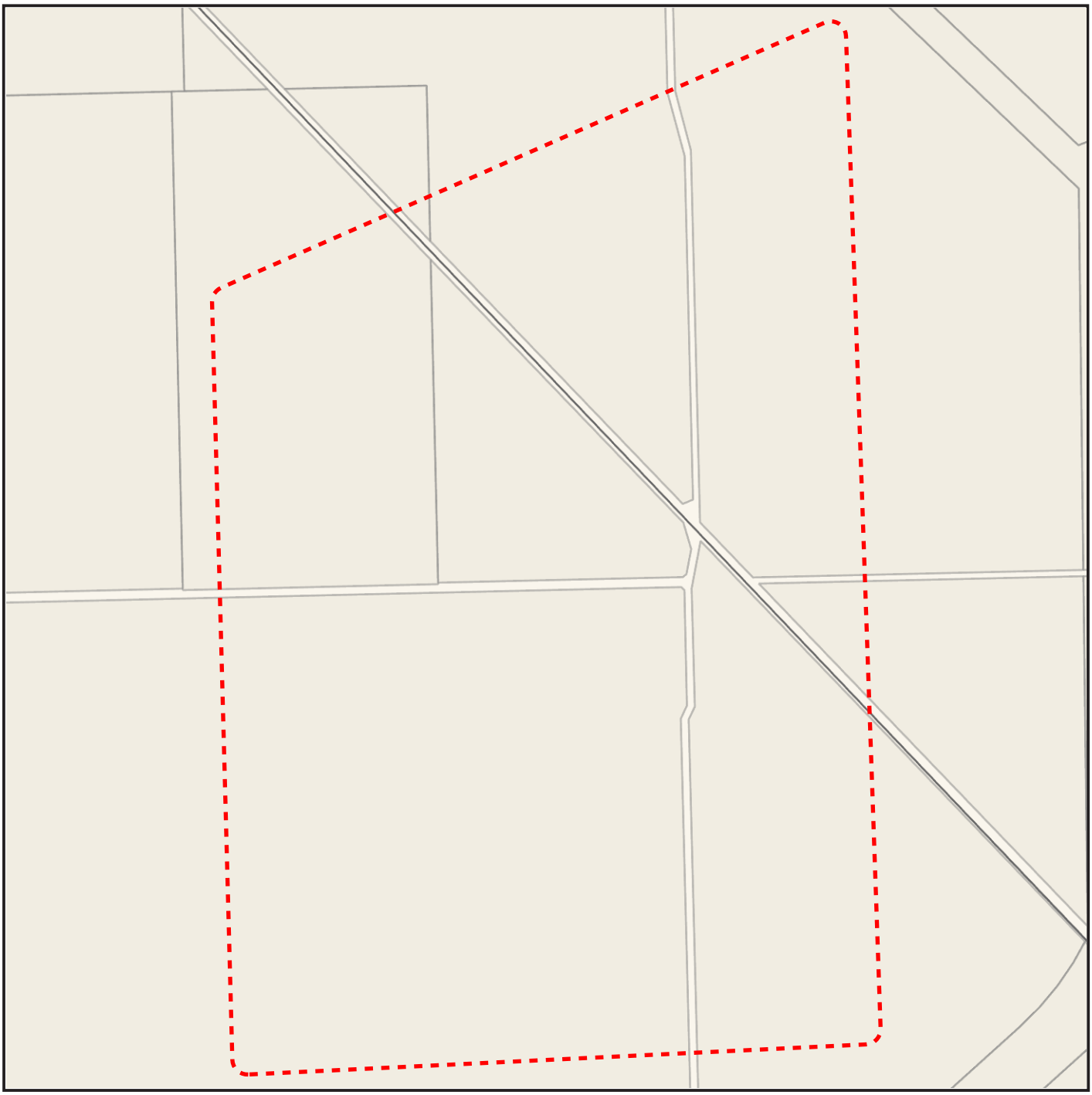
Sewer - OVERVIEW

Not to scale

N



Plans generated 06/07/2023

BYDA Infrastructure Location Advice

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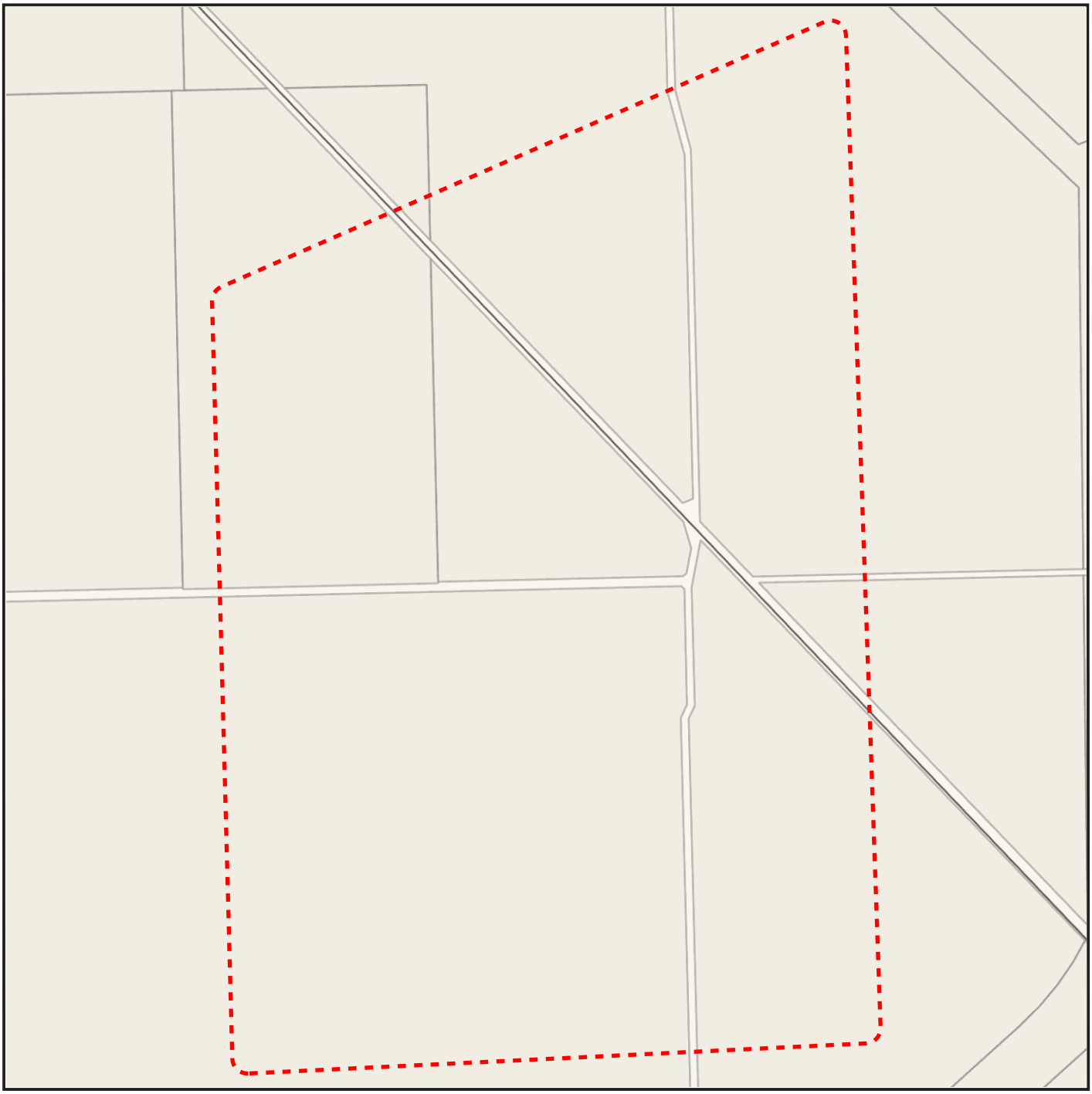
Water - OVERVIEW

Not to scale

N



Plans generated 06/07/2023

LITCHFIELD COUNCIL
Community effort is essential

Sequence No: 226754930
Job No: 34565694
Location: 905 Redcliffe Road, Lloyd Creek, NT 0822

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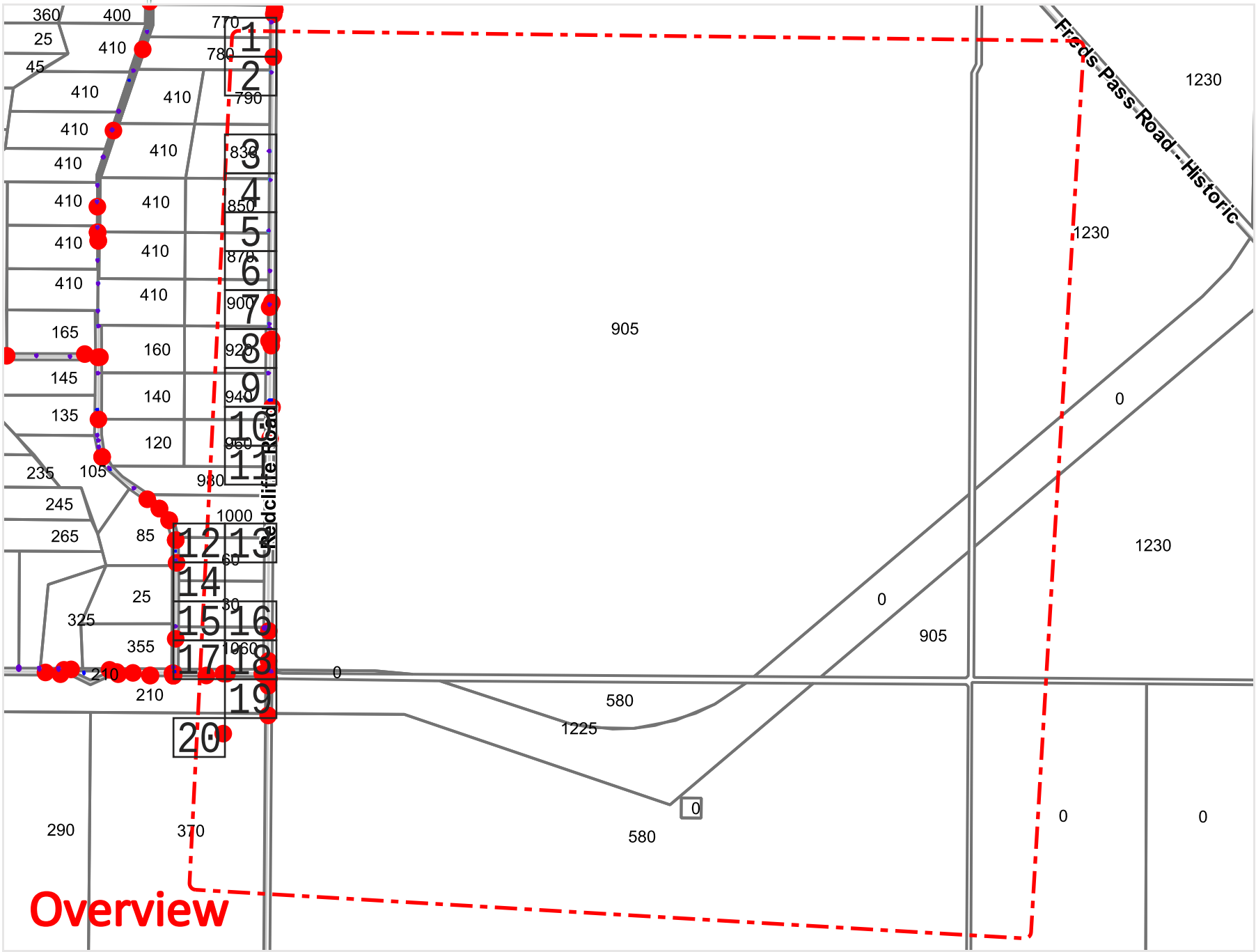

Legend

- Street Lighting
- Driveway Surfaces
- Driveway Culverts
- Cross Road Culverts
- Steet Signs
- Parcels
- Roads
- Council Boundary
- Area of Enquiry

N

Scale: 1:24254
Expires: 03 Aug 2023

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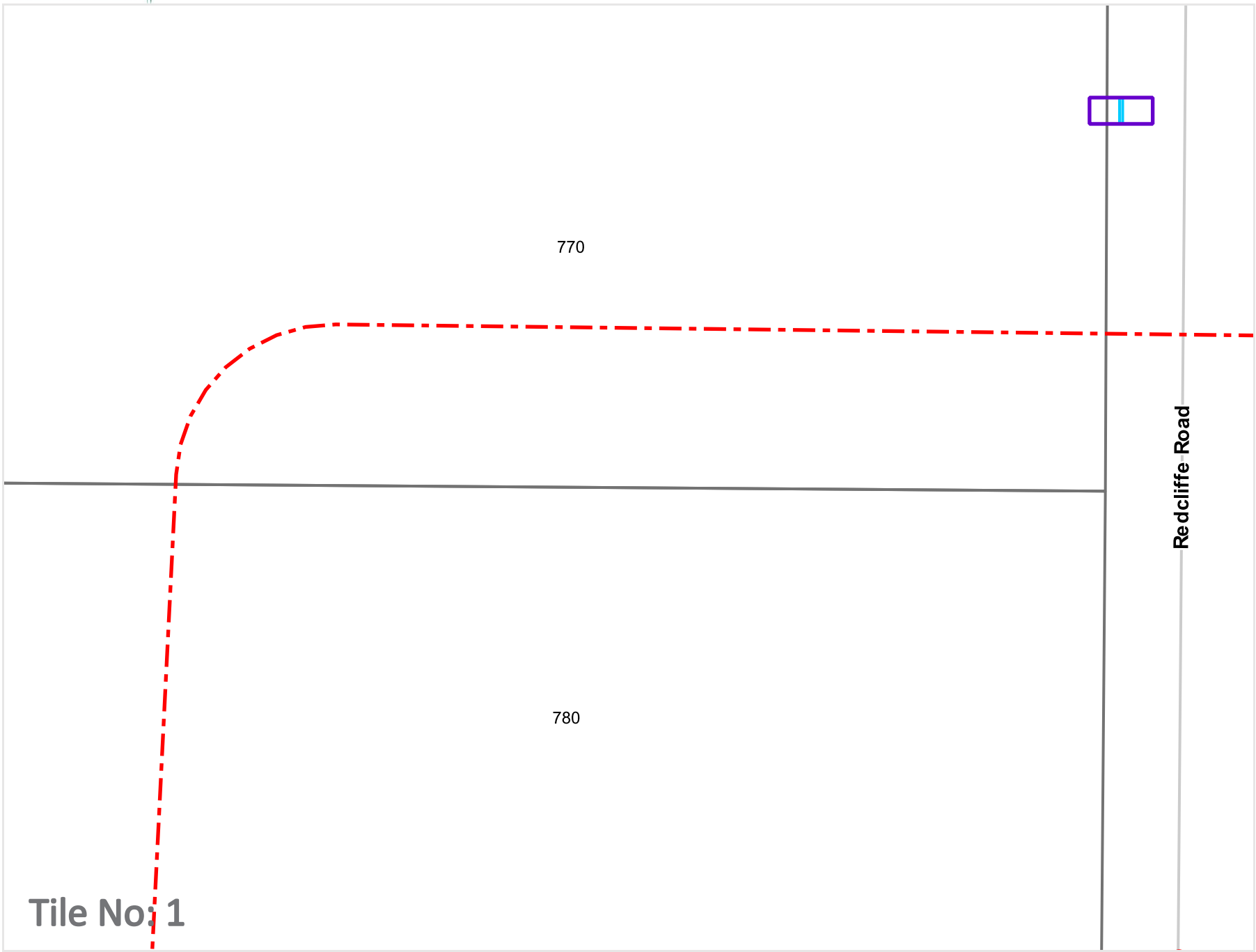

Legend

- Street Lighting
- Driveway Surfaces
- Driveway Culverts
- Cross Road Culverts
- Steet Signs
- Parcels
- Roads
- Council Boundary
- Area of Enquiry

N

Scale: 1:1000
Expires: 03 Aug 2023

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Community effort is essential

Sequence No: 226754930
Job No: 34565694
Location: 905 Redcliffe Road, Lloyd Creek, NT 0822

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Legend

- Street Lighting
- Driveway Surfaces
- Driveway Culverts
- Cross Road Culverts
- Steet Signs
- Parcels
- Roads
- Council Boundary
- Area of Enquiry

N

Scale: 1:1000
Expires: 03 Aug 2023

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Legend

- Street Lighting
- Driveway Surfaces
- Driveway Culverts
- Cross Road Culverts
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- Roads
- Council Boundary
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N

Scale: 1:1000
Expires: 03 Aug 2023

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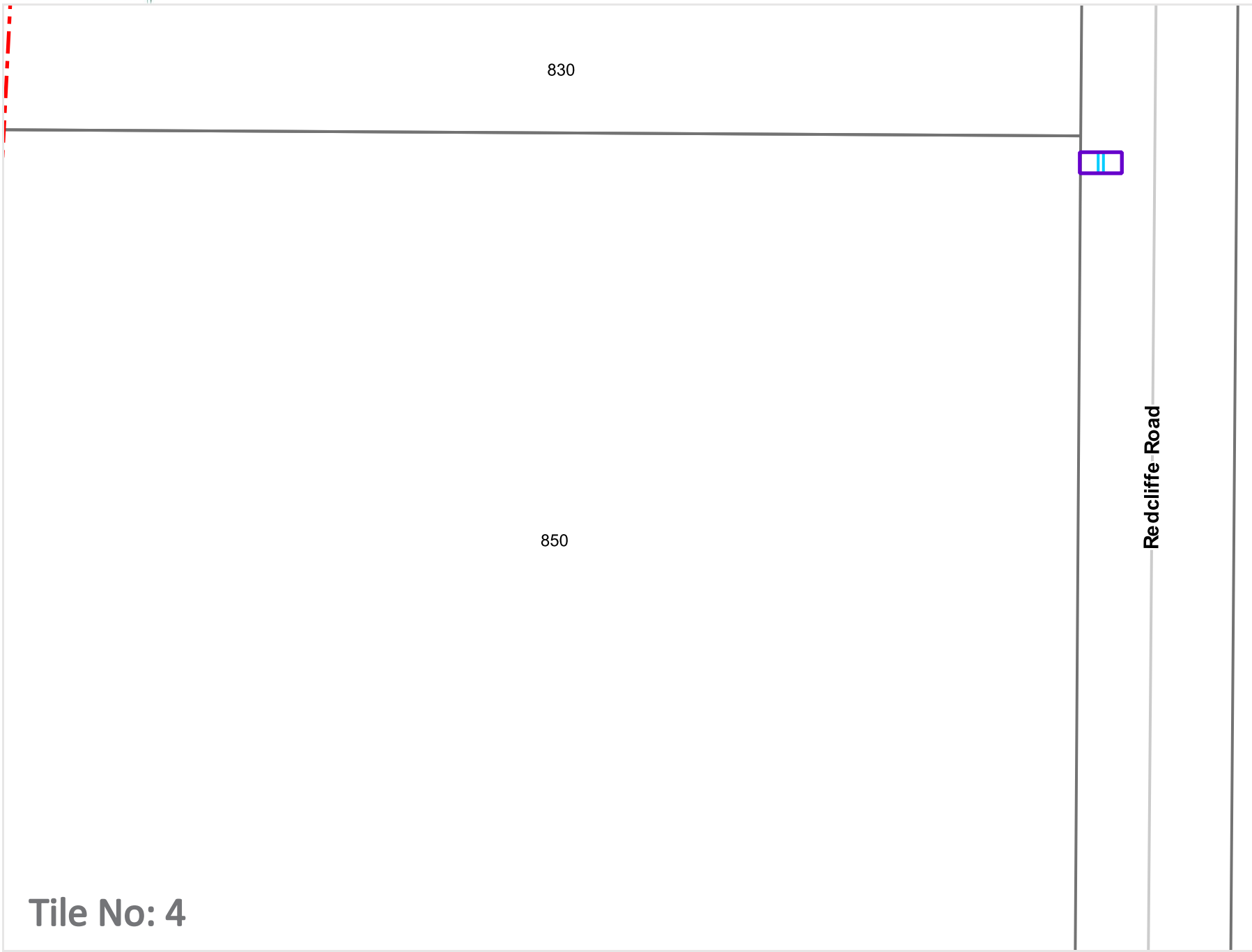

Legend

- Street Lighting
- Driveway Surfaces
- Driveway Culverts
- Cross Road Culverts
- Steet Signs
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- Roads
- Council Boundary
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N

Scale: 1:1000
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Tile No: 4

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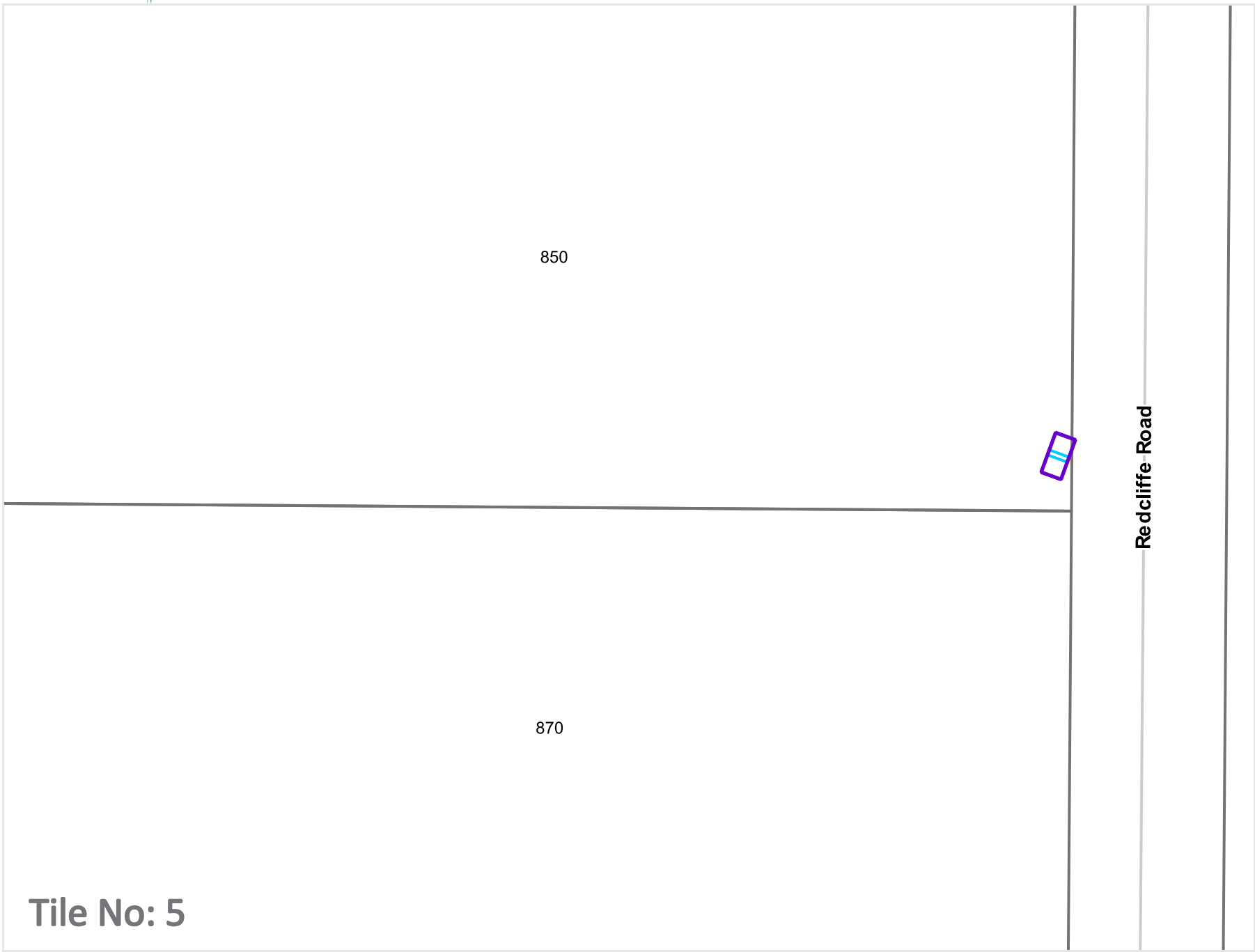

Legend

- Street Lighting
- Driveway Surfaces
- Driveway Culverts
- Cross Road Culverts
- Steet Signs
- Parcels
- Roads
- Council Boundary
- Area of Enquiry

N

Scale: 1:1000
Expires: 03 Aug 2023

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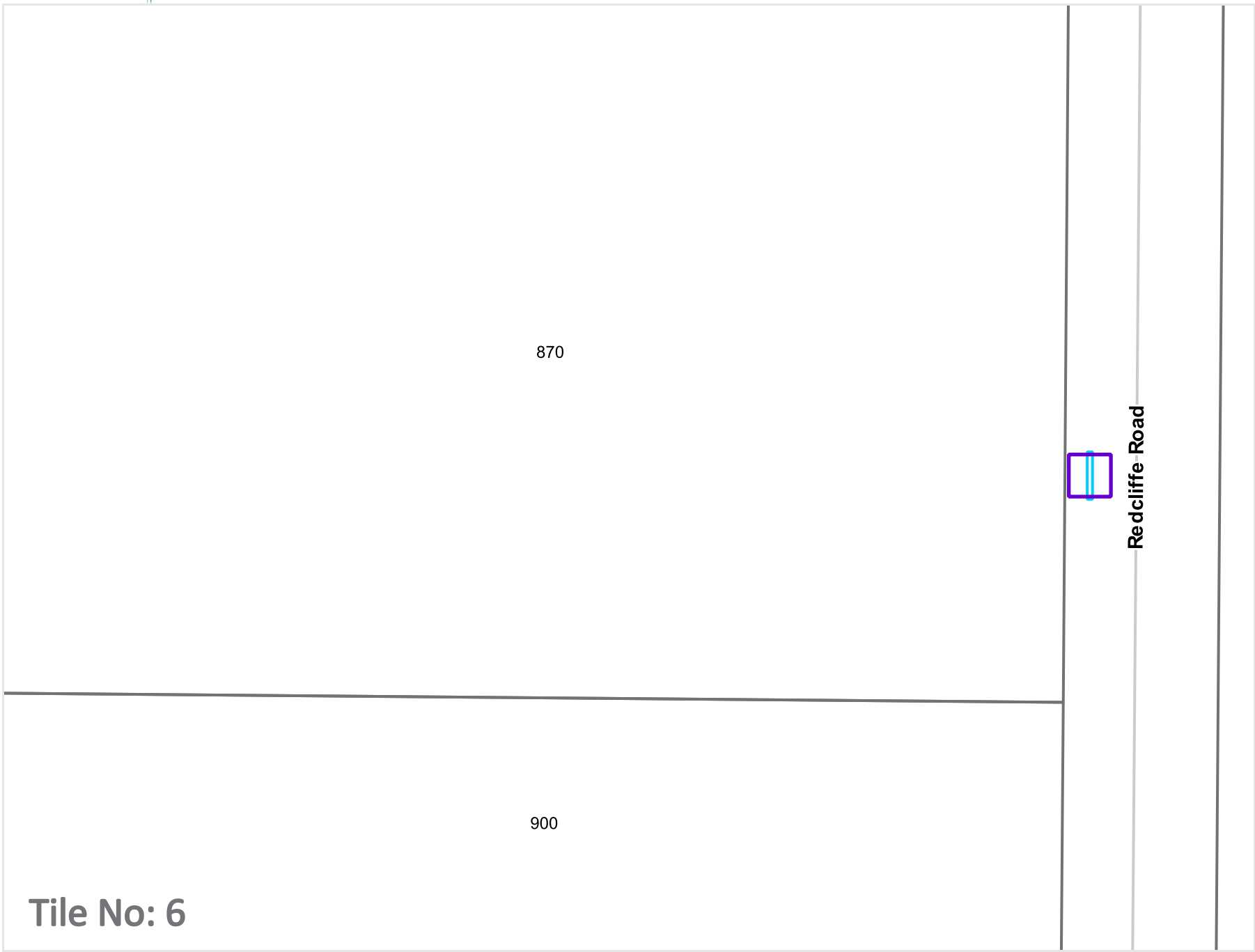

Legend

- Street Lighting
- Driveway Surfaces
- Driveway Culverts
- Cross Road Culverts
- Steet Signs
- Parcels
- Roads
- Council Boundary
- Area of Enquiry

N

Scale: 1:1000
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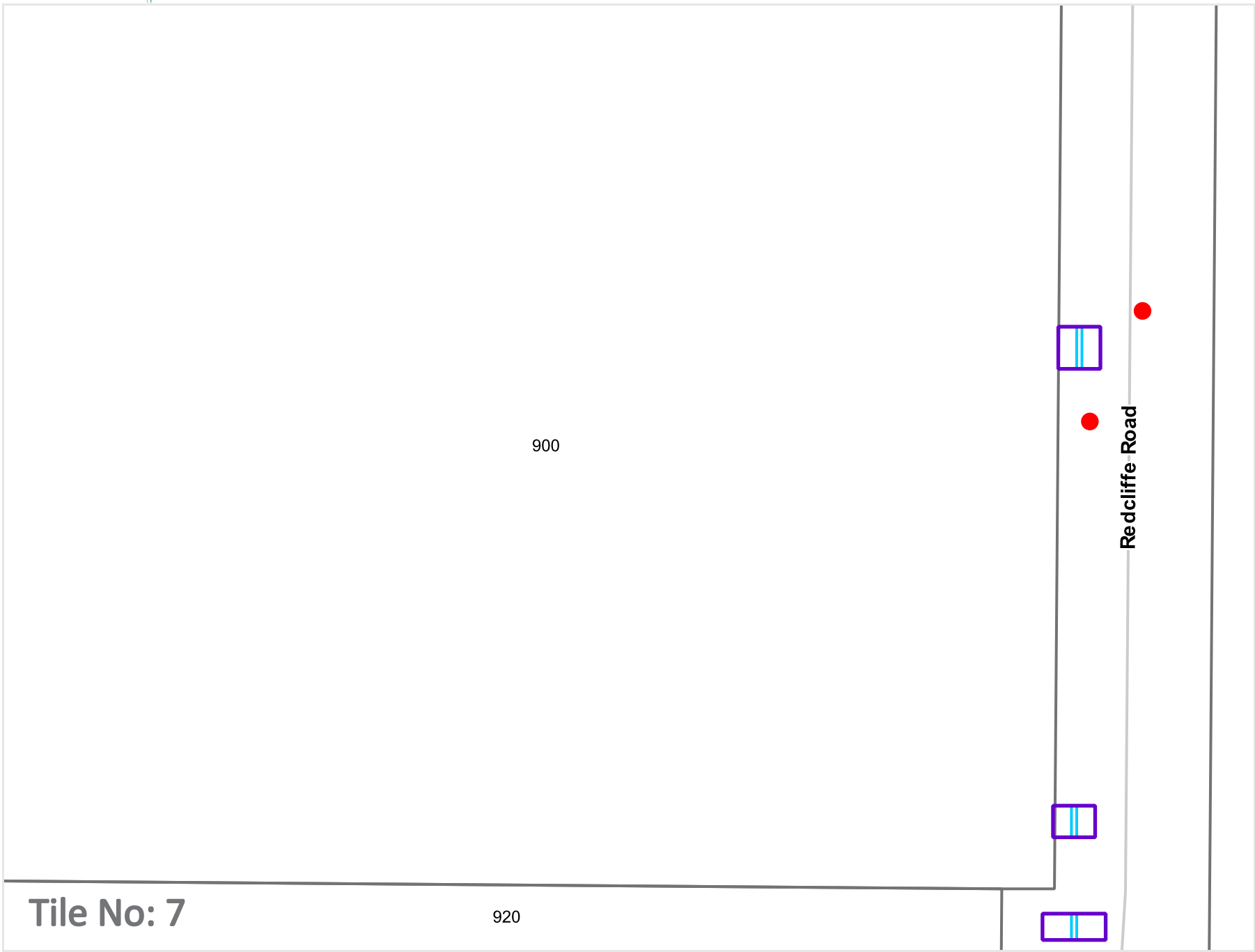

Legend

- Street Lighting
- Driveway Surfaces
- Driveway Culverts
- Cross Road Culverts
- Steet Signs
- Parcels
- Roads
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N

Scale: 1:1000
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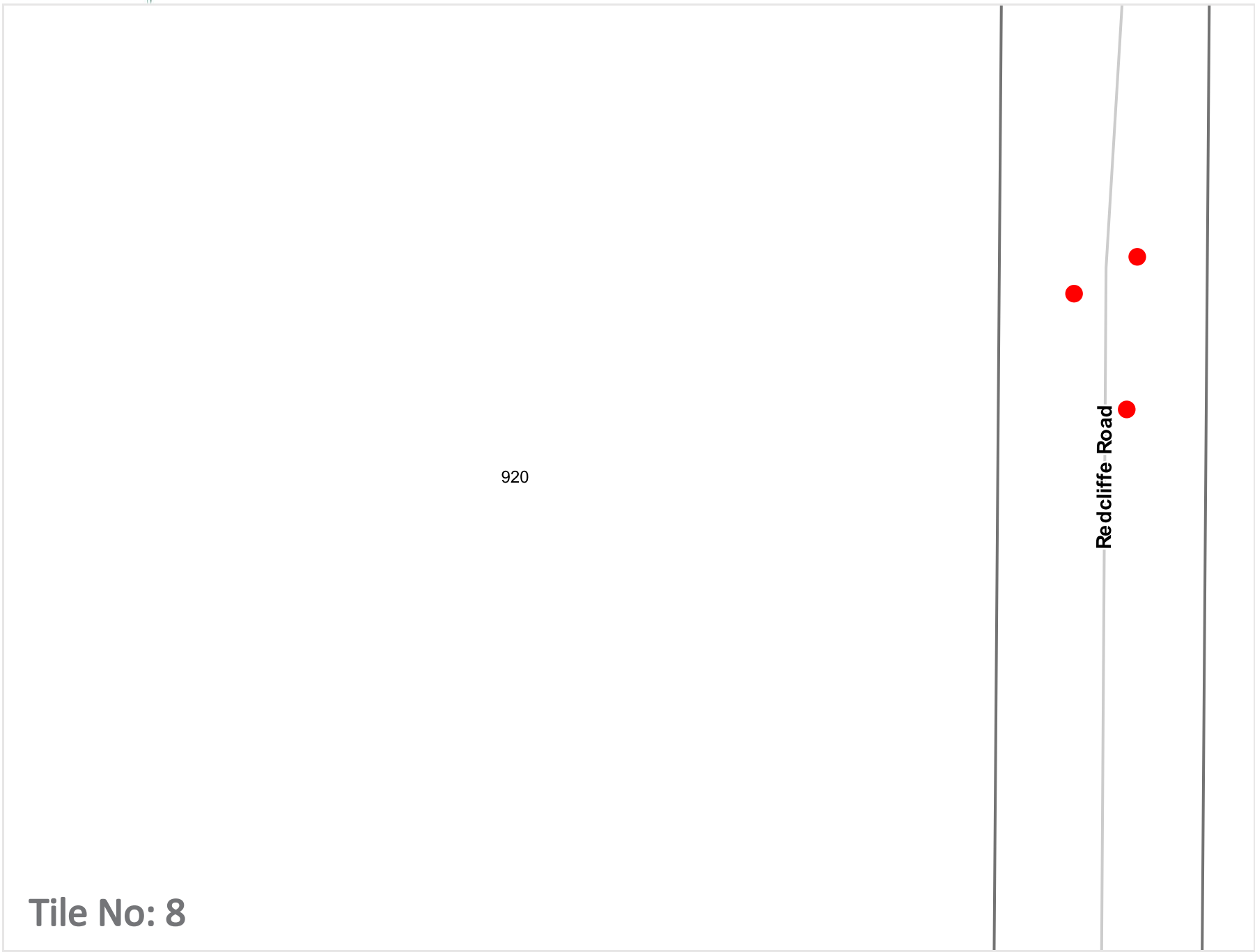

Legend

- Street Lighting
- Driveway Surfaces
- Driveway Culverts
- Cross Road Culverts
- Steet Signs
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Scale: 1:1000
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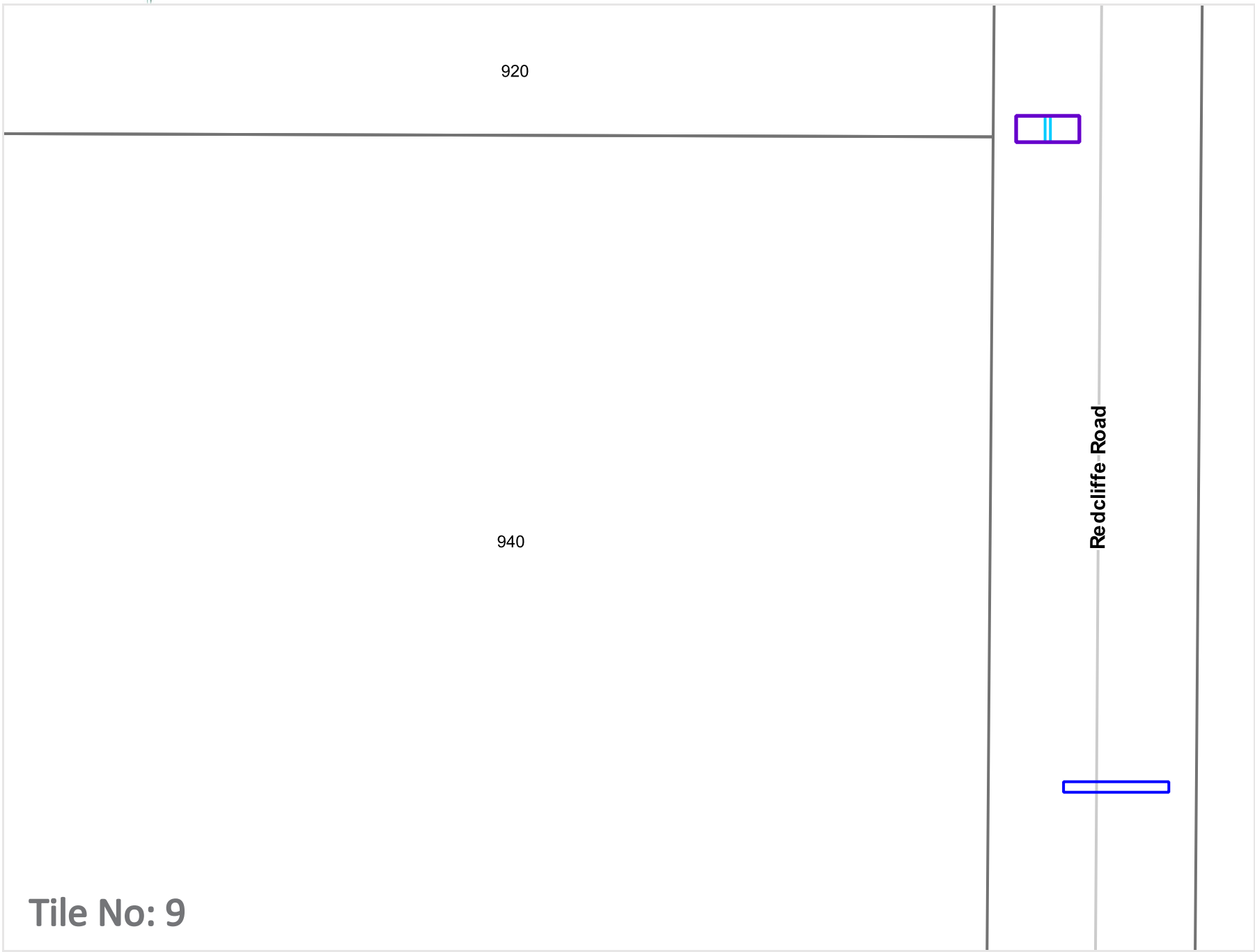

Legend

- Street Lighting
- Driveway Surfaces
- Driveway Culverts
- Cross Road Culverts
- Steet Signs
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- Roads
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N

Scale: 1:1000
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Tile No: 9

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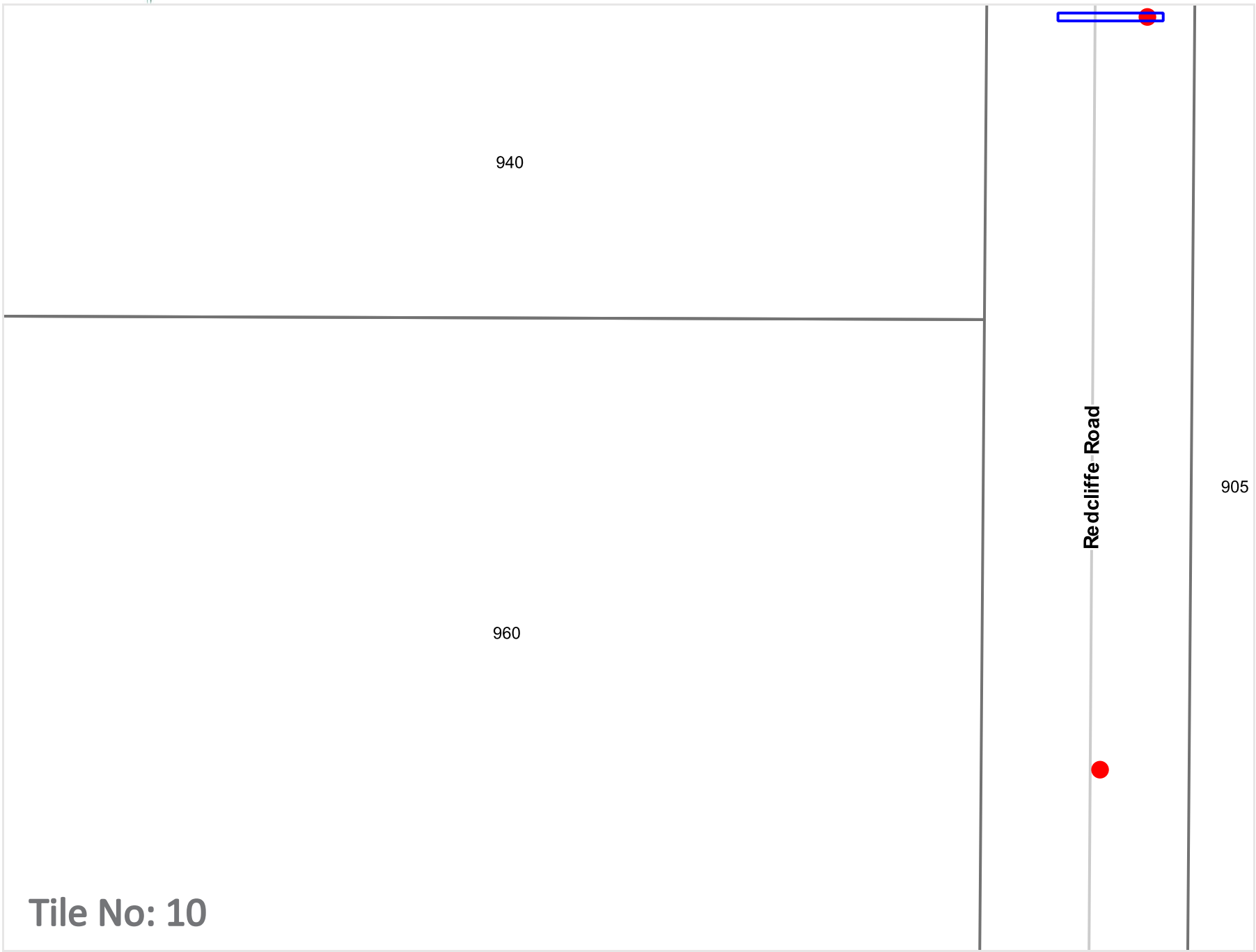

Legend

- Street Lighting
- Driveway Surfaces
- Driveway Culverts
- Cross Road Culverts
- Steet Signs
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Scale: 1:1000
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Tile No: 10

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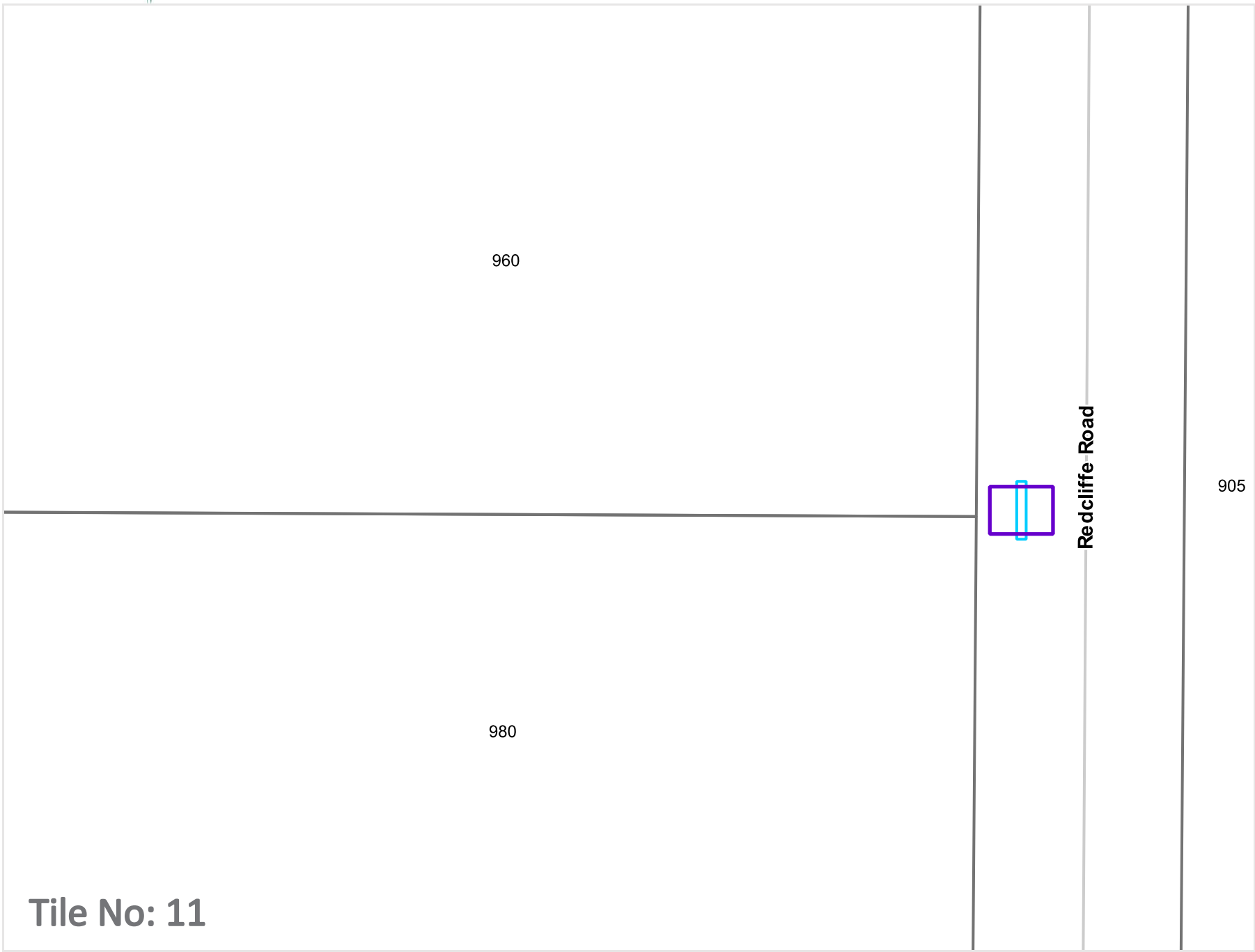

Legend

- Street Lighting
- Driveway Surfaces
- Driveway Culverts
- Cross Road Culverts
- Steet Signs
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- Roads
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N

Scale: 1:1000
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Tile No: 11

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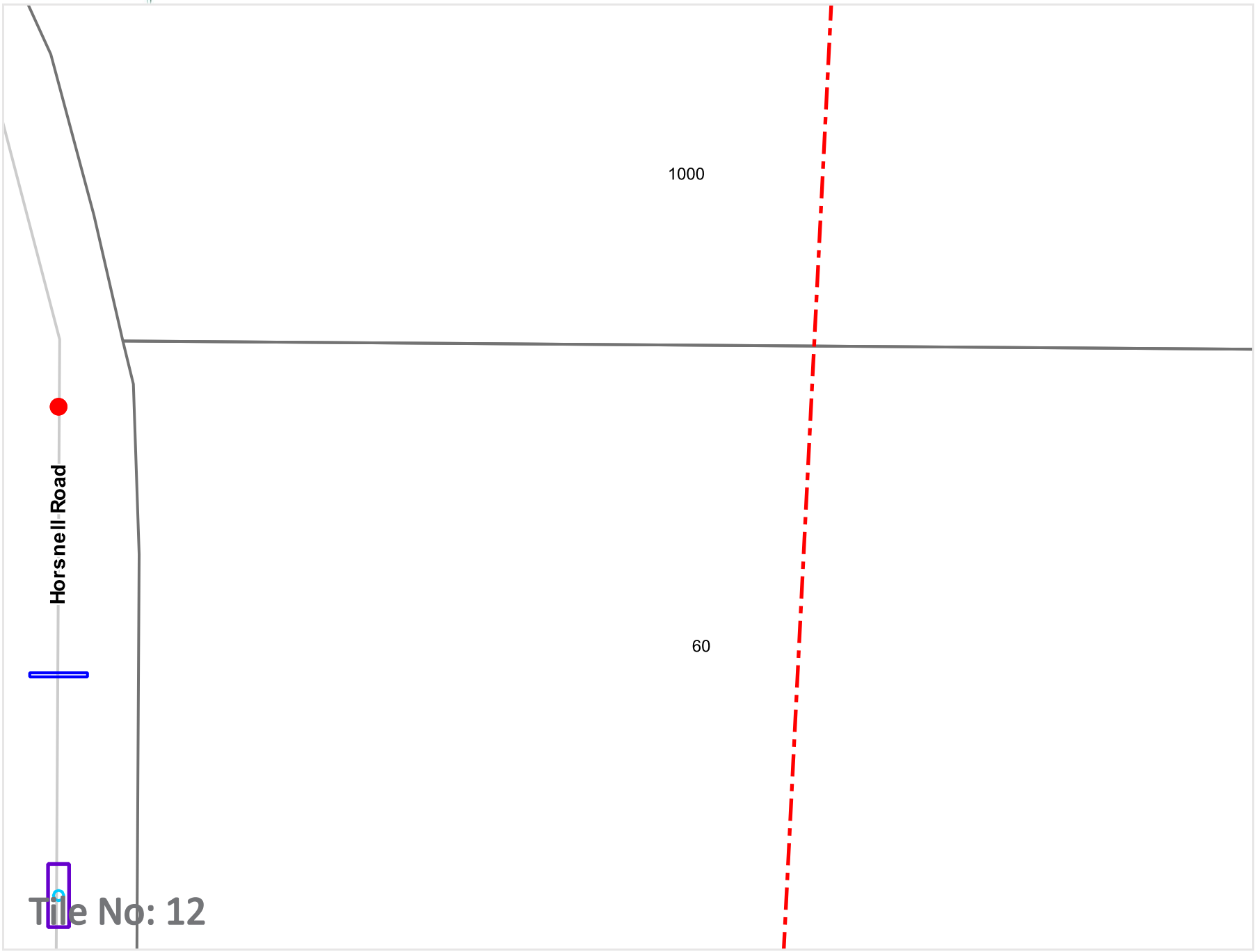

Legend

- Street Lighting
- Driveway Surfaces
- Driveway Culverts
- Cross Road Culverts
- Steet Signs
- Parcels
- Roads
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N

Scale: 1:1000
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Sequence No: 226754930
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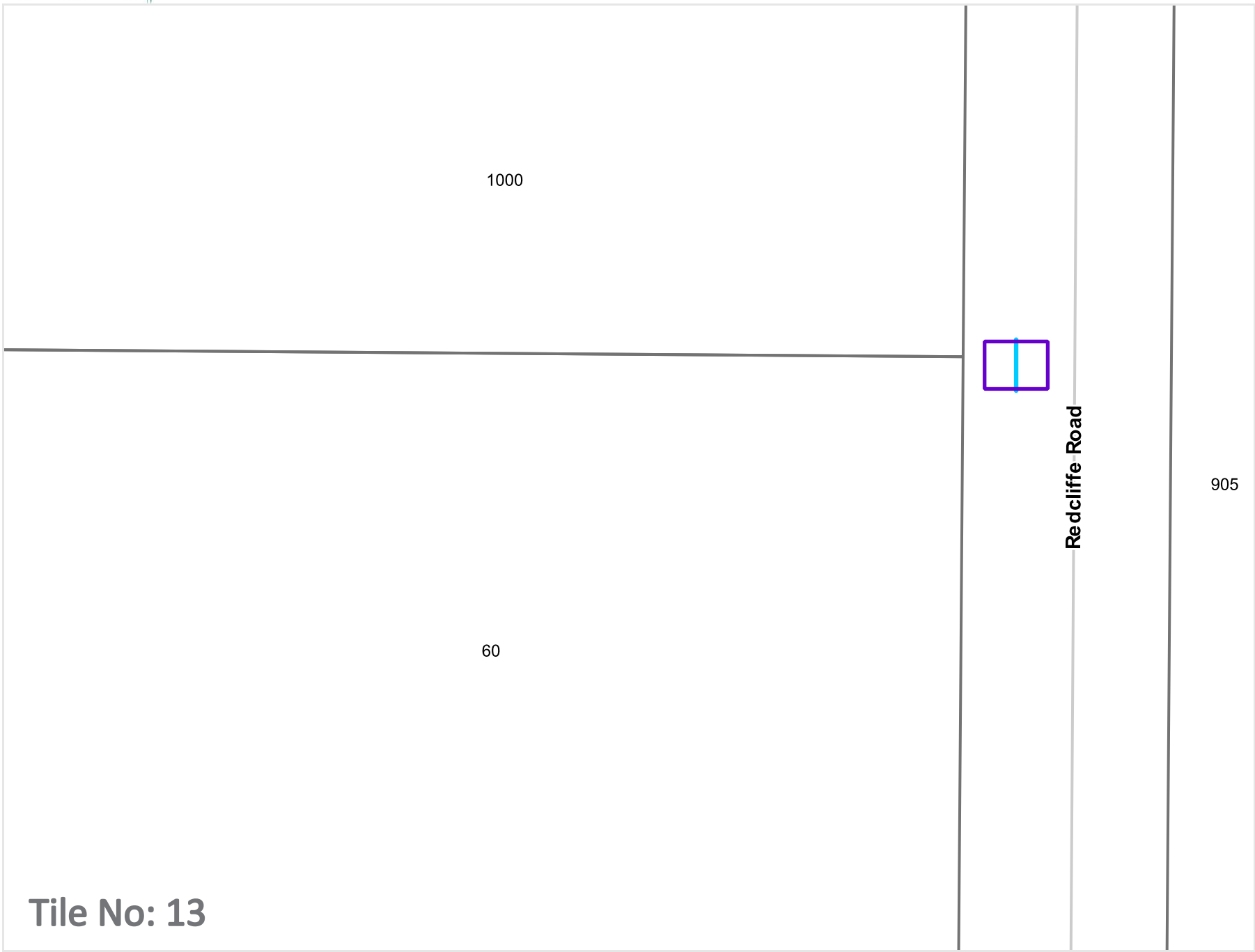

Legend

- Street Lighting
- Driveway Surfaces
- Driveway Culverts
- Cross Road Culverts
- Steet Signs
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- Roads
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Scale: 1:1000
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Tile No: 13

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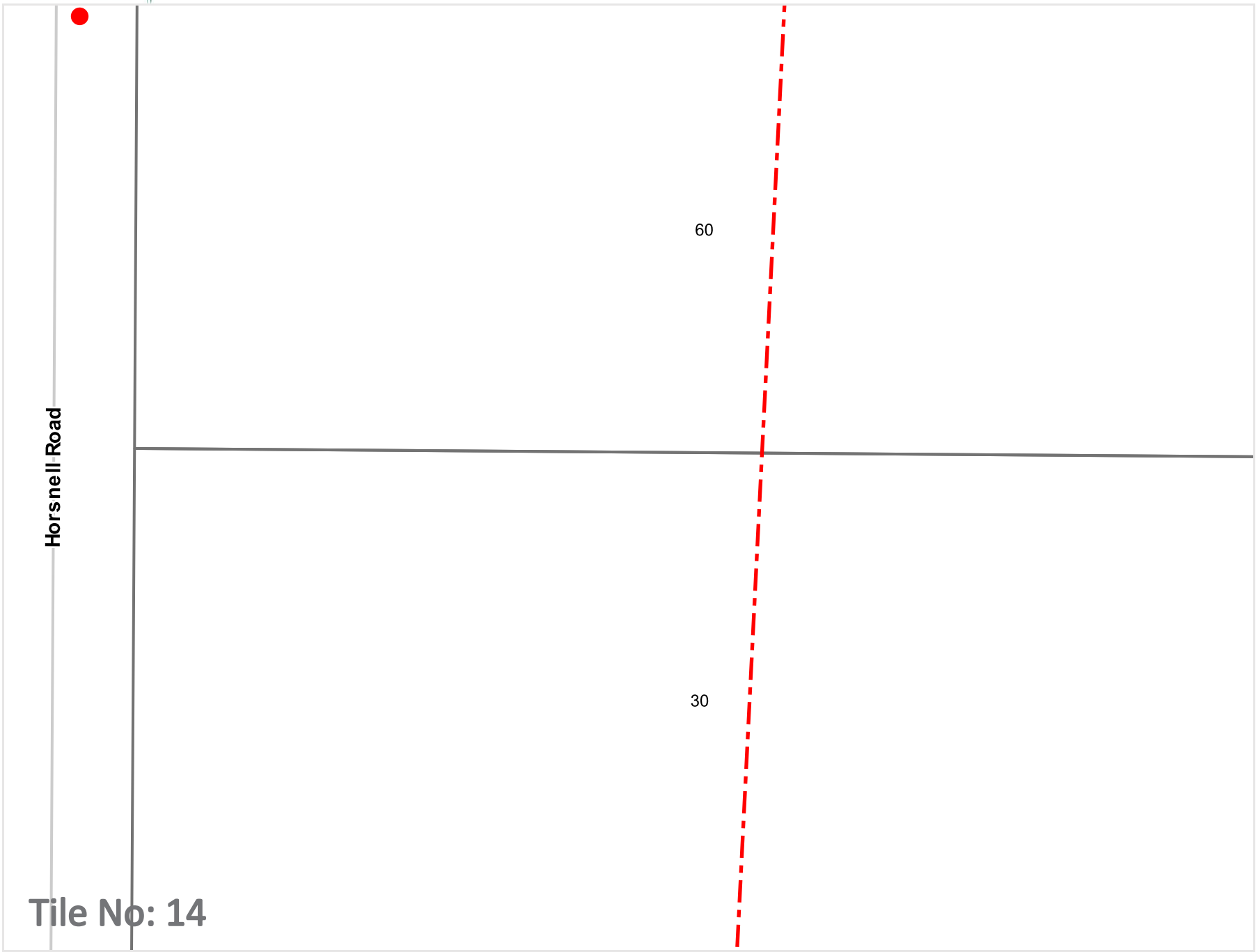

Legend

- Street Lighting
- Driveway Surfaces
- Driveway Culverts
- Cross Road Culverts
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- Roads
- Council Boundary
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N

Scale: 1:1000
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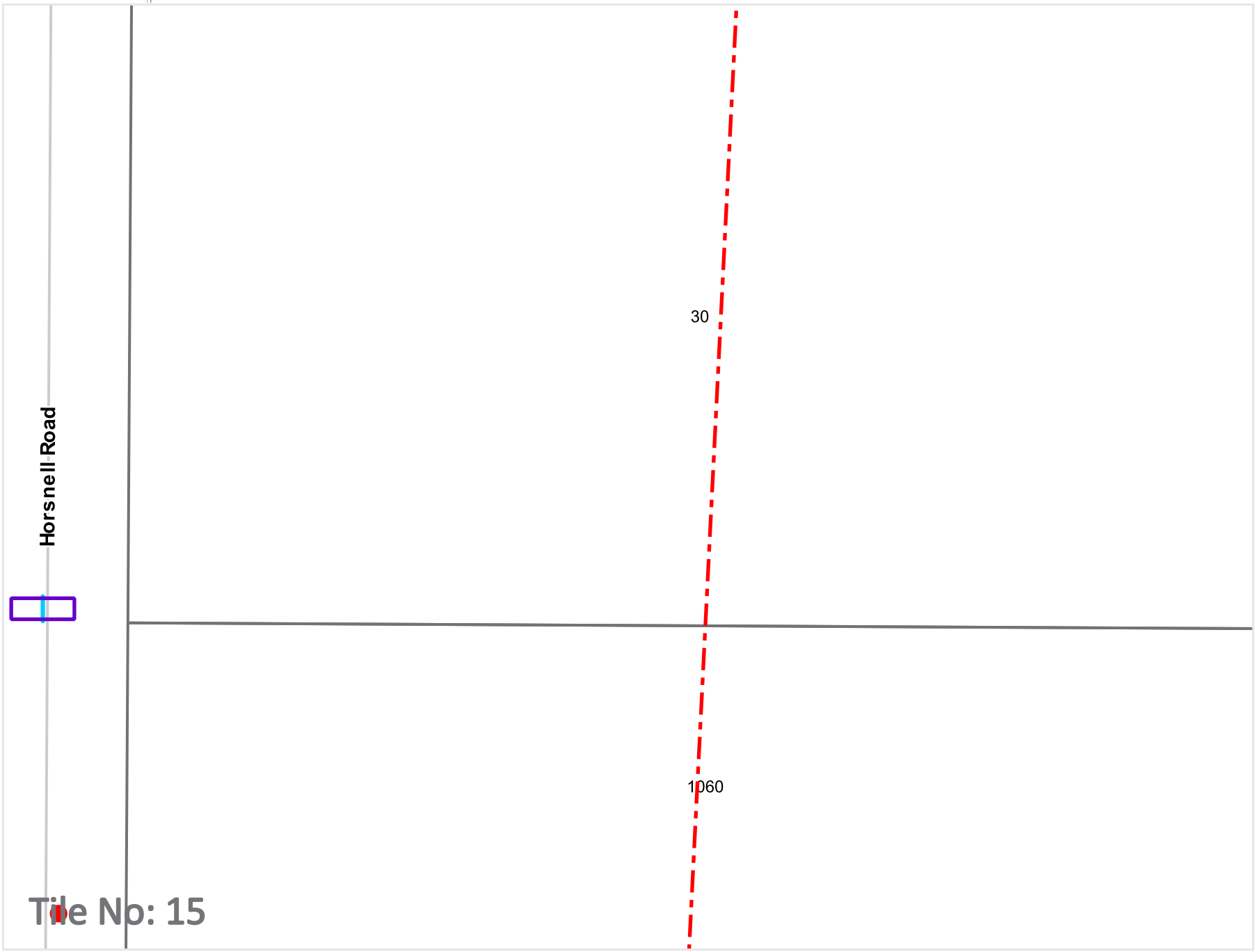

Legend

- Street Lighting
- Driveway Surfaces
- Driveway Culverts
- Cross Road Culverts
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N

Scale: 1:1000
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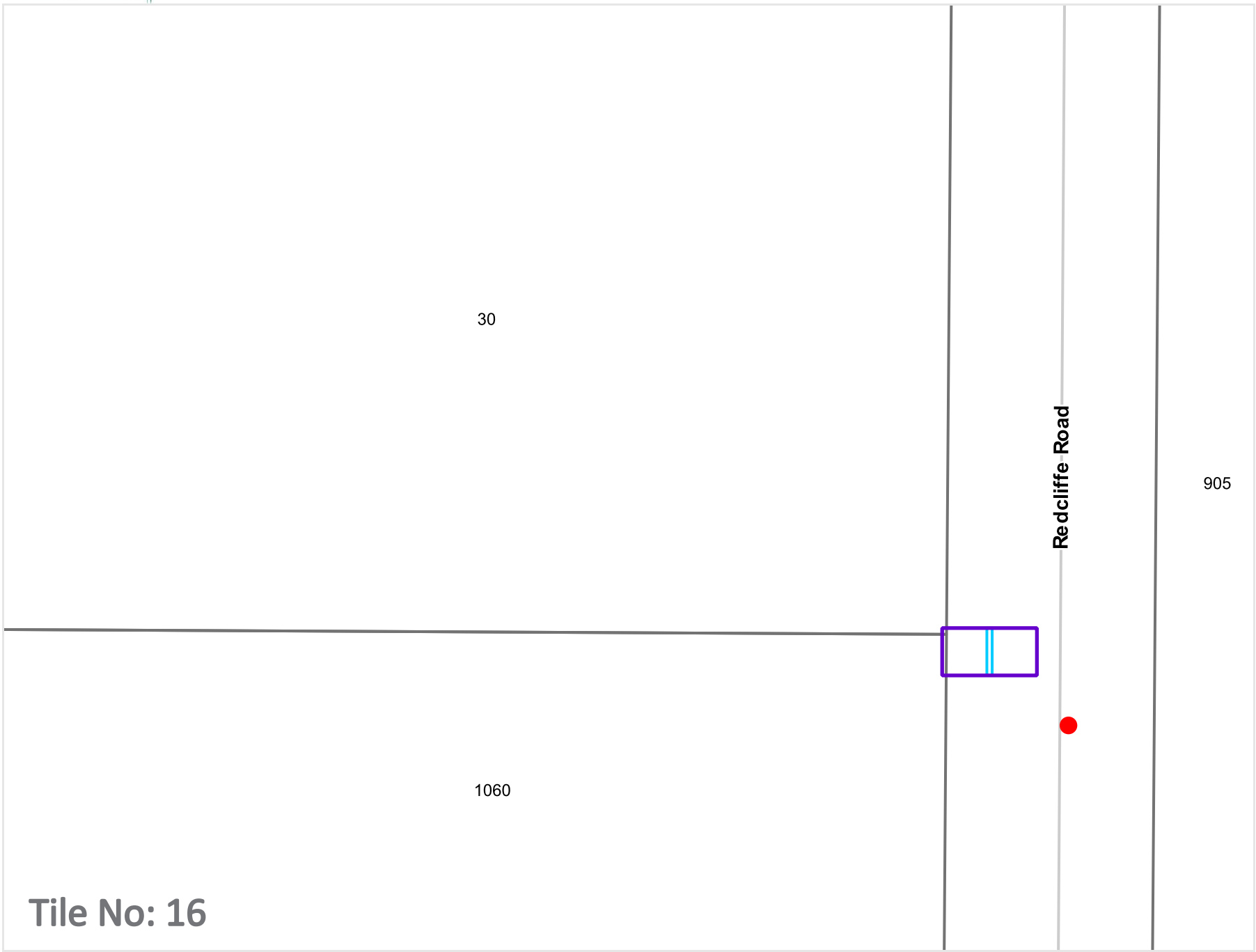

Legend

- Street Lighting
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- Driveway Culverts
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Scale: 1:1000
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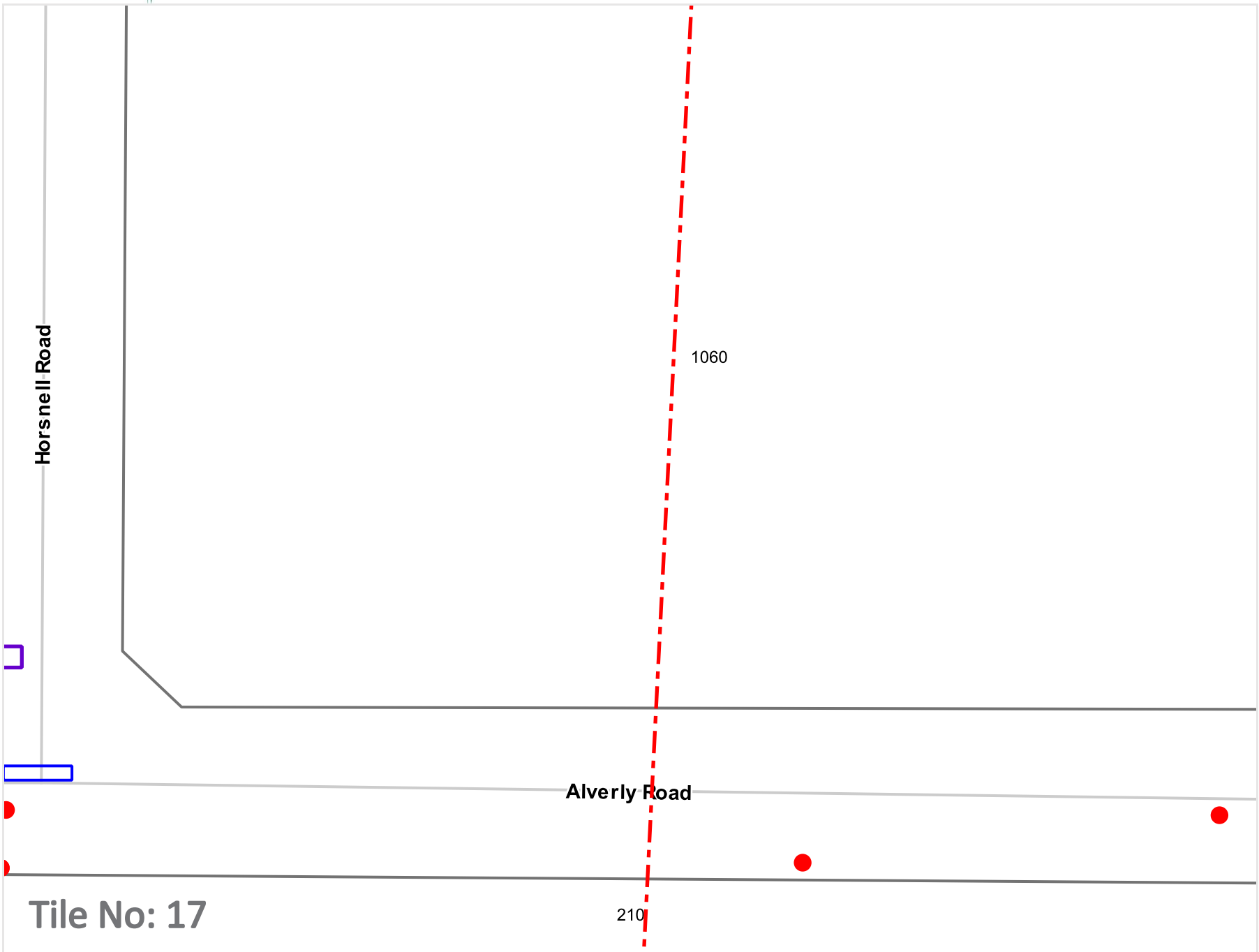

Legend

- Street Lighting
- Driveway Surfaces
- Driveway Culverts
- Cross Road Culverts
- Steet Signs
- Parcels
- Roads
- Council Boundary
- Area of Enquiry

N

Scale: 1:1000
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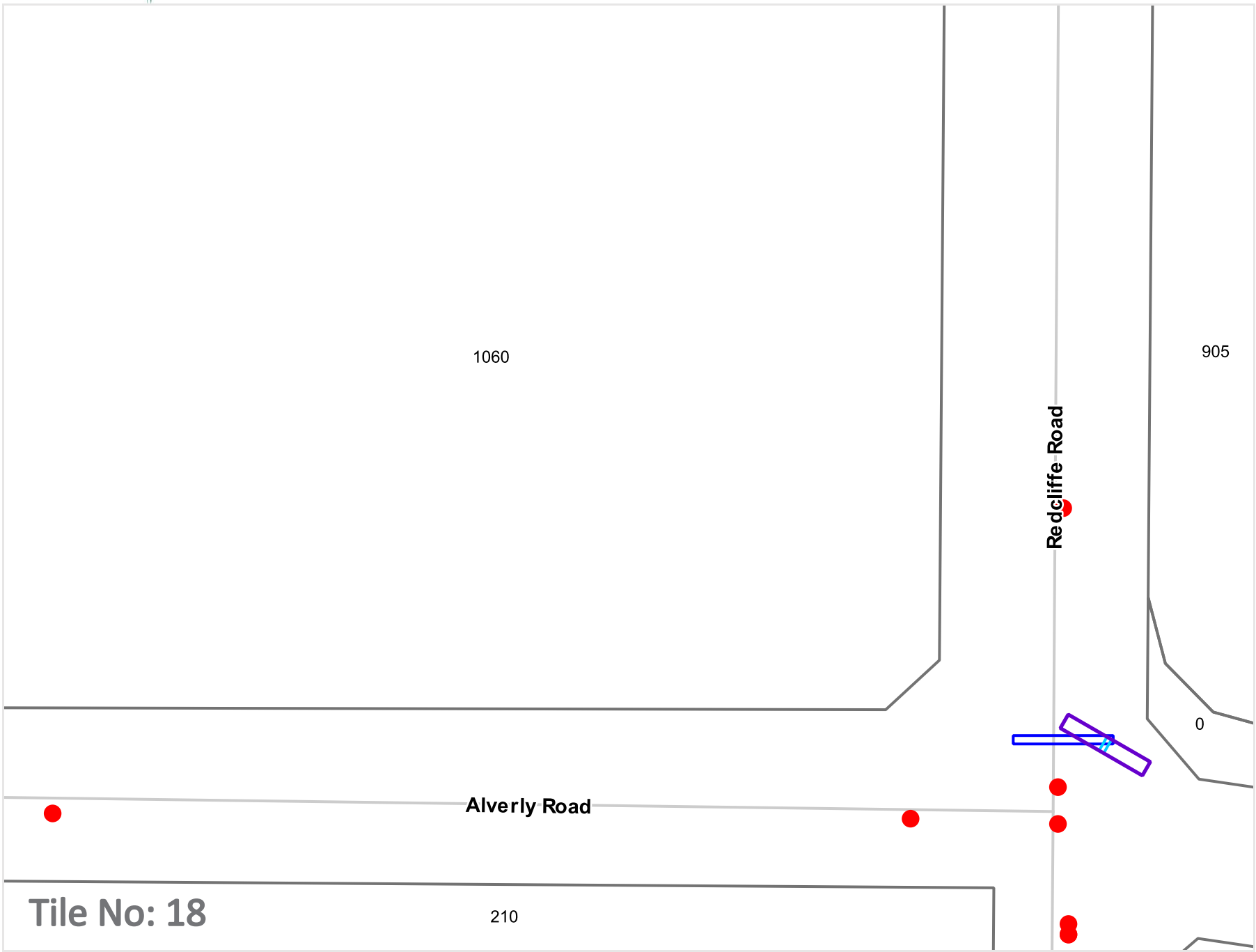

Legend

- Street Lighting
- Driveway Surfaces
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- Steet Signs
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Scale: 1:1000
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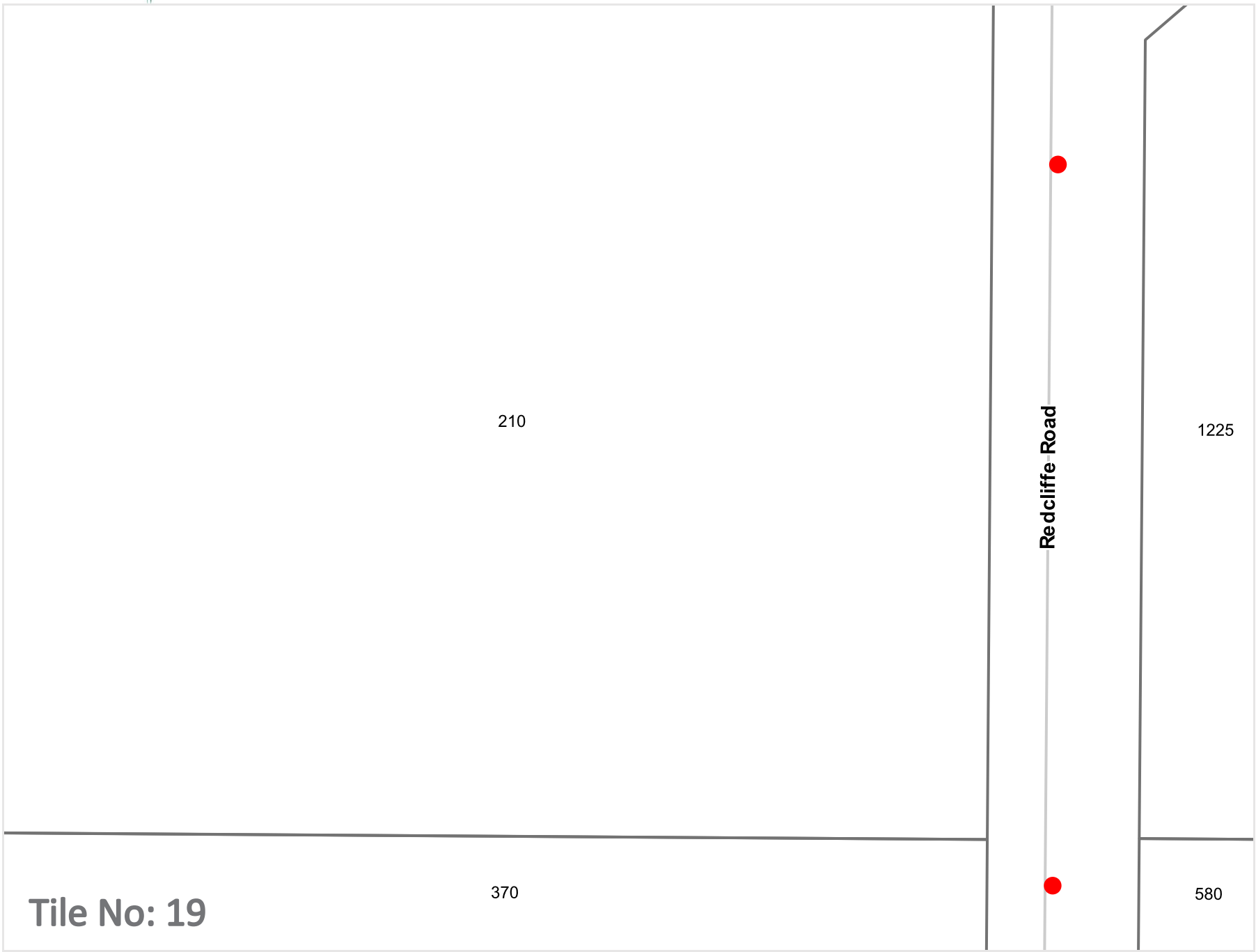

Legend

- Street Lighting
- Driveway Surfaces
- Driveway Culverts
- Cross Road Culverts
- Steet Signs
- Parcels
- Roads
- Council Boundary
- Area of Enquiry

N

Scale: 1:1000
Expires: 03 Aug 2023

Tile No: 19

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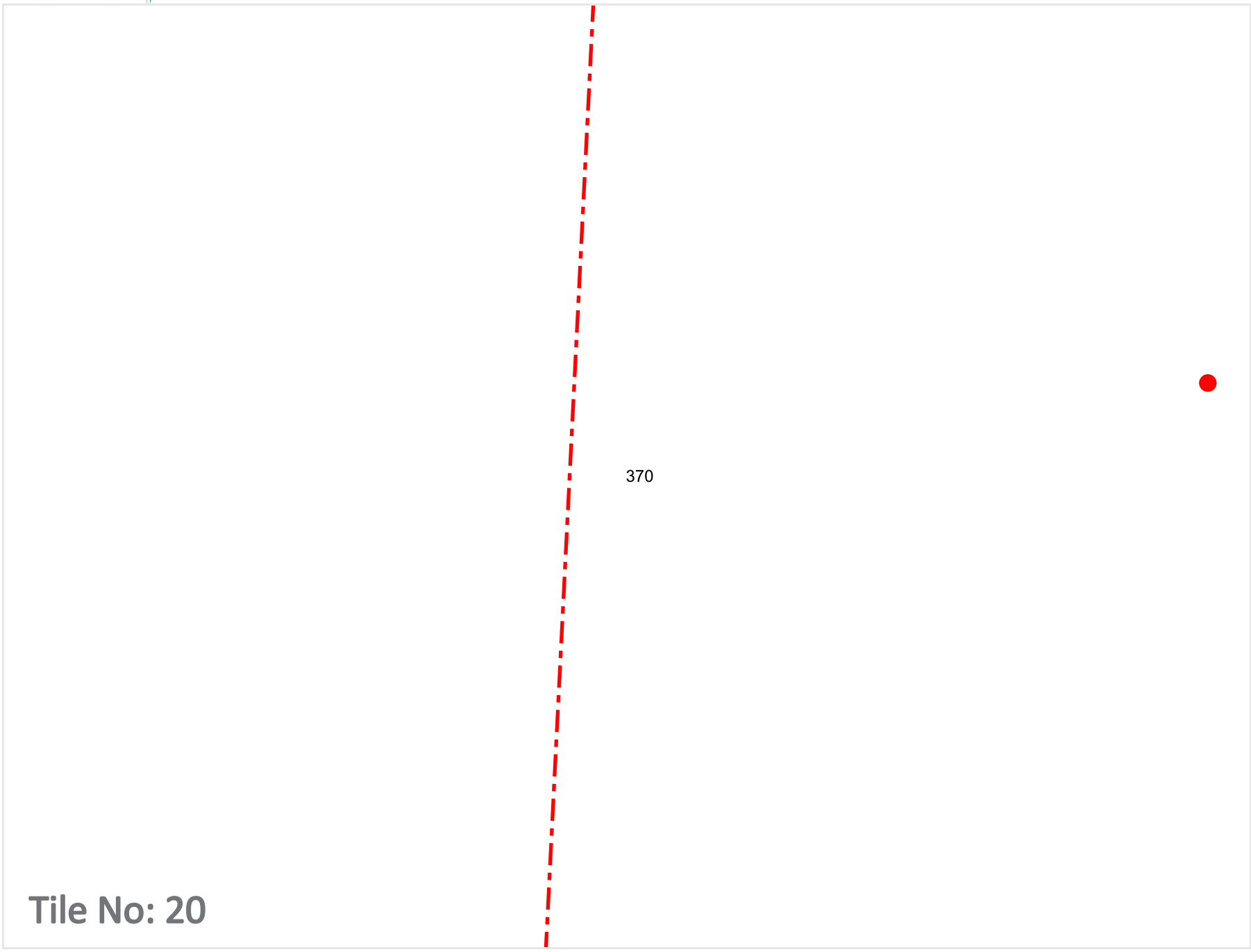

Legend

- Street Lighting
- Driveway Surfaces
- Driveway Culverts
- Cross Road Culverts
- Steet Signs
- Parcels
- Roads
- Council Boundary
- Area of Enquiry

N

Scale: 1:1000
Expires: 03 Aug 2023

Tile No: 20

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LITCHFIELD COUNCIL
Community effort is essential

Sequence No: 226754978
Job No: 34565703
Location: 500 Townend Road, Acacia Hills, NT 0822

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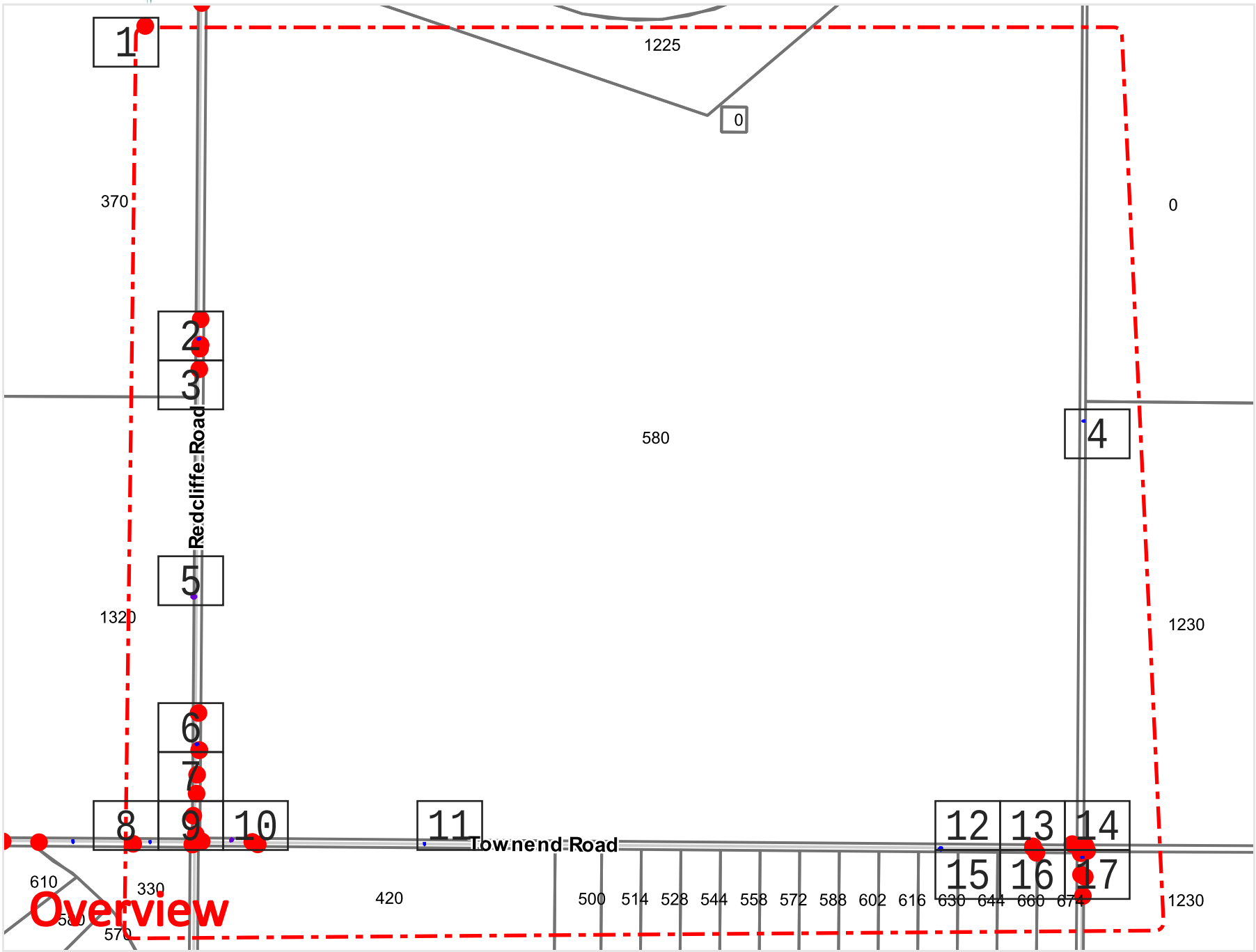

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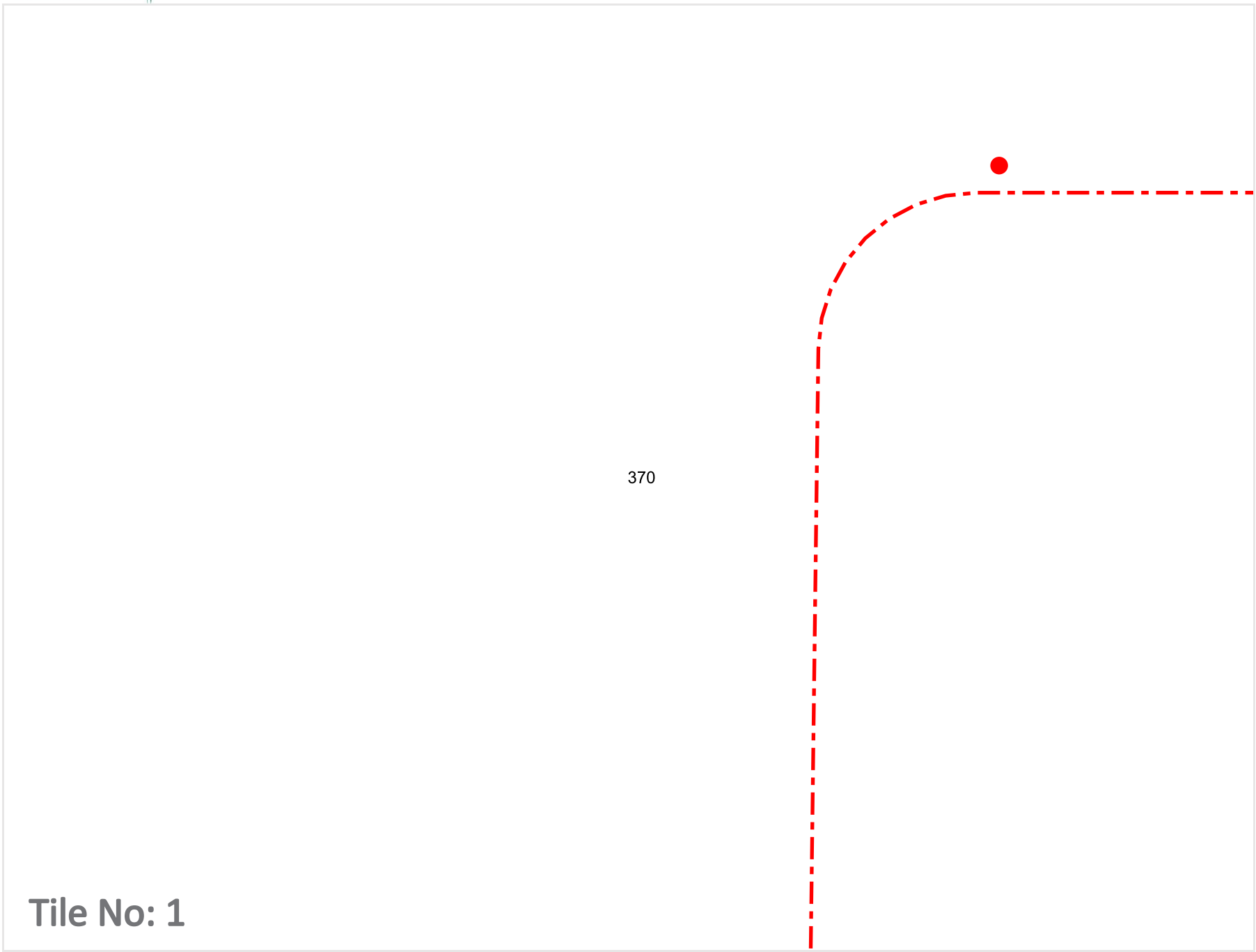

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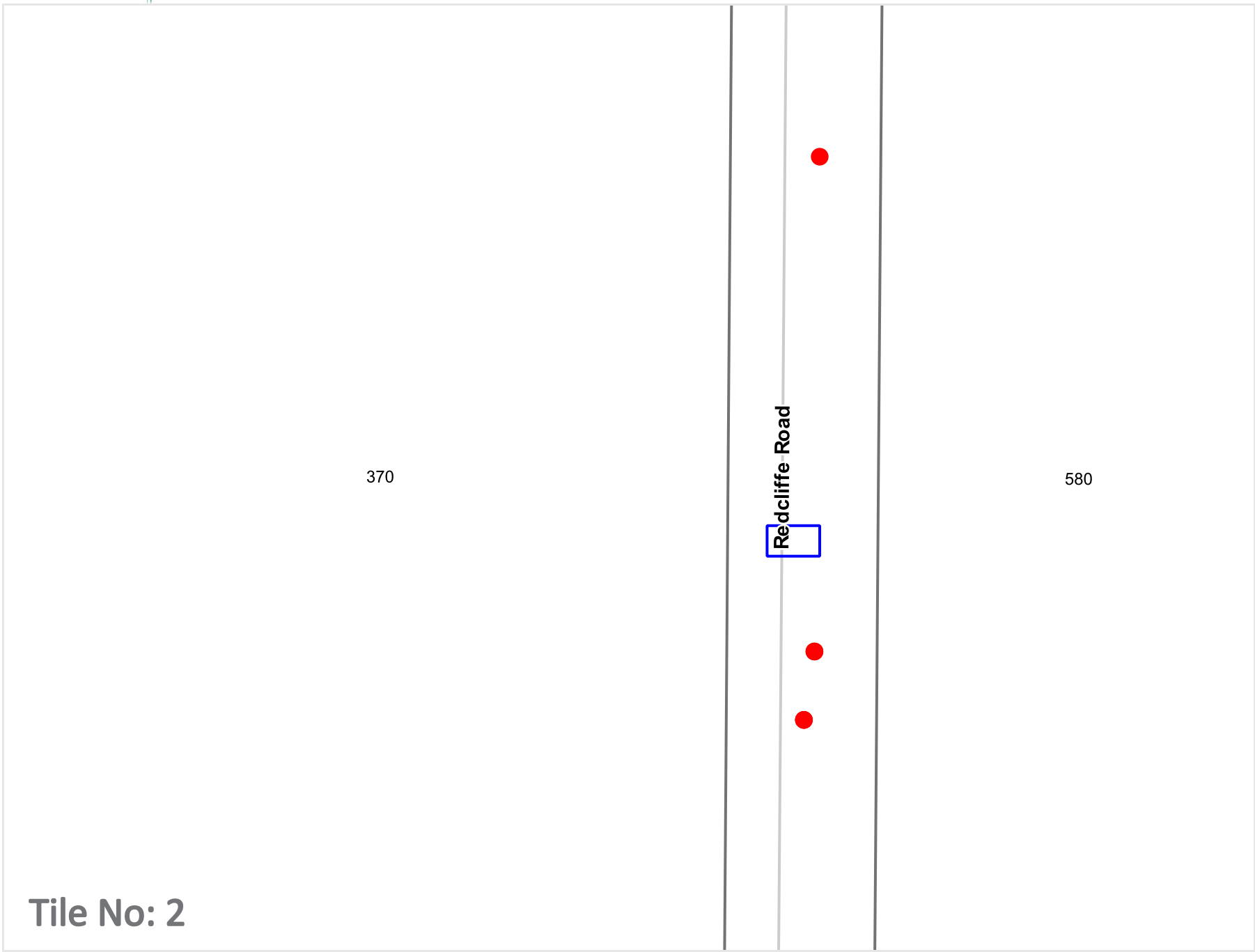

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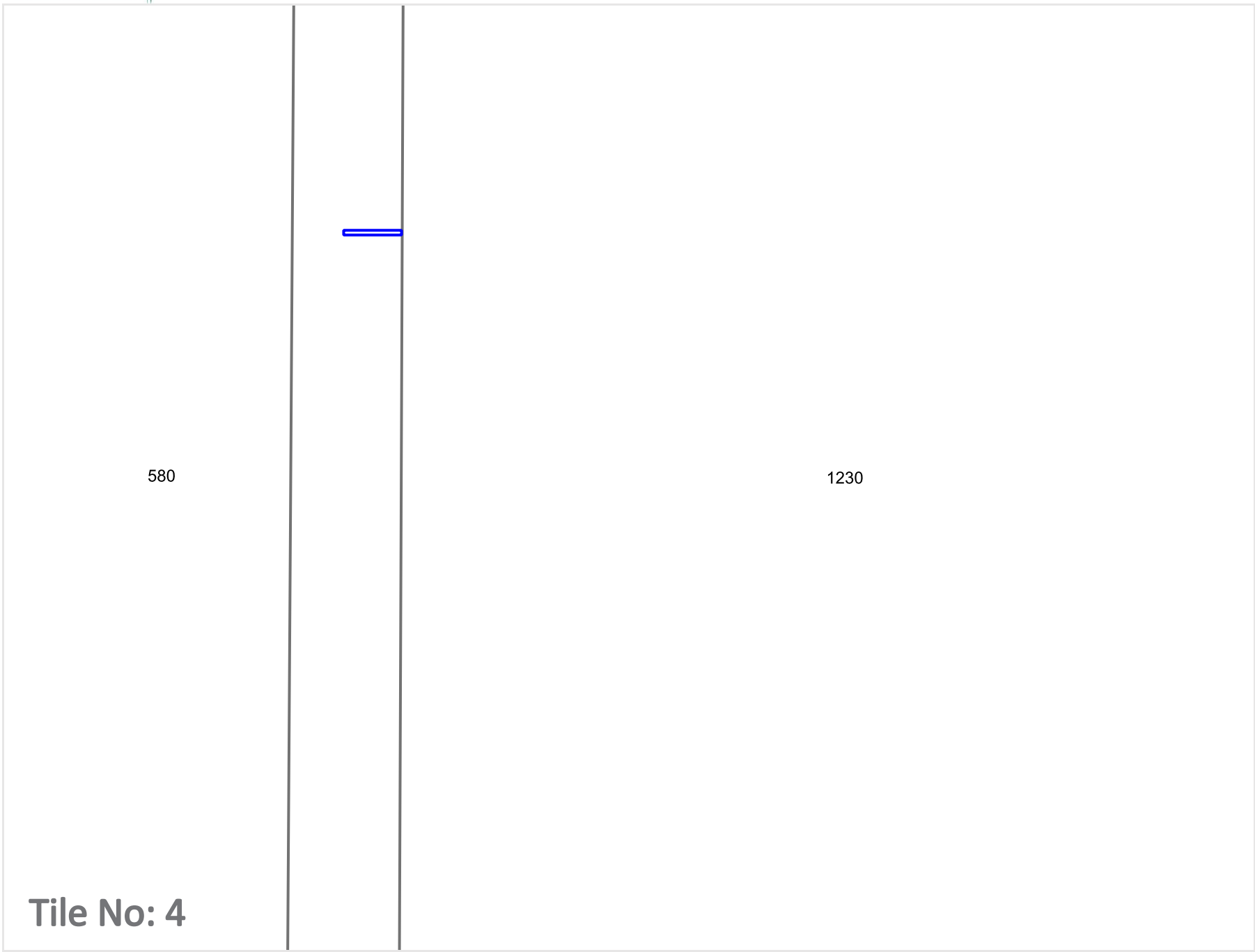

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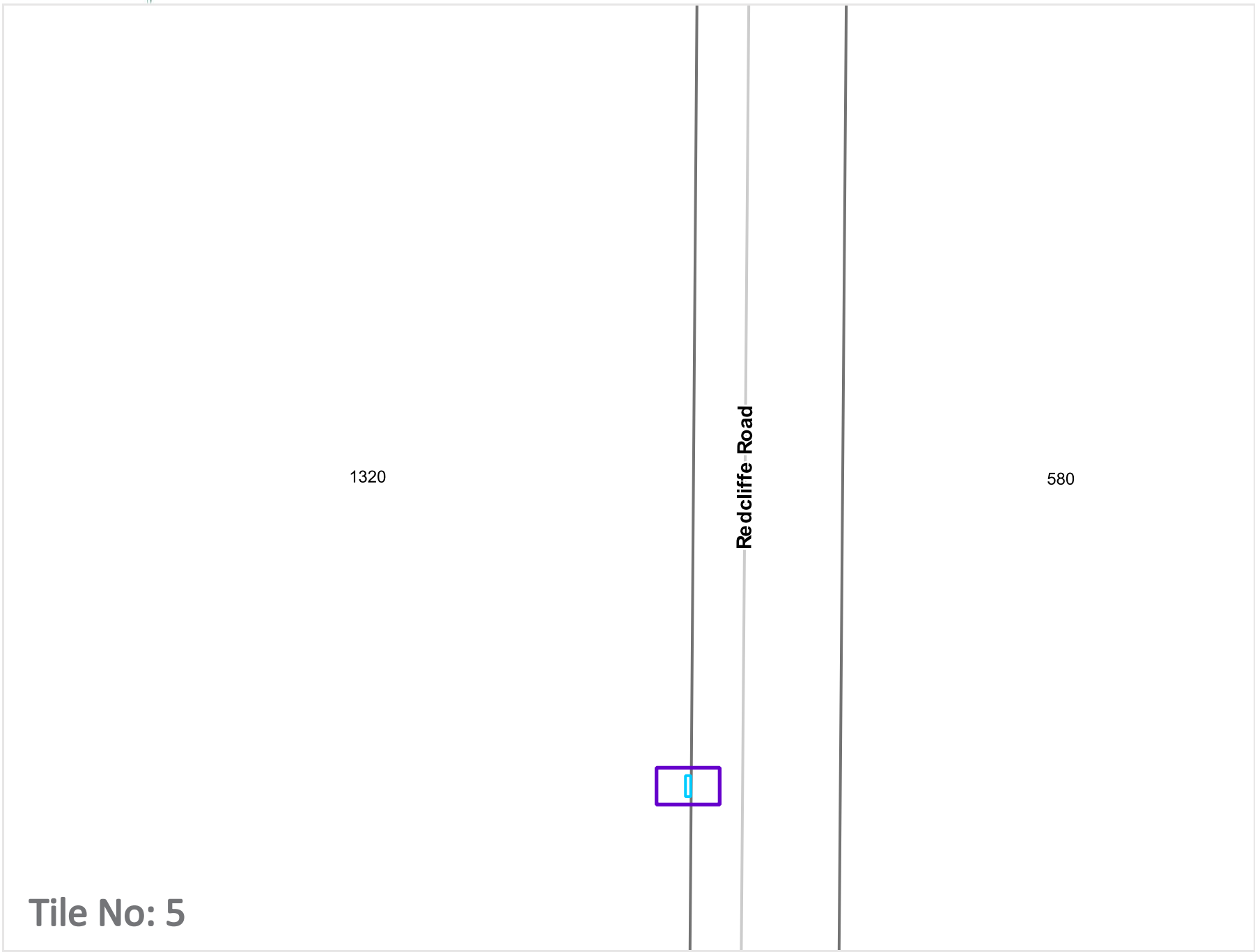

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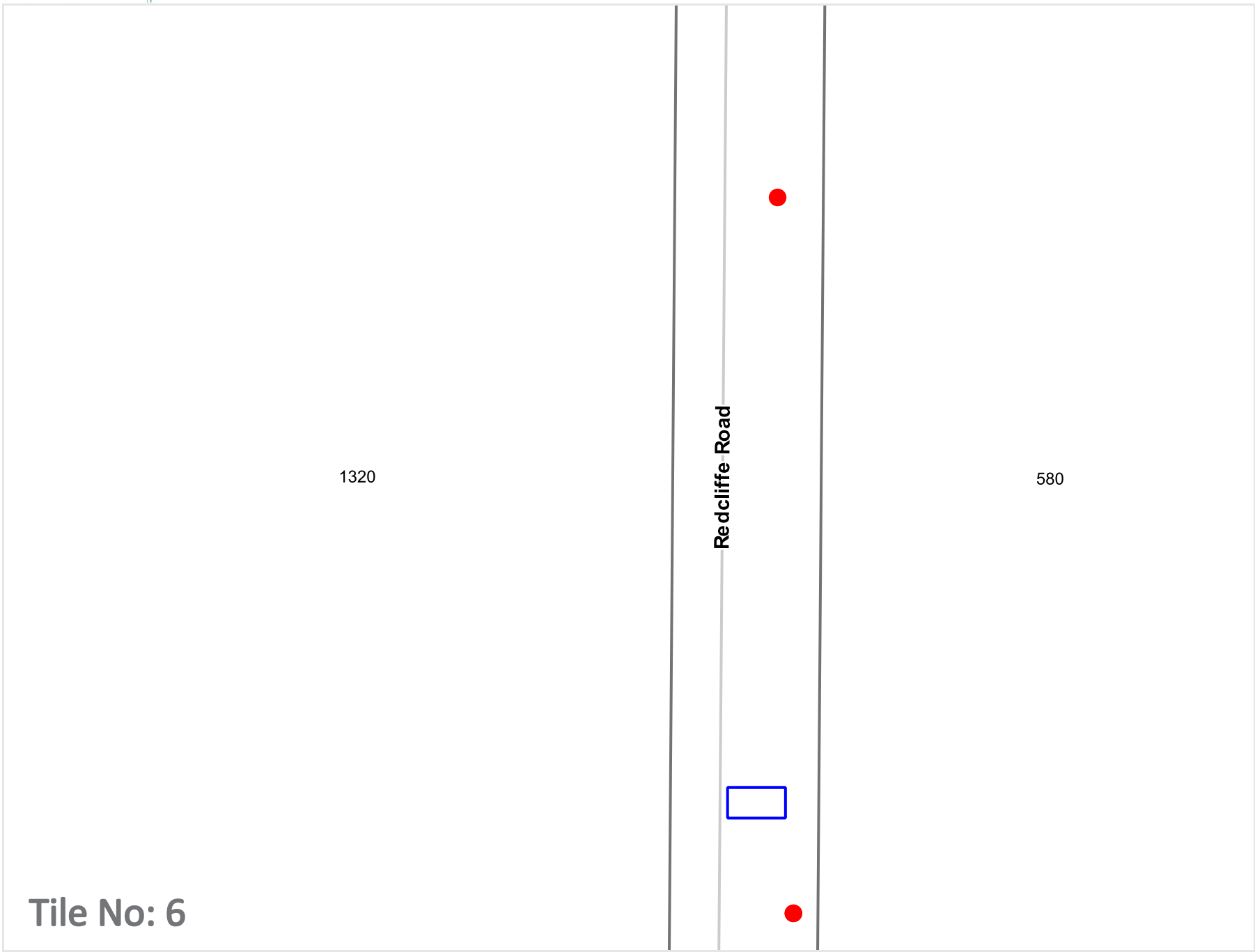

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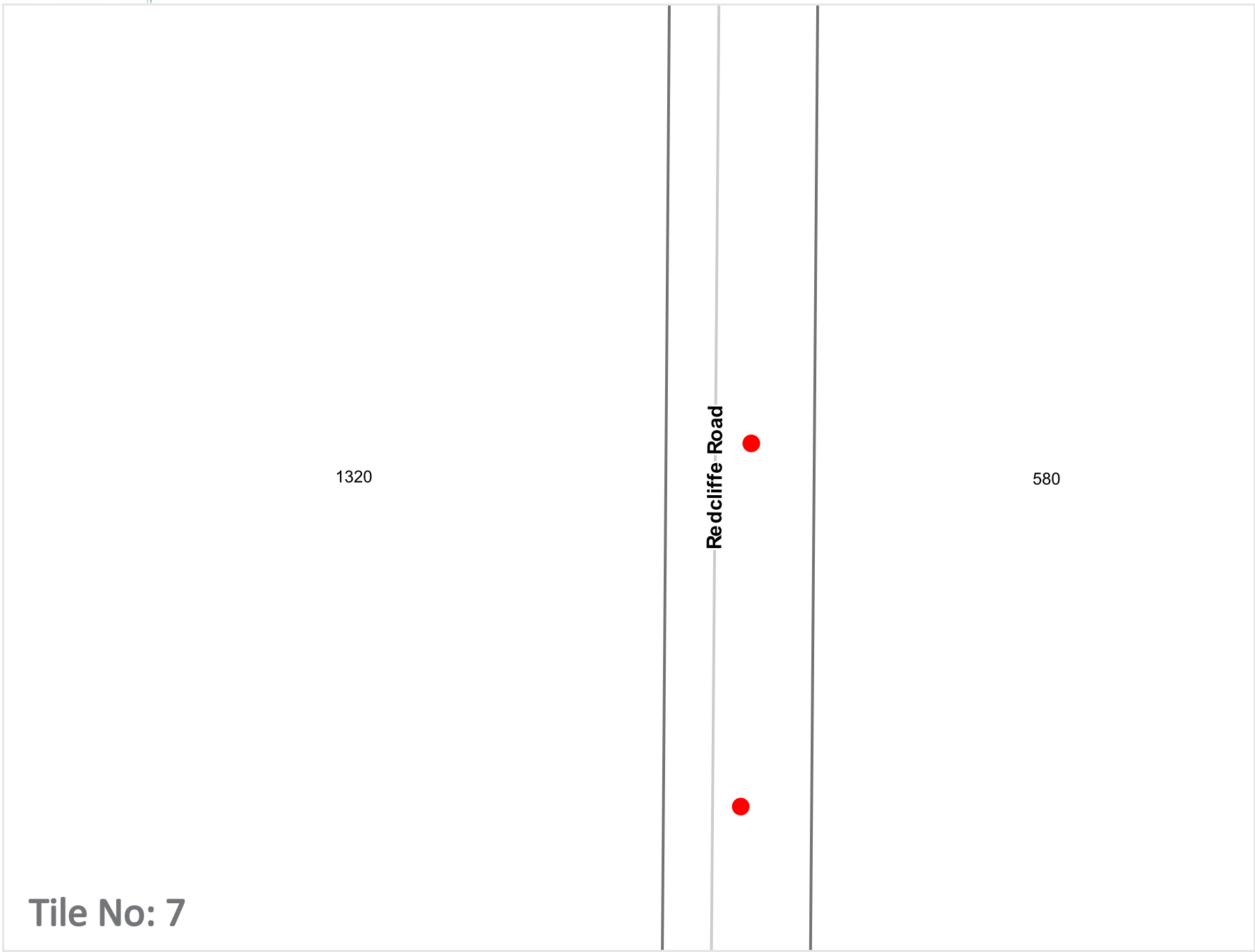

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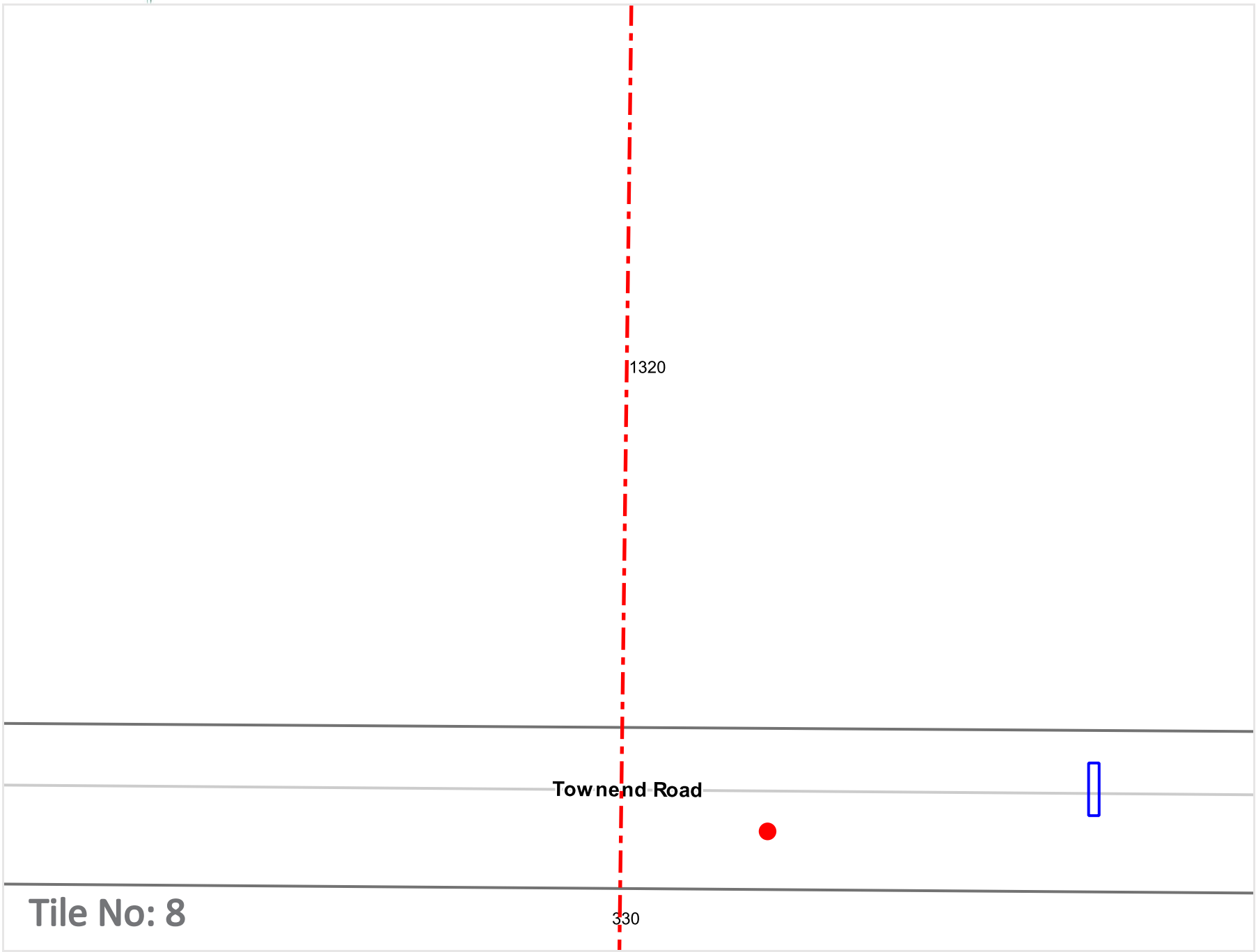

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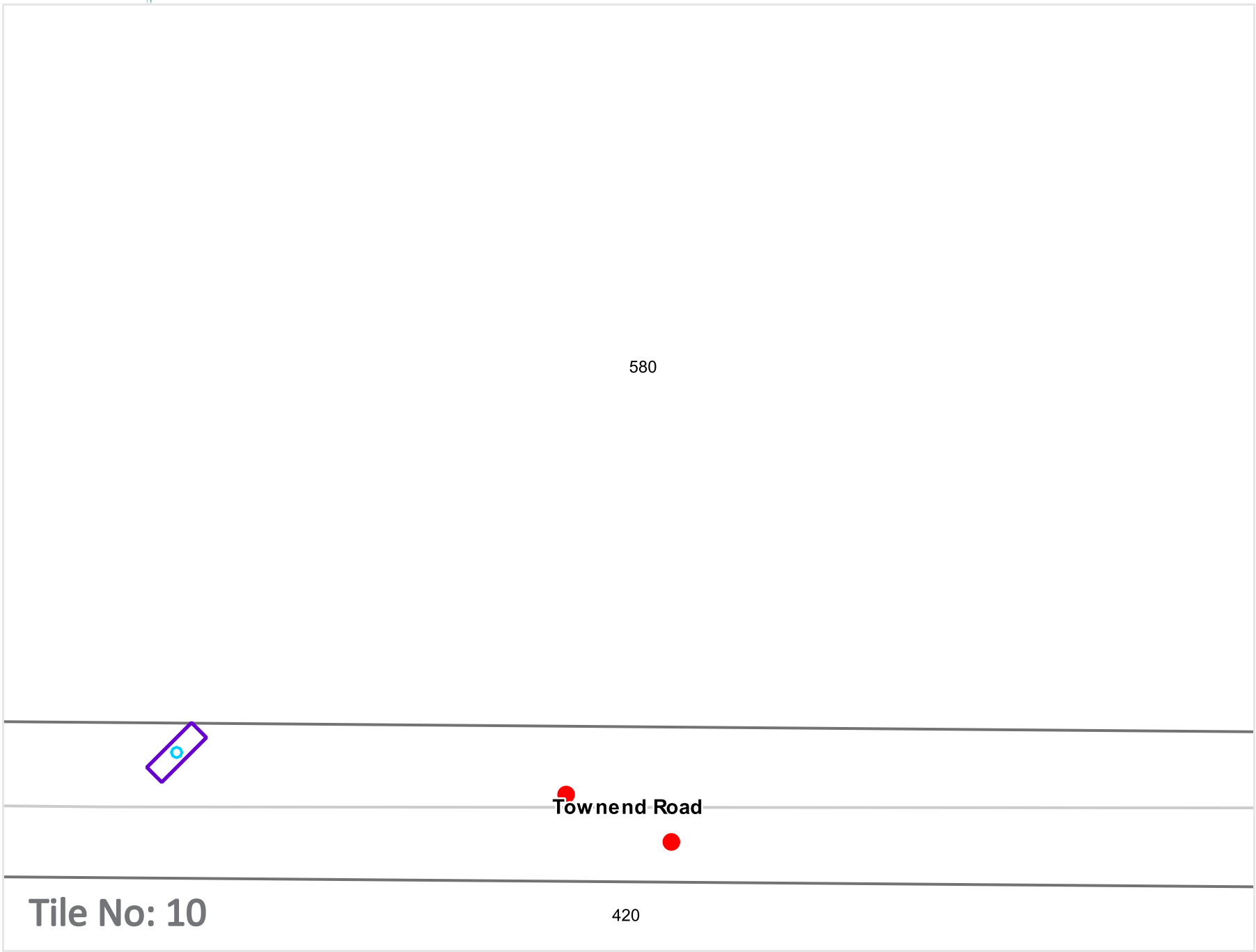

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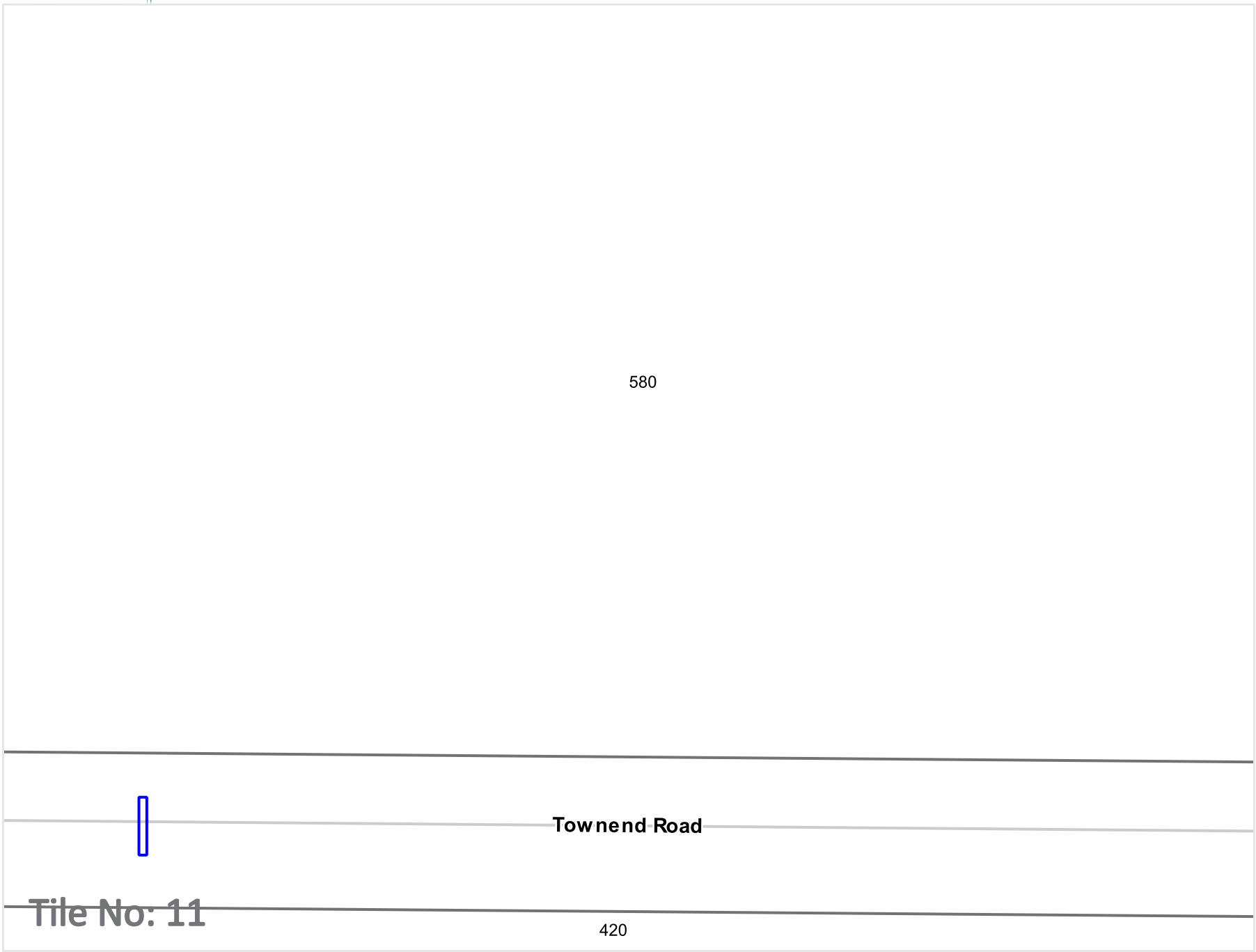

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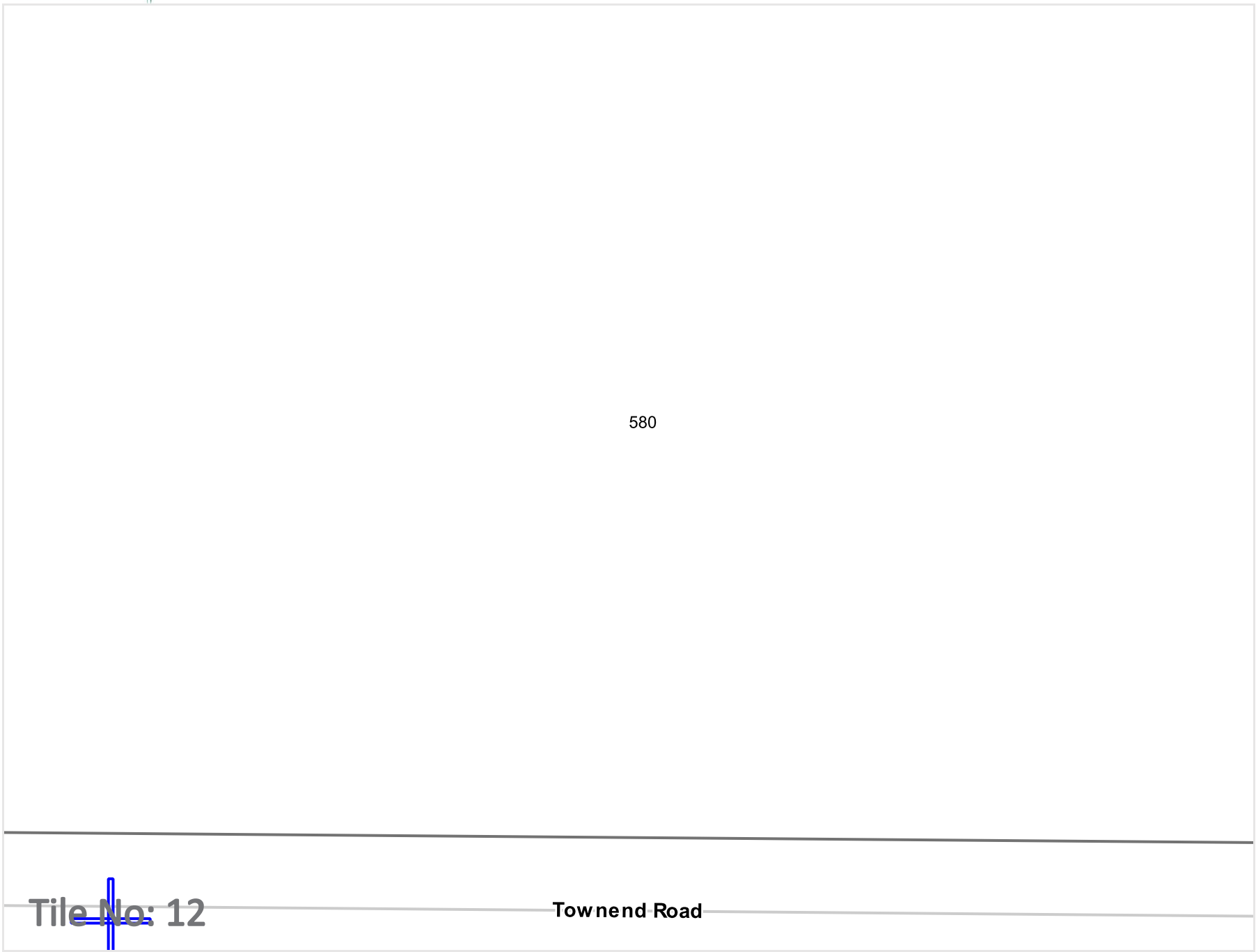

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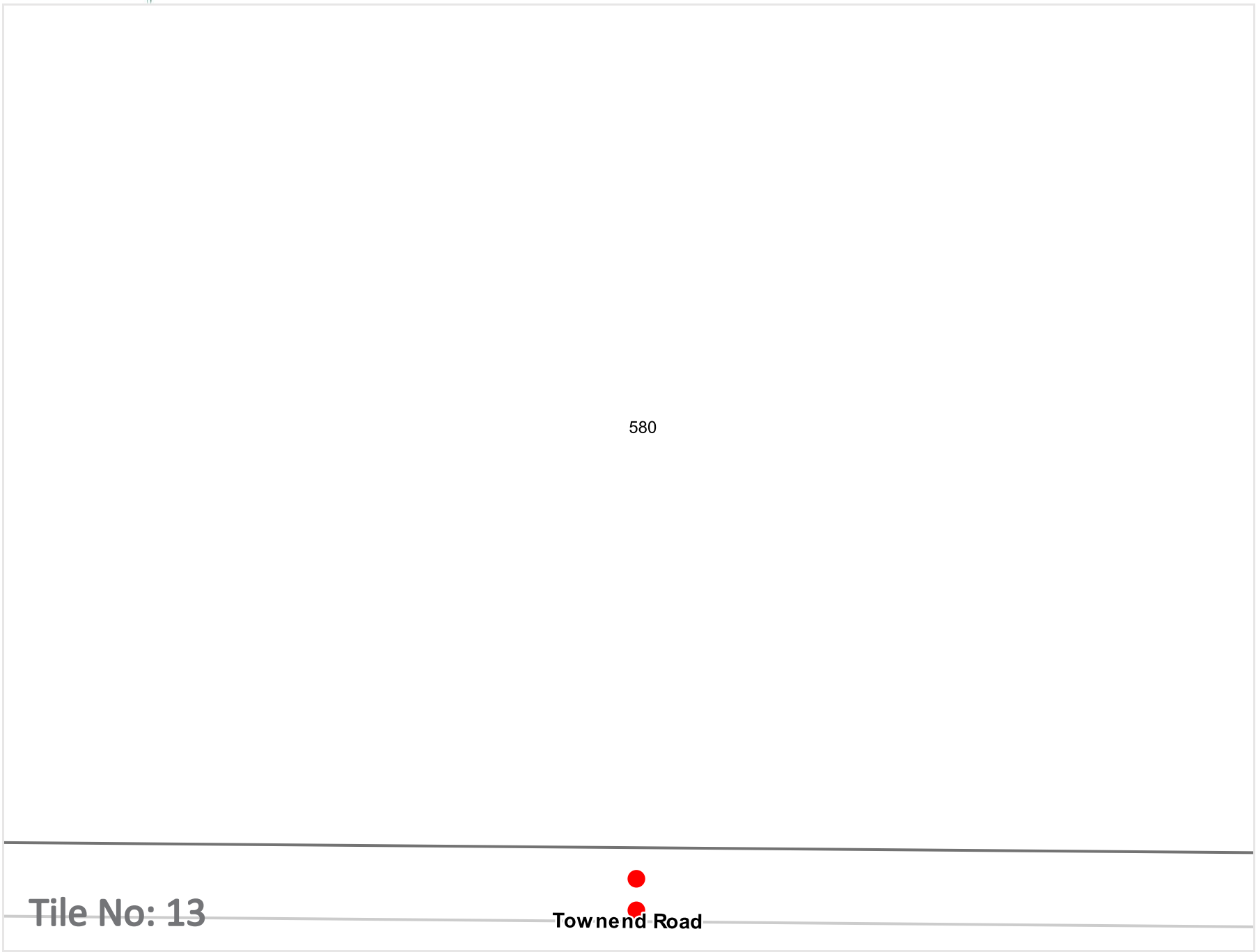

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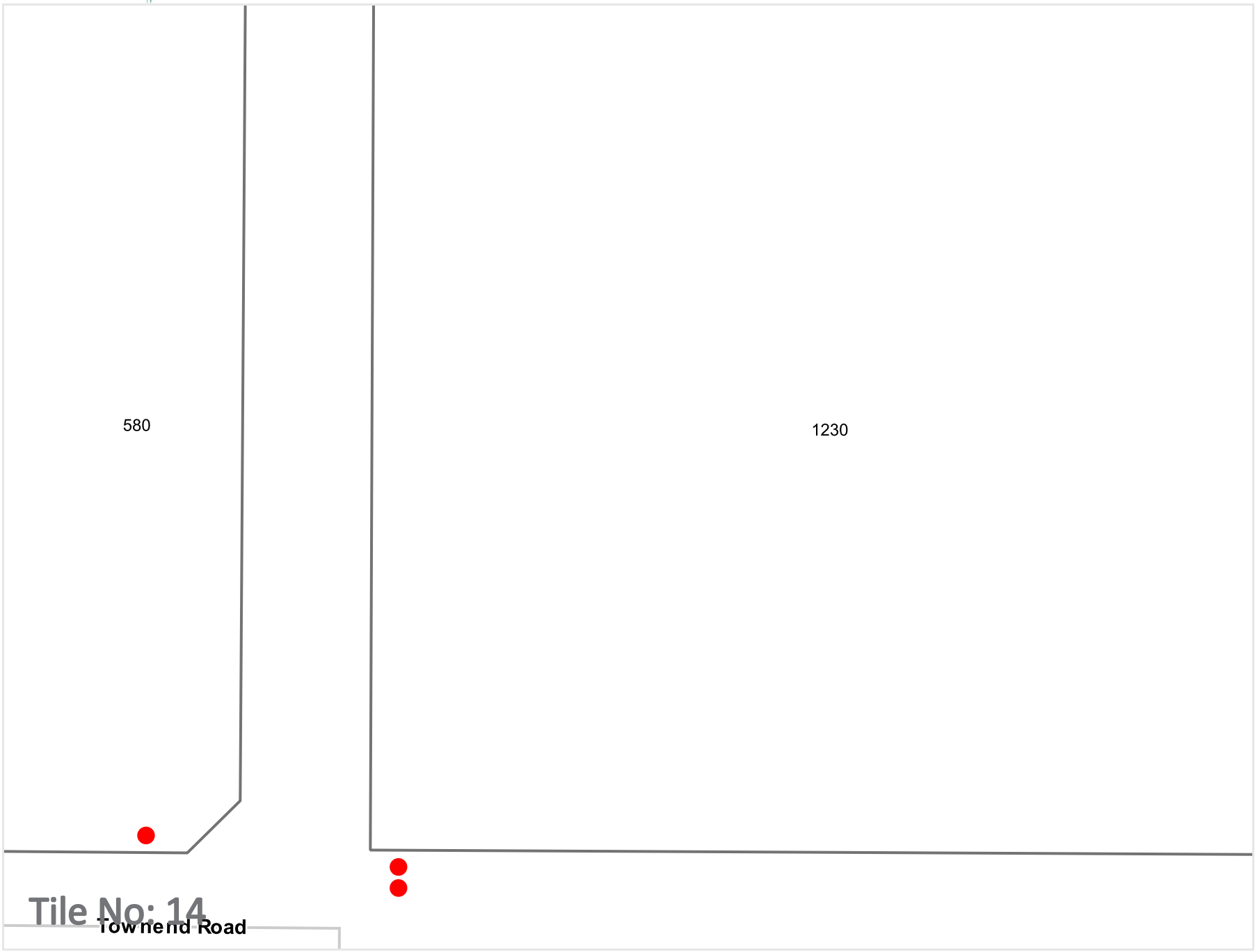

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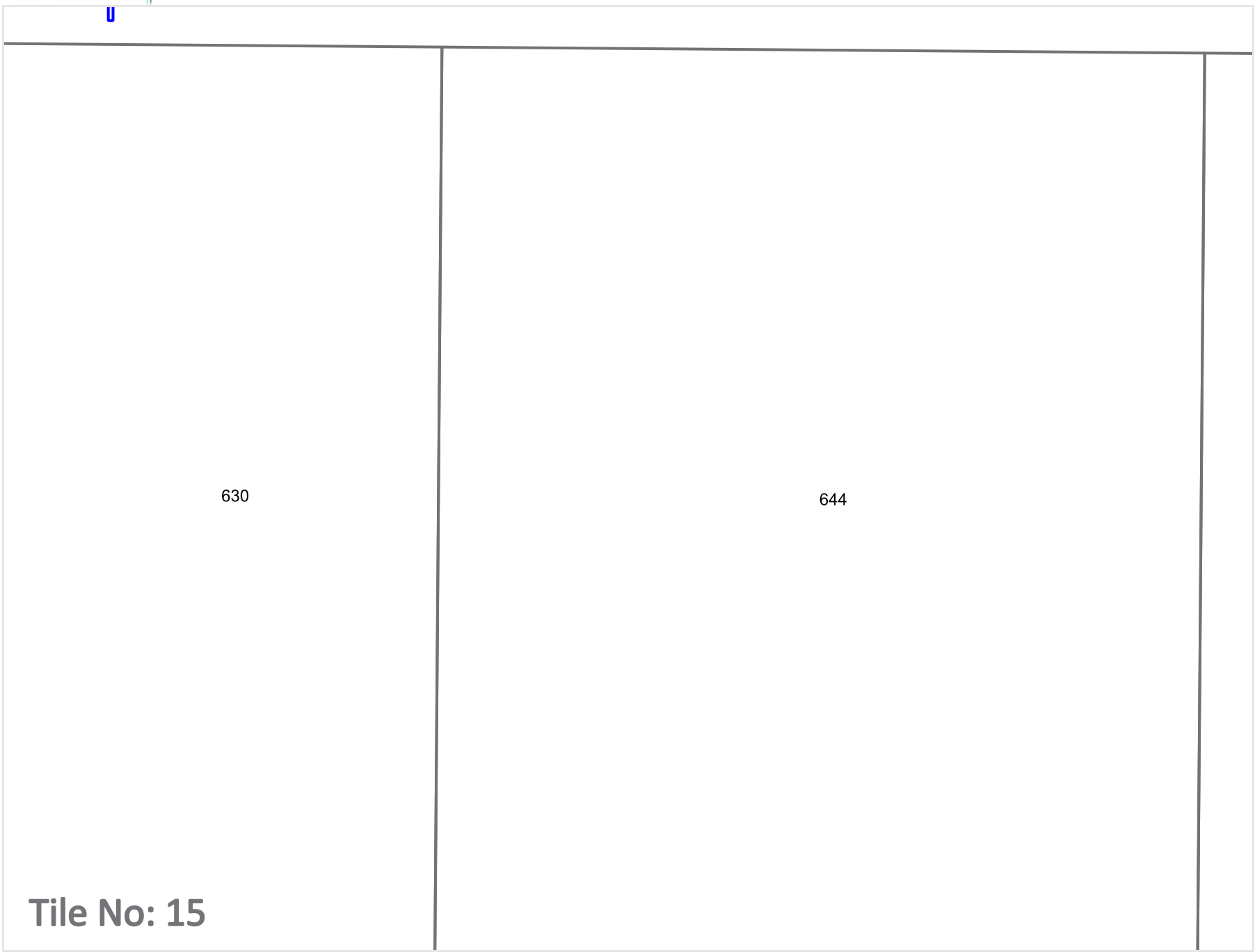

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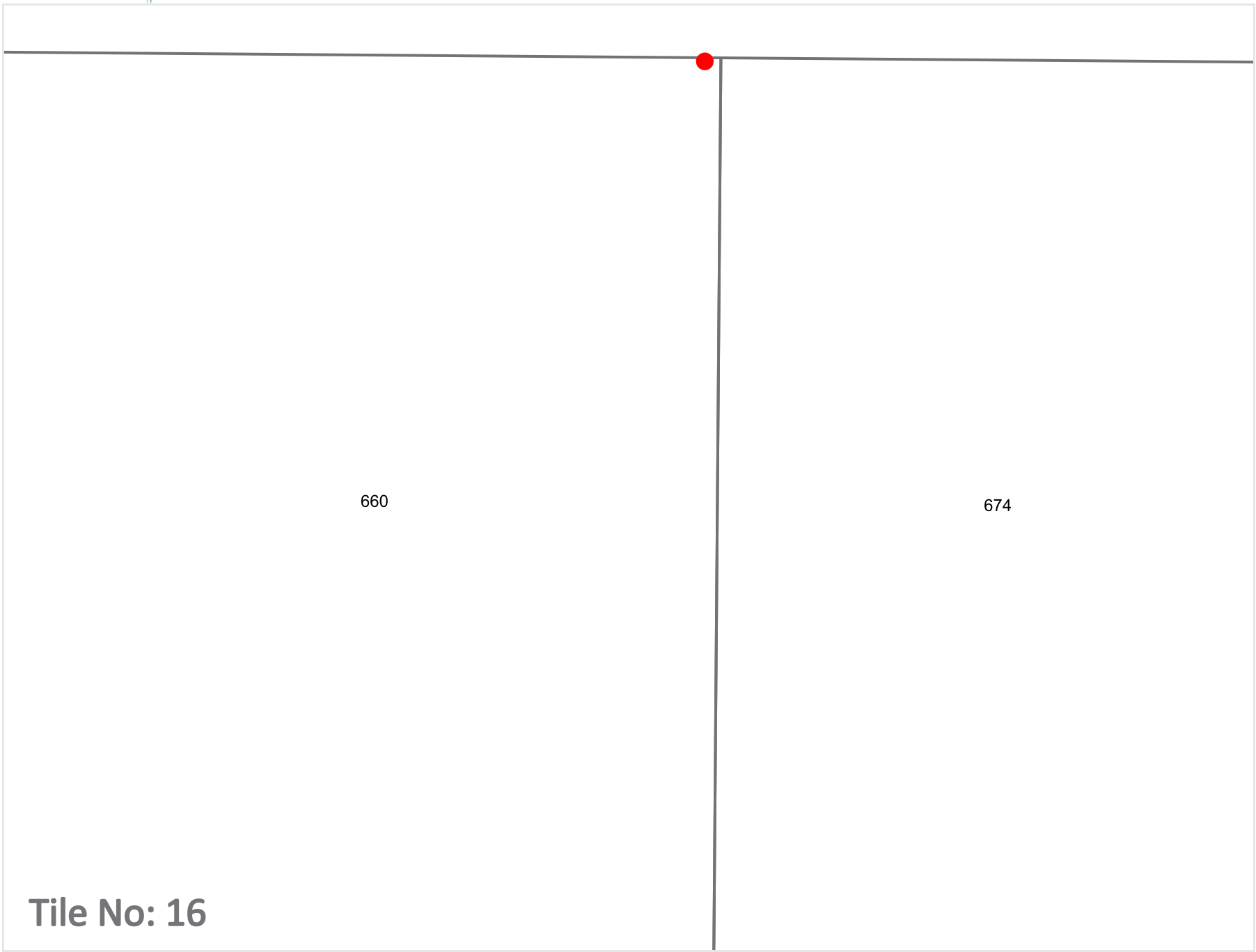

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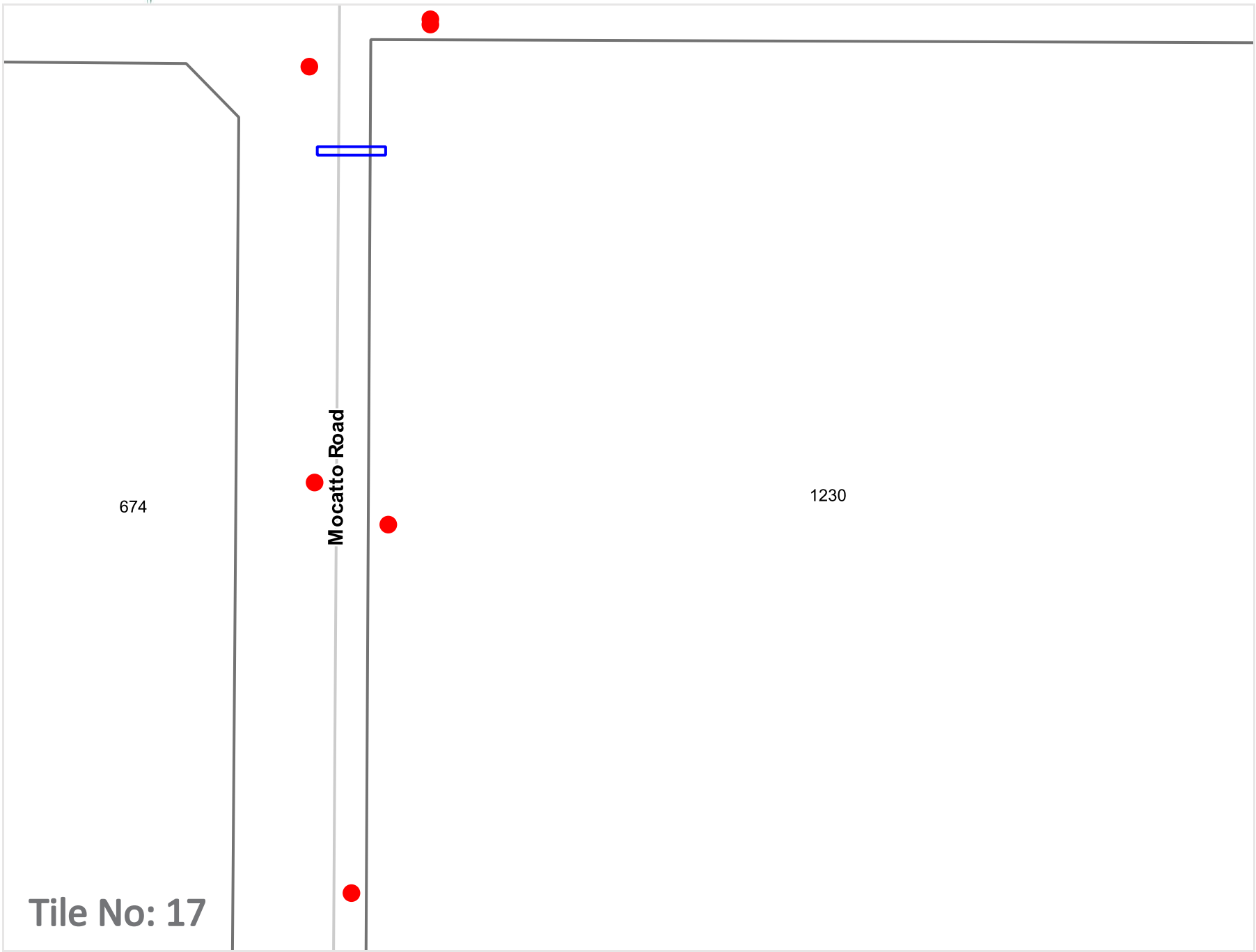

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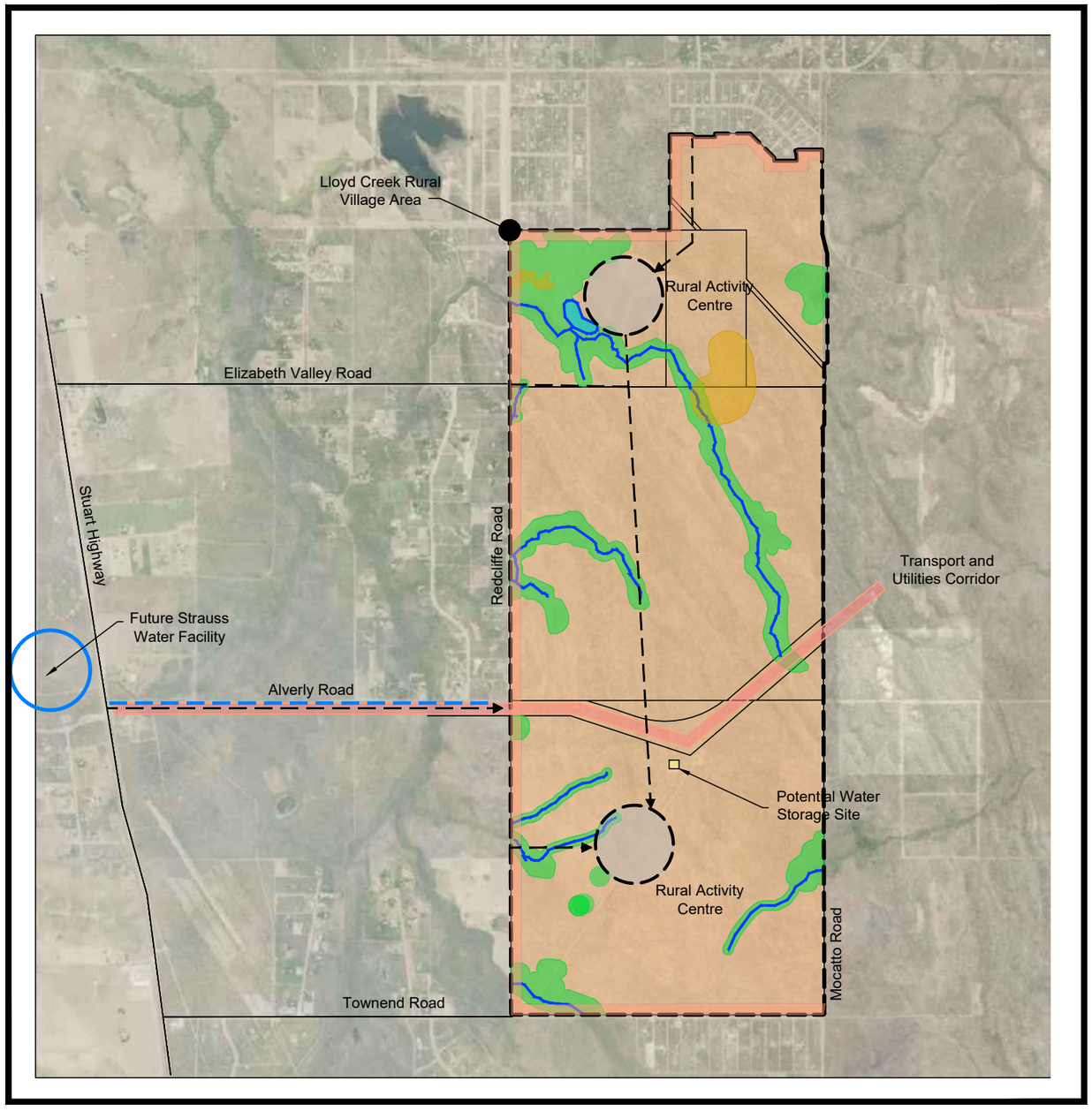
Appendix B
Llyod Creek Area Plan

Lloyd Creek Rural Village Area Plan



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METRES

LEGEND

RURAL VILLAGE AREA
- Max. 1.5 Dwellings per hectare
- On Site wastewater to DOH std.
- Lots Under 1Ha to have reticulated water

RURAL ACTIVITY CENTRE
- Max. 10 Dwellings per hectare
- On Site wastewater to DOH std.
- Lots Under 1Ha to have reticulated water

MIN. LOT SIZE REQUIREMENT
- Min 2Ha depending on adjacent lot size

ROAD CONNECTIONS

RETICULATED WATER
- Mains connection to Strauss

CONSERVATION AREAS

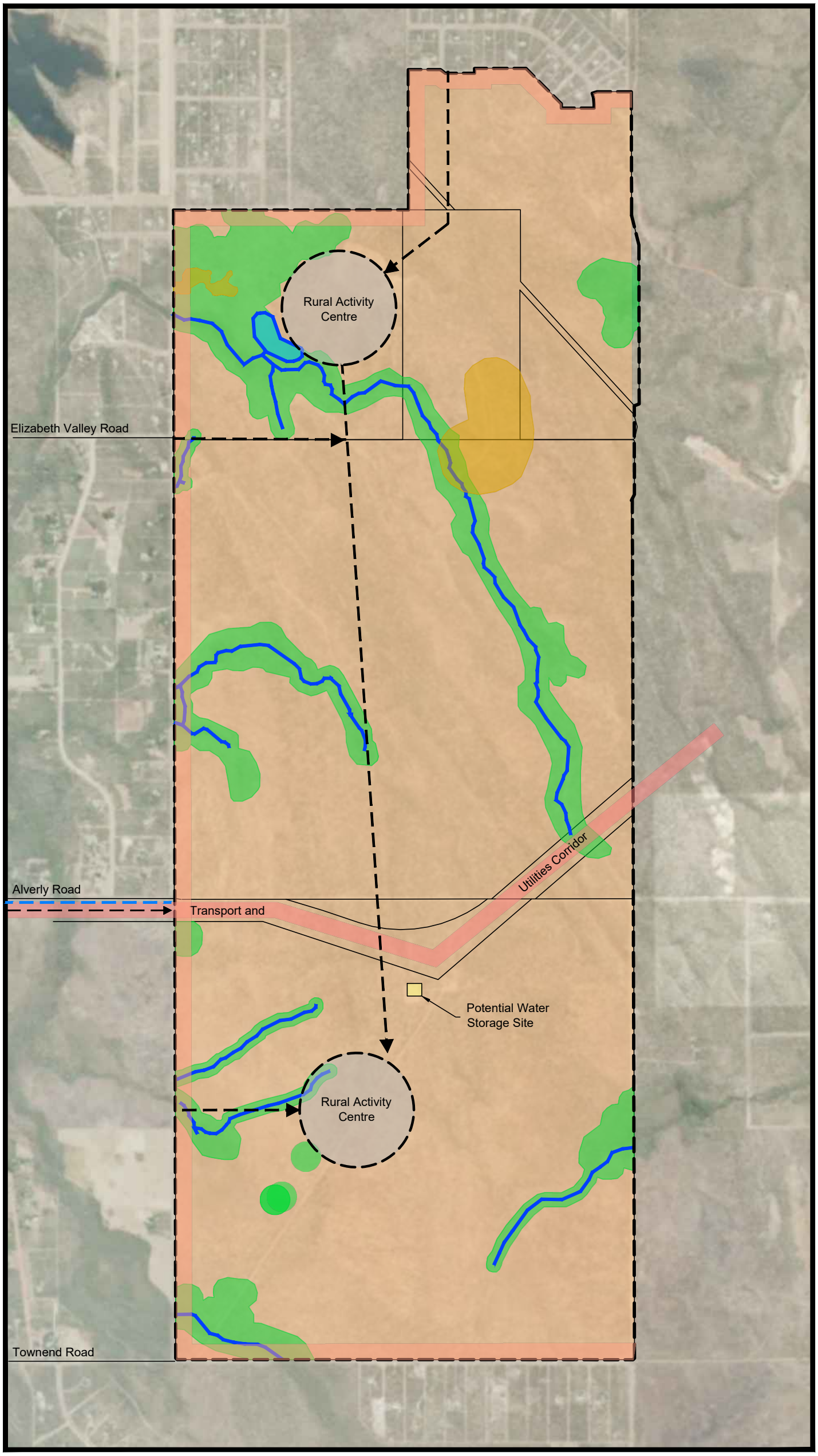
ENVIRONMENTAL FEATURES

DRAFT CONCEPT PLAN

CUNNINGTON ROSSE
Town Planning & Consulting

Client: Intrapac	Drawing Title: Proposed Village Area Plan	Drawing Number: 23-1533-SK1	Revision: 1
Project Description: Lloyd Creek Rural Village Area Plan	Date		
	Scale: AS NOTED AT A3	DO NOT SCALE DRAWINGS	
	Drawn: -	ALL DIMENSIONS TO BE VERIFIED & CHECKED ON SITE	

Lloyd Creek Rural Village Area Plan



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ENVIRONMENTAL FEATURES

0 50 100 150 200

METRES

DRAFT CONCEPT PLAN

CUNNINGTON ROSSE
Town Planning & Consulting

Client: Intrapac	Drawing Title: -	Drawing Number: 23-1533-SK2	Revision: 1
Project Description: Lloyd Creek Rural Village Area Plan	Date		
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	Drawn: -	ALL DIMENSIONS TO BE VERIFIED & CHECKED ON SITE	

Lloyd Creek Rural Village

Draft Area Plan

July 2023

TXT VERSION

Contents

1. Background

1.1 Lloyd Creek Rural Village

The proposed Lloyd Creek Rural Village is located in the suburb of Lloyd Creek within the Litchfield shire municipality of the greater Darwin Region, approximately 36km south-east of the Darwin CBD. The site has an area of 2,641.4 Hectares and includes Sections 5827, 507, 5758 & 5761, Hundred of Strangways. The proposed development area is largely undeveloped ex pastoral land with an existing telecommunications tower and transponder site in the south and associated access easement and track from the south-west corner. The site itself is bound by Redcliff Road to the west, Townend Road to the south and Mocatto Road to the east.

The project and resulting development aims to provide a high-quality Rural village community with a land product which enables serviceable and manageable rural amenity lots and a rural village product that is not currently available in the greater Darwin and rural land market.

This area plan and the development concept for the site is supported and informed by documents (in addition to those listed below) including the following:

- Lloyd Creek Village Infrastructure Plan (ADG Engineers) – (A key reference document for this area plan).
- NT EPA Environmental Assessment Report 82 (NT EPA EIS report for the site).
- Community and Market research conducted in 2022/2023 to understand the wants and needs of the NT community in relation to Rural development.
- NTG and community feedback on previous proposals for the site.
- Consideration of the Strauss Water Treatment Plant which is a key component of the Manton Dam Return to Service (Manton Dam RTS) project.
- NTG Code of Practice for Wastewater Management 2020.

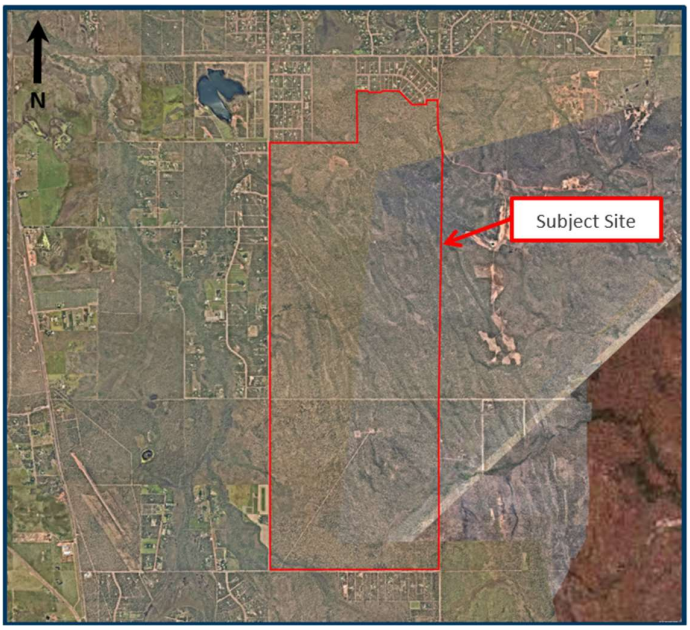

Figure 1: *Lloyd Creek Rural Village Development site*

1.2 Development Timing and Sequencing

The development proposes to enact the development designation for the site as per the NT Planning scheme strategic framework, which will logically take place over a long period of time and be governed by regional demand. The project has an anticipated 30-year lifespan from commencement to completion. It is acknowledged that there are several Crown Lease developments in the Greater Darwin Area and noted that the proposed Lloyd Creek offers a different style of development appealing to a different style of landholder. The Northern Territory Government is proposing a growth strategy that is centric to a $40 billion economy by 2030, and with the current shortage for housing nationwide, the development will provide support to regional development.

As an estimate, Figure 2 shows a proposed timeline for the development. It is important to note that the first stages of the development (including master planning, detailed design and construction) will take place within the rural fringes (rural village area) of the proposed area plan. Planning and design works for the rural activity centres will be dependent on planning and demand for the product, as well as attainment of a critical mass within the area to support commercial & community facilities.

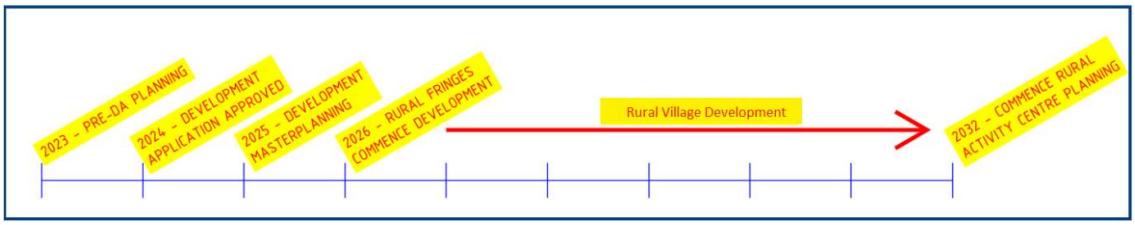

Figure 2: *Lloyd Creek Rural Village Development timing and sequencing*

2. Purpose of the Area Plan

This Area Plan will guide future land use within the Lloyd Creek Rural Village. The proposed planning principles and area plan will guide the development of land within the Lloyd Creek Rural Village. The proposed land uses aim to cater for future population growth and support the efficient delivery of infrastructure and viability of future rural activity centers within the village.

Pprinciples of and best practice sustainable planning and development are applied throughout this Area Plan. The plan also seeks to respond and respect the surrounding rural locality and proposes a Rural Village development to deliver a master planning Rural community for the Northern Territory to meet the needs of existing and future Territorians.

3. Context

The subject site for this Area Plan is clearly highlighted for future development in the hierarchy of Strategic Framework contained within Part 2 of NT Planning Scheme.

The Strategic Framework documents set the strategic policy and strategic land use plans to guide development in the Northern Territory. The identification of the site for future development within the

Strategic Framework of the NT Planning scheme reinforces the intended outcome as a future community and this Area Plan seeks to progress the development concept for the site.

3.1 Strategic Framework Documents

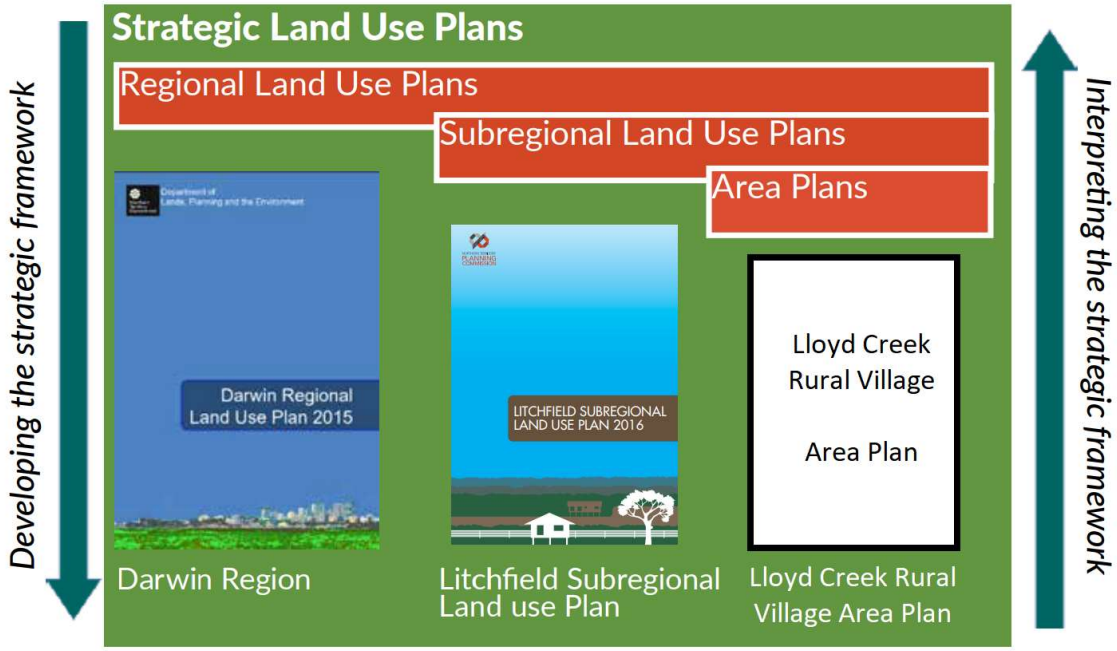

Figure 3: *Lloyd Creek Rural Village Area Plan within the Strategic Framework of the NT Planning Scheme 2020*

Darwin Regional Land Use Plan 2015

The Darwin Regional Land Use Plan 2015 provides a strategic framework to anticipate and manage future growth in the Darwin Region. The framework and policy approach established by the plan will result in better integrated land use, transport and infrastructure planning, to deliver more sustainable and cost-effective outcomes, and provide for economic and community growth in balance with protection of the environment. The Darwin Regional Land use plan identifies the Lloyd Creek locality and site as a future development area dissected by a future utilities and transport corridor.

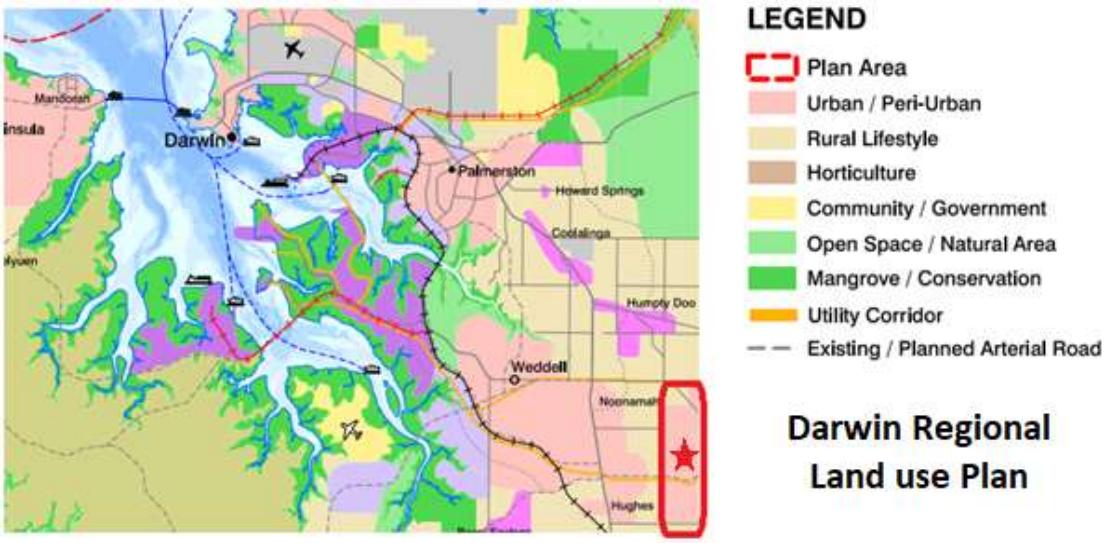

Figure 4: *Lloyd Creek Rural Village Area Plan site - DRLUP*

Litchfield Subregional Land Use Plan 2016

The Litchfield Subregional Land Use Plan 2016 provides statements of policy specific to the Litchfield subregion and land use concept plans to guide the future preparation of area plans for the rural activity centers. The Litchfield Subregional Land Use Plan 2016 identifies the Lloyd Creek locality and site as a future development area dissected by a future utilities and transport corridor.

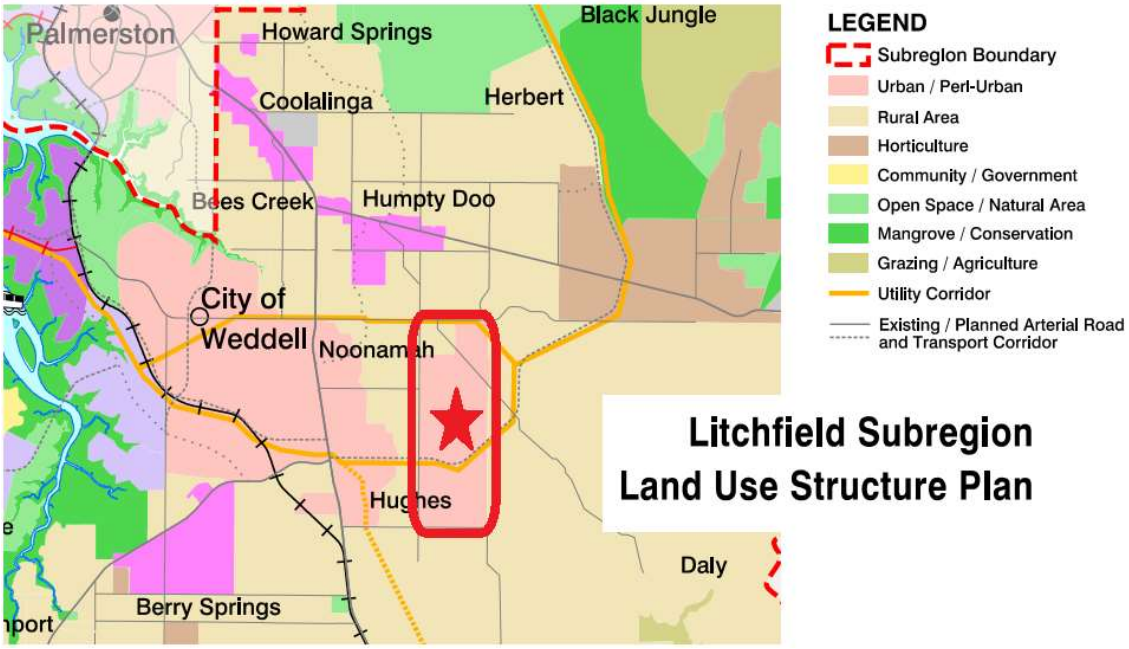

Figure 5: *Lloyd Creek Rural Village Area Plan site – Litchfield Sub region Land use plan*

3.2 Supporting Strategic Documents

NT Infrastructure Plan and Pipeline 2022

The NTG NT Infrastructure Plan and Pipeline 2022 provides a detailed roadmap to the investments that will enact the Government's vision of a sustainable and diverse $40 billion economy by 2030. The focus is on a place-based approach, which was strongly supported through consultation feedback. The Plan and pipeline identifies projects, programs and proposals that will address challenges and capture opportunities in each of the regions throughout the Territory from a nationally significant perspective, The *"Lloyd Creek - master planned rural residential community*" is identified (page 138) as a key proposal to enable economic development and population growth by increasing land availability.

4. Structure of the Area Plan

The locality plan below shows the Lloyd Creek Rural Village in the context of broader infrastructure and transport links of the surrounding area.

The **vision statement** captures the aspirations for the Lloyd Creek Rural Village and provides context to the planning principles.

The planning principles throughout this draft Area Plan provide an overarching statement of policy, including context and background to that statement.

Each planning principle is supported by a set of objectives and acceptable responses that provide more detailed information and guidance summarised below:

- **Planning Principles** provide policy to guide development and are supported by an introduction to set the context of each principle. Planning Principles must be addressed when developing land that is subject to an Area Plan.

- **Objectives** are the performance based outcomes sought by a Planning Principle, often given in relation to a specific element or area identified in the Plan. Development proposals must demonstrate how the proposal will meet each Objective.

- **Acceptable Responses/Solutions** identify potential standards which demonstrate how each Objective may be met. A departure from the acceptable responses/solutions can be considered where an alternate solution that achieves the Objective is provided; and the alternative solution demonstrates an equal, improved or best practice response to that set out by the acceptable response.

5. Vision Statement

The Lloyd Creek Rural Village will be established as a sustainable rural community that reflects the rural setting through development of appropriate scale and character to achieve rural amenity outcomes for residents.

The Rural Activity Centres within the rural village will develop as rural centres to provide community, commercial and residential facilities at a scale similar to other small scale rural activity centres in the rural area.

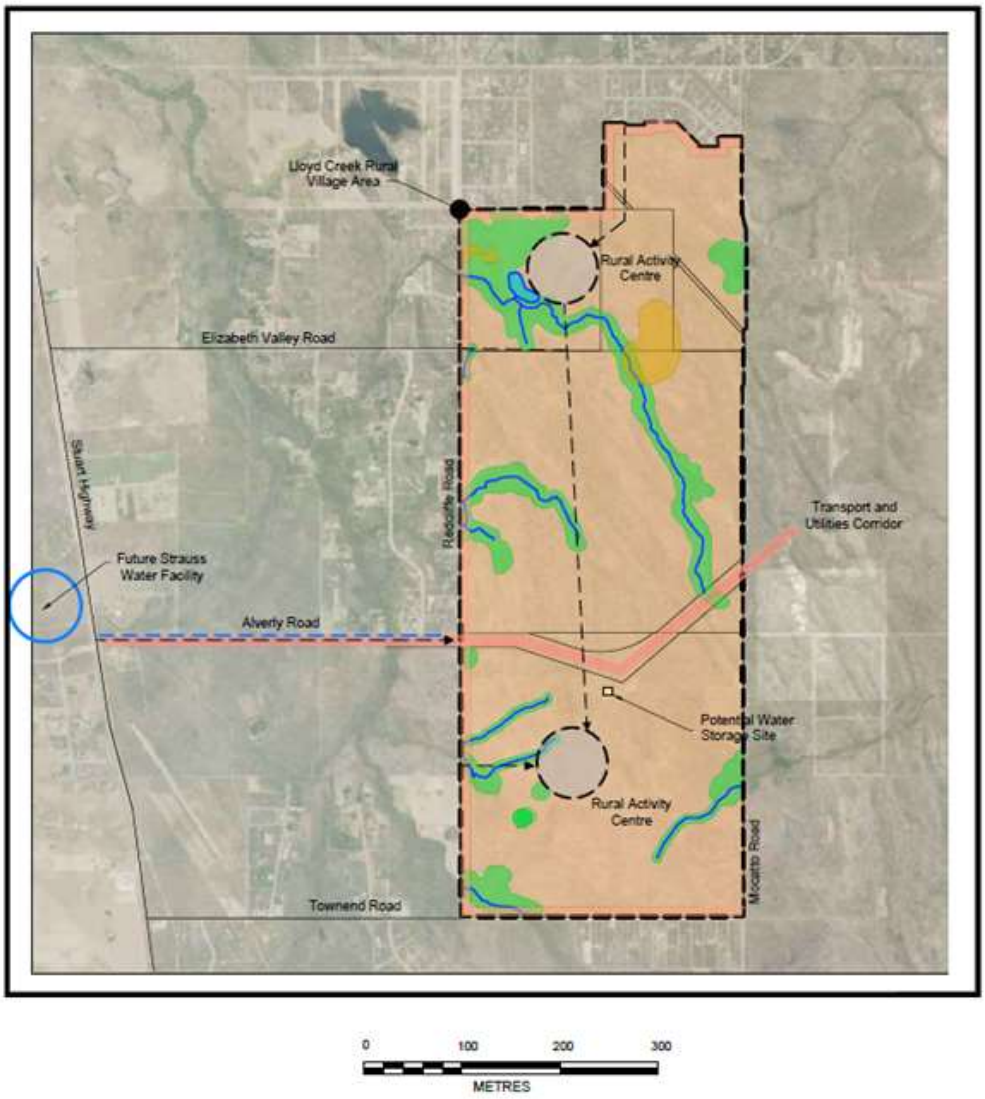

Figure 6: *Lloyd Creek Rural Village Area Plan Concept*

6. Planning Principles for Lloyd Creek Rural Village

The Natural Environment

1. Minimise detrimental impacts of development on the natural environment

The landscape and natural environment contribute to the amenity and rural character of the Rural Village. Development must have regard for the natural environment by retaining native vegetation, maintaining habitat for native wildlife, and protecting natural drainage systems where possible.

Objectives	Acceptable Land Use and Development Response
1.1 Minimise and manage stormwater impacts on the receiving natural environment	i. Stormwater drainage systems comply with the requirements of the relevant government agencies. ii. Pollutants or nutrients in stormwater and associated weed growth is managed to comply with the requirements of the relevant government agencies. iii. Site-based stormwater management plans are prepared to assess the proposed development with relation to both stormwater quantity and quality and in accordance with the requirements of the NT Subdivision Guidelines and relevant government agencies. iv. Any detention basin/s on site are to be modelled in accordance with NT Subdivision Guidelines and be provided with suitable outlet arrangements that throttle flows back to predevelopment flows to preserve natural systems and processes.
1.2 Ensure development within environmental investigation area does not compromise the environmental values of the area	i. Development proposals within the identified environmental investigations areas (see area plan) must present outcomes of further investigations and demonstrate suitable responses to environment considerations are made for any development in these areas.
1.3 Where possible, development is to follow the natural contours of the land to minimise the extent of significant cut and fill across the site.	i. An earthworks design shall be developed wholistically for the Lloyd Creek Rural Village as part of the masterplan and initial stage and shall be refined during the detailed design of each stage of the development. ii. The earthworks design shall be developed in accordance with the Northern Territory Subdivision Development Guidelines.

Rural Village Development

2. Provide for Rural housing choice compatible with rural village character and amenity

Lloyd Creek Rural Village will respond to the rural lifestyle and living needs of future residents and the nature of the existing rural locality.

Objectives	Acceptable Land Use and Development Response
2.1 Provide for a variety of residential lot sizes within a suitable rural density cap to support a variety of housing choices.	i. Providing for a range of Rural Village living options across a range of lot sizes between 1,000m^2-20,000m^2 via suite of Rural Village Zones. ii. Development will not exceed a gross density of 1.5 Dwellings per hectare within Rural Village area.
2.2 Development respond to the surrounding existing rural locality and promote a sequence of Rural Village lot sizes.	i. Development responds to the surrounding existing rural locality (external to the site) by ensuring that where development occurs bordering the area plan boundary, initial adjacent lots on the initial Lloyd Creek Rural village site are to be no less than existing lots opposite or adjacent to the site. ii. Development provides a transition of lot sizes within the site to locate smaller lots in proximity to Rural activity centers and transition to larger lots further from activity centers.
2.3 Ensure development is sustainably sequenced across the development lifespan	i. Development is to demonstrate the greater sites development sequencing across the 30 year development lifespan and how development proposals will be serviced by essential infrastructure (where relevant)

Rural Activity Centre Development

3. Provide for successful and diverse rural activity centres to meet the needs and aspirations of the community

The Lloyd Creek Rural Activity centres will provide a range of commercial, community and recreational opportunities for local residents and visitors to the area. Residential development is contained within the rural activity centres and considers suitable transition for residential lot sizes for the Lloyd Creek rural activity centres.

The Area Plan seeks to support the establishment of the rural activity and the needs of rural residents and visitors. Development is encouraged through landscaping and built form to contribute to the rural amenity and natural environments of the Lloyd Creek locality.

Objectives	**Acceptable Land Use and Development Response**
3.1 Ensure a master planned and coordinated approach to development occurs within the activity centres	i. Development within the rural activity centres is supported with the provision of an activity centre master plan and staging plan to determine the ultimate development intent for the activity centre which considers all objectives (3.)
3.2 Promote and enhance rural amenity within the Lloyd Creek Rural Activity centres	ii. Built form, with the exception of utilities and other essential infrastructure, is restricted to two stories or a height generally not exceeding 8.5m within the Rural Activity Centre. iii. Development along main thoroughfares of the Rural Activity Centre provides a visually appealing environment that is sympathetic to the wet-dry tropics climate, natural environment, and rural character
3.3 Provide for a variety of residential lot sizes to support a variety of housing choices.	i. Residential development within the activity centres is located in residential areas as shown in this Area Plan, with Zone LMR (Low to Medium Density Residential) the highest permitted urban residential density, restricted to within 400 m walking distance of Zone C (Commercial). ii. A maximum density of 10 Dwellings per hectare within Rural Activity Centers
3.4 Facilitate the activation of public spaces.	iii. Urban residential subdivision provides public open space in accordance with the NT Planning Scheme.
3.4 Promote a sequence of residential density in the rural activity centre by providing a transition of residential lot sizes	iv. A transition of residential density is achieved by subdivision design that locates Zone LR (Low Density Residential) lots within the activity centre, of no less than 800 m² next too and adjacent to those areas outside of the Rural Activity Centre as is practicable
4.4 Facilitate retirement living.	i. Subdivision and development for the purpose of retirement living is encouraged within and adjacent to the Rural activity centres identified by the Land Use Structure Plan at Figure 2. ii. Retirement living is encouraged within 600 m distance of Zone C (Commercial) and community facilities.

Infrastructure Servicing and Transport

4. Provide suitable infrastructure services to meet demand and facilitate future development of the Lloyd Creek Rural Village

Servicing technology improvements, contemporary policy updates and new infrastructure projects in the greater rural area provide Lloyd Creek an opportunity to be serviced in a sustainable manner. The establishment of the nearby Strauss Water treatment facility on the Stuart highway provides a potential point of connection to supply the Lloyd Creek Rural Village with potable water. Improved environment sensitive technology and policy updates relating to waste water treatment present the opportunity for best practice waste water treatment to occur on site for the rural development.

The Darwin Regional Land Use Plan, Litchfield Subregional Land Use Plan, existing zoning and proposed area plans identify a utility and transport corridor that dissects the site. This corridor provides both a servicing corridor (reticulate water etc) and future road connectivity point for the development.

Objectives	**Acceptable Land Use and Development Response**
4.1 Provide and/or demonstrate essential infrastructure can be provided to minimize adverse impacts on groundwater systems.	i. Water is provided to all lots for domestic/residential (potable) purposes within the development via the following means: a. Reticulated water infrastructure for domestic/residential purposes is provided to lots within the Rural Village and Rural Activity Centre Areas; OR b. Onsite water storage is provided for domestic/residential purposes is provided to lots within the Rural Village where supported by statutory requirements; and c. Reticulated water infrastructure for domestic/residential purposes is provided to all lots within the Rural Activity Centre Areas; ii. Suitable on site wastewater management for Rural village lots must be demonstrated by a site and soil evaluation report completed by an appropriately qualified site-and-soil evaluator demonstrating that onsite wastewater management systems can be installed on each lot in accordance with the requirements of the Code of Practice for Wastewater Management. iii. Wastewater treatment within the Rural Activity Centres is to be provided to the satisfaction of Power Water/ or relevant authority/agency.

4.2 Local road connections, utilities and trunk infrastructure are provided sequentially to facilitate development.	i. Land is developed in accordance with the Area Plan when and where required infrastructure is provided to enable development. ii. Provide for access intersections where required to the satisfaction of the relevant authorities. iii. Infrastructure for roads, utilities and trunk services is incorporated into the engineering design for development and demonstrates consideration for the sequential and successive development of adjoining lots. iv. Connect local roads to the arterial network in accordance with the strategic framework indicated in the Area Plan , infrastructure plan supporting document and provide viable access for public transport;

Social Infrastructure

5. Support social infrastructure that meets the needs and aspirations of the community

Development within Lloyd Creek Rural Village is to provide community facilities to meet the needs of the future population.

Servicing technology improvements, contemporary policy updates and new infrastructure projects in the greater rural area provide Lloyd Creek an opportunity to be serviced in a sustainable manner. The establishment of the nearby Strauss Water treatment facility on the Stuart highway provides a potential point of connection to supply the Lloyd Creek Rural Village with potable water.

Improved environment sensitive technology and policy updates relating to waste water treatment present the opportunity for best practice waste water treatment to occur on site for the rural development.

The Darwin Regional Land Use Plan, Litchfield Subregional Land Use Plan, existing zoning and proposed area plans identify a utility and transport corridor that dissects the site. This corridor provides both a servicing corridor (reticulate water etc) and future road connectivity point for the development.

Objectives	**Acceptable Land Use and Development Response**
5.1 Provide and preserve land for social infrastructure.	i. Prior to the development of a Rural Activity centre the developer is required to identify and allocate a suitable area of land for Community Facilities (schools, multi use sports and recreation areas) to the satisfaction of the community and Local Government. The Community facilities site/s is to: a. Locate community facilities in appropriate locations to provide convenient access via public transport, pedestrian and cycle corridors; b. establishing community facilities sites to allow co-location and integration of education, community uses and active recreation facilities; and
5.2 Provide for formal and informal active recreation (i.e. organised sport and non-prescriptive open space).	i. Urban residential subdivision is consistent with the requirements of the NT Planning Scheme and NT Subdivision Development Guidelines for the provision of useable public open space, footpaths and bicycle paths.

Appendix C
Groundwater Headworks Option report by Byrne Consultants

GROUNDWATER HEADWORKS OPTION

NOONAMAH RIDGE

REPORT NO. 19074_R001_RevA

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NT 0820

REV	DESCRIPTION	AUTHOR	REVIEWER	BC APPROVAL	DATE
A	Issued for comment	GB	GM	GB	14/05/2020

DISCLAIMER

This report has been prepared on behalf of and for the exclusive use of INTRAPAC, and is subject to and issued in accordance with the agreement between INTRAPAC and Byrne Consultants. Byrne Consultants accepts no liability or responsibility whatsoever for this report in respect of any use of or reliance upon this report by any third party.

Contents

1. EXECUTIVE SUMMARY

Intrapac proposes to develop a 2,641 ha subdivision known as Noonamah Ridge Estate. Noonamah Ridge is located in the Lloyd Creek area of the Greater Darwin region, approximately 36 km south east of Darwin CBD. Intrapac's vision for Noonamah Ridge is to provide a high quality, predominantly rural residential and lifestyle estate, with a range of lot sizes and an emphasis on retaining the rural character and amenity of the area. The project will be built over a period of 30 years and provide up to 4,200 rural and lifestyle lots, a new local town centre and associated services and infrastructure.

There is no water infrastructure within the project area. Existing allotments in the vicinity of the site are serviced with on-lot groundwater bores. Intrapac proposes to provide a public potable water supply to Noonamah Ridge by extracting water from groundwater resources in the vicinity of the development. To do this, Intrapac will require a water supply licence. A water supply licence will generally require a licencee to provide potable water with infrastructure design and capacity in accordance with Power and Water Corporation (PWC) design guidelines.

Intrapac has engaged Byrne Consultants to investigate the costs associated with supplying the Noonamah Ridge development from surrounding ground water resources and to estimate an indicative cost of the water supply headworks.

Based on planning guidelines, the ultimate, total Noonamah Ridge residential water demand is estimated as:

- Peak hour 611 L/s
- Peak day 27.8 ML/day

It is proposed that the 1,246 larger rural lots which are 2 ha or larger are serviced by on-lot bores and will be not connected to the proposed reticulated water supply. This reduces the reticulated residential water supply demand to around:

- Peak hour 232 L/s
- Peak day 10.6 ML/day

Based on planning guidelines, the Noonamah Ridge non-residential water demand is estimated as:

- Peak hour 112 L/s
- Peak day 8.3 ML/day

The estimated annual water demand was calculated as:

- Total ultimate development 10,600 ML
- Residential 3,088 ML
- Non-residential 2,471 ML
- Rural larger lots 5,030 ML
- Residential + Non-residential 5,559 ML

Available groundwater for extraction assumed a water harvest depth of 40 mm per annum. The required borefield catchment area to provide the annual water demand is:

Demand Component	Annual Demand (ML)	Catchment Area (ha)
Total ultimate	10,600	26,500
Reticulated supply	5,559	14,000
Rural lots (planning rate 0.16 L/s)	5,030	12,500
Rural lots (reduced rate 3.5 EP)	1,400	3,500

A potable water supply headworks schematic was developed to consider key water headworks components which included:

- 30 x bores assuming production bores sustainably produce 10 L/s
- 10 ML borefield ground level reservoir
- Raw water transfer pumps
- DN500 raw water rising main from borefield to treatment plant
- Water treatment plant
- 2 x 10 ML potable water ground level reservoir
- Potable water pressure booster pumps
- DN600 potable water trunk main
- HV and LV electrical supply
- 1,246 on-lot bores

Key water headworks components were considered and costs of supplying and installing the headworks were estimated based on indicative industry costs. No allowance was made in the costs for water reticulation within the subdivision. No contingency amount was included. The order of cost is expected to be ± 50%.

A cost estimate of key water headworks components indicates the overall cost of providing potable water to Noonamah Ridge is in the order of $83.7M. This overall cost is comprised of:

- Borefield development $10.4M
- Raw water transfer $ 8.9M
- Potable water $12.7M
- Private bores to rural lots $51.7M

2. INTRODUCTION

2.1. Site Location

The proposed Noonamah Ridge subdivision is located in the Lloyd Creek area of the Greater Darwin region, approximately 36km south east of Darwin CBD and 23km south east of Palmerston CBD. The Humpty Doo Local Town Centre is located approximately 7km to the north west of the site. The Noonamah Tavern and service station are located 6km directly to the West on Stuart Highway. The location is shown below in Figure 1.

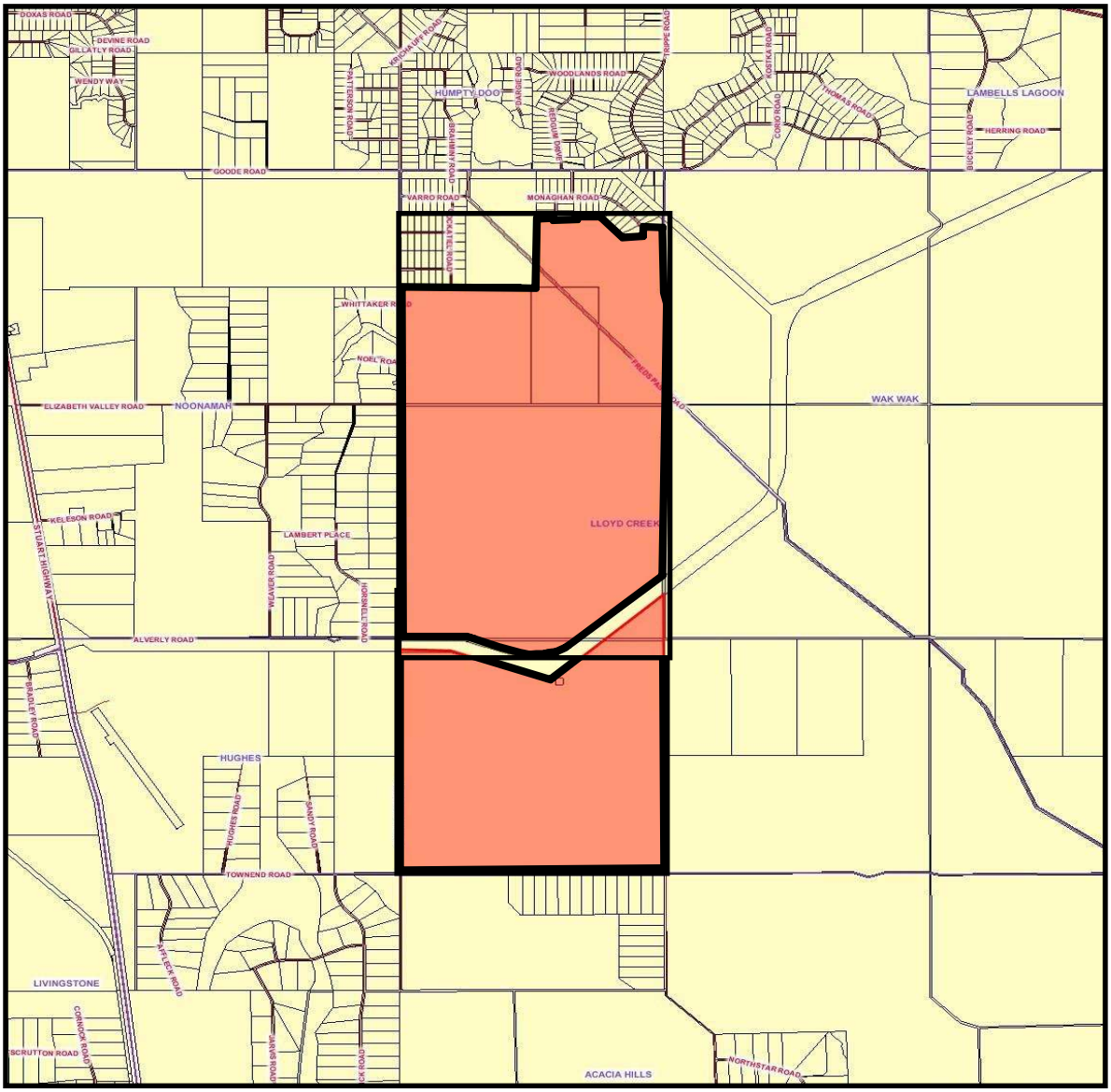


Figure 1: Site Locality ***Source: NT Atlas and Spatial Data Directory***

The development proposal covers approximately 2,461 ha in four land parcels as shown in Table 2.1.

Table 2.1: Property Details

Registered Description	Section 5827 Hundred of Strangways	Section 507 Hundred of Strangways	Section 5758 Hundred of Strangways	Section 5761 Hundred of Strangways
Address	Monaghan Road, Lloyd Creek, NT	800 Freds Pass Road, Lloyd Creek, NT	905 Redcliffe Road, Lloyd Creek, NT	580 Alverly Road, Lloyd Creek, NT
Area	523.1 hectares	129.5 hectares	1008 hectares	980.8 hectares
Current Zone	Zone RL	Zone RL	Zone RL Zone R	Zone RL Zone R

2.2. Proposed Development

The Noonamah Ridge development is proposed to include:

- Two rural activity centres.
- Single Residential lots within the rural activity centre of 800m² to 3,999m².
- Multiple Dwelling lots within the rural activity centre to a maximum size of 1,200m². These will accommodate duplex, single dwellings and aged care development.
- Rural Residential lots between 4,000m² and 1.99ha.
- Rural Living lots between 2ha and 7.99ha.
- Rural lots of 8ha and above.
- A maximum of 4,200 residential lots with an average lot size of 1.5ha across the site area.
- Approximately 875ha of natural area (33% of site area), including 500ha of open space (18% of the site).

2.3. Proposed Water Supply

There is no existing water infrastructure in the area and Intrapac proposes to provide a public potable water supply to Noonamah Ridge by extracting water from groundwater resources in the vicinity of the development. Water supply infrastructure will be in accordance with PWC guidelines, standards and specifications.

3. GROUND WATER

3.1. Water Control District

Noonamah Ridge (indicative red area) is located within the Darwin Rural Water Control District as shown in Figure 1 and Attachment A.

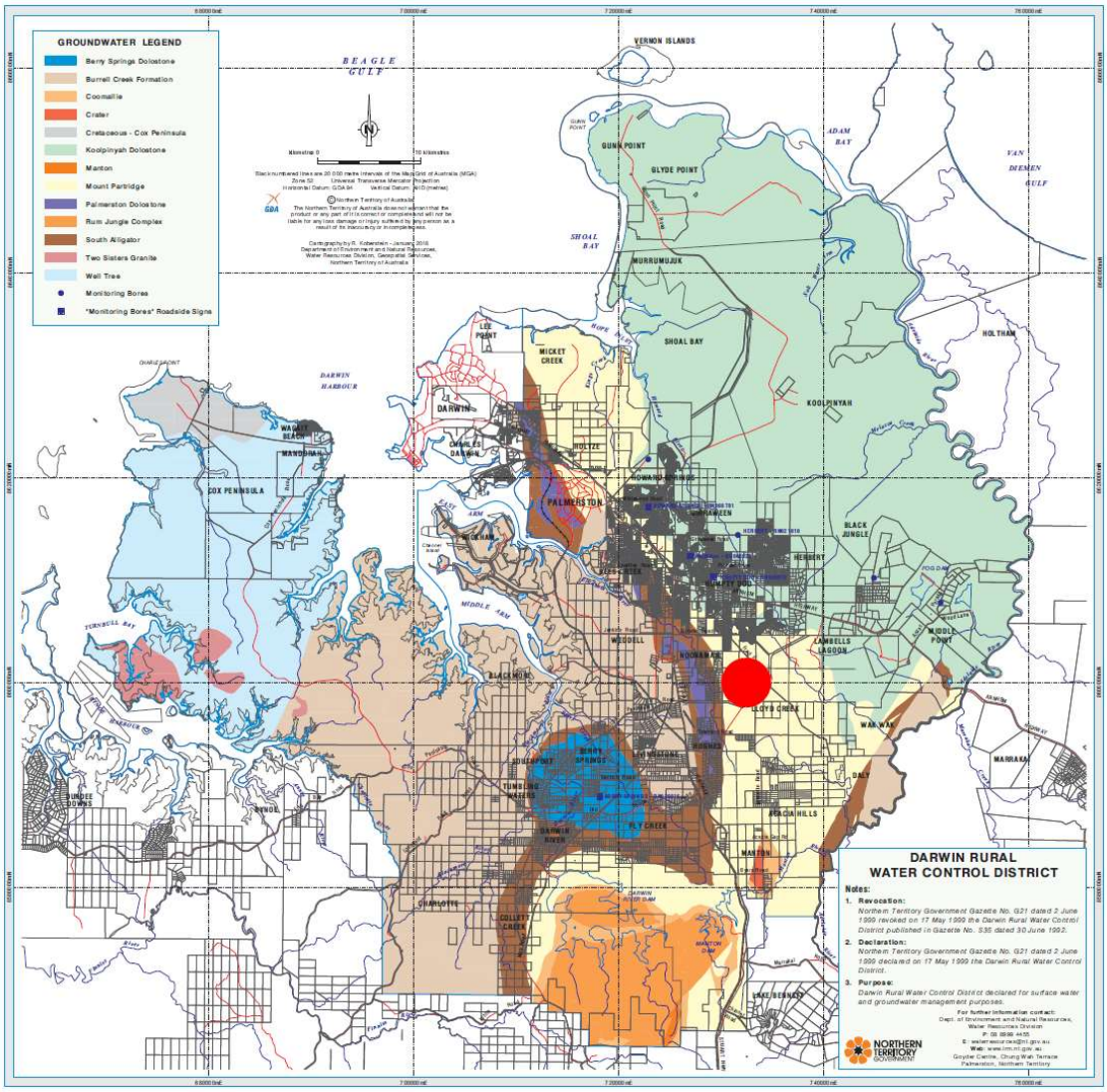


Figure 1: Darwin Rural Water Control District. *Source DENR.*

3.2. Darwin Rural Water Control District Groundwater Aquifers

As shown in Figure 1, Noonamah Ridge is generally located over the Mount Partridge aquifer with the South Alligator aquifer located to the west and the Koolpinyah dolostone located to the east.

The Noonamah Ridge Groundwater Report (Fell-Smith and Woodgate 2015) noted:

> *The prospects for groundwater production on NRE are overall similar to the surrounding areas to the north and east, apart from the high-yielding aquifers adjacent to the Noonamah Fault Zone. Most (if not all) aquifers on NRE would be limited in lateral and vertical extent. Nonetheless, seasonal recharge would enable a sustainable extraction. The north-eastern sector of NRE appears to be the least prospective, although small yields could probably be obtained on sites of lower*

elevation or where geological lineaments are visible.

The Koolpinyah Dolostone aquifer, which is located 20-30 km east and north of NRE has better prospects in areas where karstic development has occurred. The Koolpinyah, however is thought to be 'over-extracted' (Des Yinfoo, pers. comm.) and may not be available as a groundwater source for NRE.

3.3. Water Allocation Plans

The *Northern Territory Water Act*, allows for water resource management through Water Allocation Plans which cover specific regions within designated Water Control Districts. A Water Allocation Plan has been developed for Berry Springs (Figure 2) while the Howard Water Allocation Plan is under development (Figure 3). As shown in Figure 2 and Figure 3, Noonamah Ridge is located outside both the Berry Springs and Howard Water Allocation Plan areas.

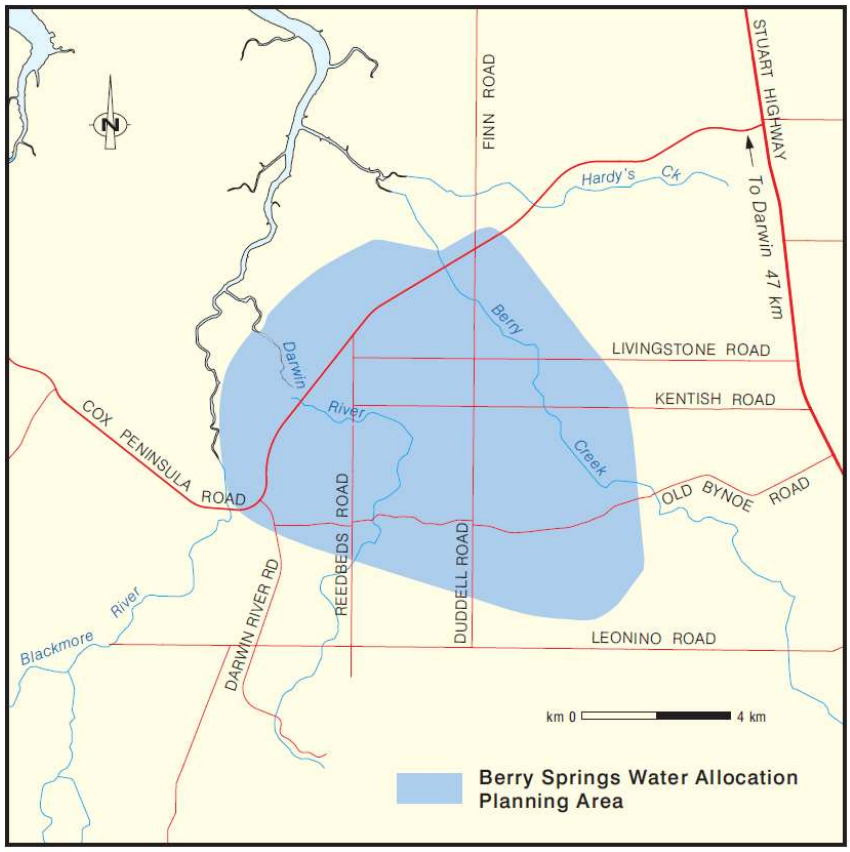


Figure 2: Berry Springs Water Allocation Plan Area. *Source DENR*

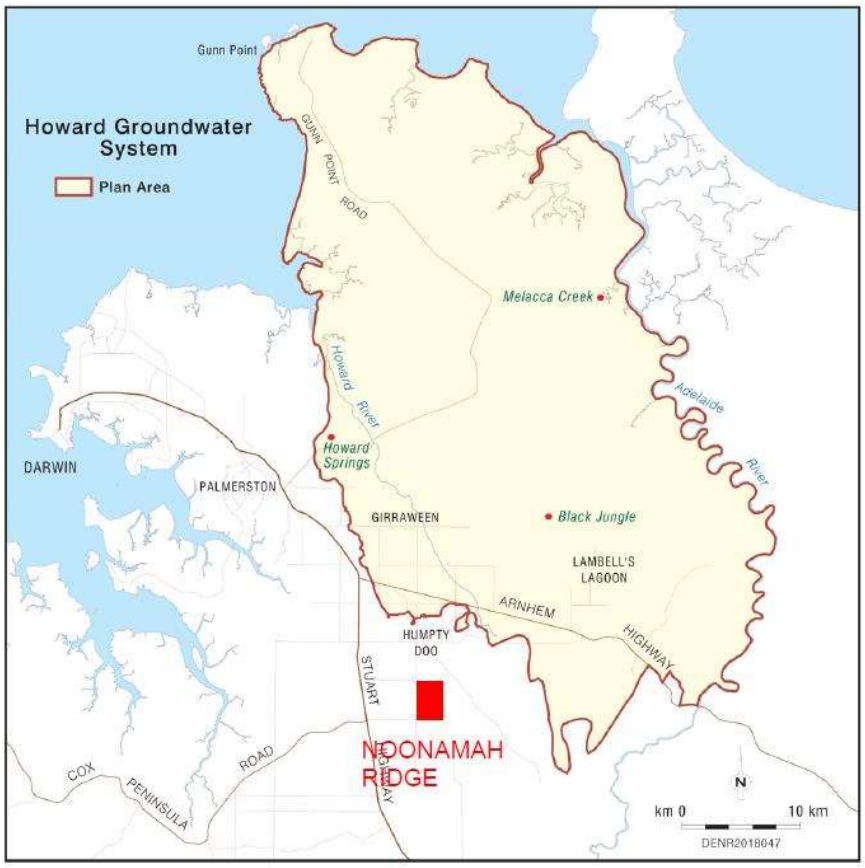


Figure 3: Proximity of Noonamah Ridge to the Howard Groundwater Plan Area.

4. LEGISLATIVE BASIS

4.1. Key Legislation

Intrapac proposes to provide a public water supply to Noonamah Ridge as a licenced water provider. Water is to be extracted from local groundwater resources. Key relevant water legislation is shown in Table 4.1.

Table 4.1: Key legislation and area of interest

Legislation	Area of Interest
Water Act	• Water allocation • Drilling licence • Bore construction permit • Water extraction licence

Water supply and Sewerage Services Act	• Declaration of water supply licence area
	• Obligations of water service provider
	  ○ Asset management plan
	  ○ Water quality
	  ○ Customer contract
	  ○ Metering code
	• Power of entry
	• Minimum standards of service
	• Pricing order for water supply

Public Health Act	• Provision of water
Planning Act	• Clearing of native vegetation
National Measurement Act	• Requirements for metering
Utilities Commission Act	• Regulation of water prices • Licencing functions

4.2. Water Extraction Licence

A water extraction licence is required to take or use water using a bore or river pump system. Water licences are not attached to land, although the licence states what property the water is to be used on.

A groundwater extraction licence is usually granted for 10 years, but longer term licences can be approved in special circumstances.

Supporting information for a new licence includes:

- a map with the location of existing or proposed bores
- the location where the water is to be used
- the method and route of moving the water
- the lands in the immediate area - this includes lot, portion, section, lease numbers and boundaries
- a property development plan

4.3. Water Extraction Licence Criteria

An application for a water extraction licence is assessed using all of the following criteria:

- availability of water in the area
- existing water licence entitlements
- water allocation plan rules
- potential effects of water extraction and the condition of the water resource
- development and land use in the area

5. DESIGN BASIS

5.1. General

A water supply licence will generally require a licencee to provide potable water with infrastructure design and capacity I accordance with Power and Water Corporation (PWC) design guidelines. PWC design guidelines are based on the Water Services Association Australia WSA 03-2011 Water Supply Code of Australia and the Queensland Planning Guidelines for Water Supply and Sewerage. PWC publish Northern Territory Supplements to the WSAA Water Supply Code and the Qld Guidelines.

5.2. Sizing of Water Supply System Components

Noonamah Ridge water supply system component sizing based on the Northern Territory Supplement to the Queensland Planning Guidelines for Water Supply and Sewerage (Attachment B) requirements are shown in Table 5.2.

Table 5.2: Noonamah Ridge water supply system component sizing

Component	Sizing	Comment
Groundwater	Safe yield for population serviced within the planning horizon	• Up to 6 bores (n-1) • 7-12 bores (n-2)
Bore pumps	Long term safe yield	• Pump rate < recommended maximum
Raw water pumps	1.5 x ultimate MDMM	• Staged install permitted • Pipework designed for ultimate flow • Pump run time < 16h/day • Up to 4 pumps all pumps 100% duty • Up to 6 pumps (n-2)
Raw water mains	1.5 x ultimate MDMM	• Max velocity 1.4 m/s
Treatment plant	1.5 x ultimate MDMM	• No raw water storage at treatment plant
Transfer pumps to ground level reservoir	1.5 x ultimate MDMM	• Staged install permitted • Pipework designed for ultimate flow • Pump run time < 16h/day • Up to 4 pumps all pumps 100% duty • Up to 6 pumps (n-2)
Single reservoir in zone ground level on hill	1 x ultimate PD	• Major centre peak day for end of reservoir life • Minimum life 50 years
Trunk reticulation	Greater of fire flow or ultimate PH	• Max velocity 1.4 m/s
Reticulation booster pump	Ultimate PH + fire flow	• Pipework designed for ultimate flow • Pump (n-1) • Variable speed drives preferred
MDMM	Mean day maximum month demand * *assumed as 80% PD for concept*	
PD	Peak day demand	
PH	Peak hour demand	

5.3. Water Demand Planning

Noonamah Ridge water supply system component sizing based on the Northern Territory Supplement to the Water Services Association Australia WSA 03-2011 Water Supply Code of Australia (Attachment C). Selected demand planning values are shown for expected activities in Table 5.3.

Table 5.3: Rural water demand - planning

Parameter	Allowance
Nominal peak day flow	1100 L/EP/day (0.0127 L/s)
Single dwelling	3.5 EP
Multiple dwelling	2.2 EP
Rural lot < 2 ha	3.5 EP
Rural lot 2 ha	0.16 L/s/lot
Rural lot 8 ha	0.16 L/s/lot
Retail, office, shopping centre	20 EP/gross ha 60% non-synchronous flow
Commercial, etc	35 EP/gross ha 60% non-synchronous flow
School	45 EP/gross ha 60% non-synchronous flow
Parks, open space	80 EP/gross ha 60% non-synchronous flow

5.4. Noonamah Ridge Lot Yield

Noonamah Ridge is expected to yield a total of up to 4200 lots including a number of multiple dwelling lots and lots ranging in size from single dwelling lots of 800 m2 to rural living lots of approximately 8 ha. The indicative lot yield is shown in Table 5.4.

Table 5.4: Indicative lot yield

Land use	Lot Yield (No)
Single dwelling	2493
Multiple dwelling	415
Rural lot	1246

6. ESTIMATED WATER DEMAND

6.1. Residential Demand

The ultimate Noonamah Ridge residential water demand is estimated as approximately 611 L/s (peak hour) and 27.8 ML/day (peak day) as shown in Table 6.1. Residential demand peak hour flow rate drops to around 232 L/s and peak day demand to around 10.6 ML/day without the 1246 larger (2 ha+) rural lots.

Table 6.1: Ultimate residential water demand

Land Use	Lot	Allowance	Total EP	Flow rate	PD Flowrate	PH Flowrate	PD Volume
	(No)	(EP)	(No)	(L/s/unit)	(L/s)	(L/s)	(ML)
Single dwelling	2493	3.5	8726	0.0127	110.8	210.5	9.6
Multiple dwelling	415	2.2	913	0.0127	11.6	22.0	1.0
Rural lot	1246			0.16	199.4	378.8	17.2
Total			**9,639**		**322**	**611.4***	**27.8**

**Fire flow allowance 25 L/s, peak hour flowrate dominates*

6.2. Non-residential Demand

The ultimate Noonamah Ridge residential water demand is estimated as approximately 112 L/s (peak hour) and 8.5 ML/day (peak day) as shown in Table 6.2.

Table 6.2: Ultimate non-residential water demand

Land Use	Area	Allowance	Total EP	Flow rate	PD Flowrate	PH Flowrate	PD Volume
	(ha)	(EP)	(No)	(L/s/unit)	(L/s)	(L/s)	(ML)
Shopping	8	20	160	0.0127	2.0	2.3	0.2
Commercial	193	35	6755	0.0127	85.8	97.8	7.4
School	3.5	45	158	0.0127	2.0	2.3	0.2
Parks	8	80	640	0.0127	8.1	9.3	0.7
			7,713			**111.7***	**8.5**

**Fire flow allowance 45 L/s, fire flowrate dominates, adopted PH flowrate 120 L/s*

6.3. Total Water Demand

The ultimate Noonamah Ridge total PH water demand (residential + non-residential) was estimated as 731 L/s, while peak day volume was estimated as approximately 36.3 ML.

Total peak hour flow rate drops to around 352 L/s and peak day demand to around 19 ML/day without the 1246 larger (2 ha+) rural lots.

Table 6.3: Water demand - Noonamah Ridge - ultimate development

Land Use	Unit	PD Flowrate	PH Flowrate	PD Volume	MDMM Volume	MDMM Annual Volume
		(L/s)	(L/s)	(ML)	(ML)	(ML)
Single dwelling	2493 lots	110.8	210.5	9.6	7.7	2,795.7
Multiple dwelling	415 lots	11.6	22.0	1.0	0.8	292.5
Rural lot	1246 lots	199.4	378.8	17.2	13.8	5,029.6
Sub-total		321.8	611.4	27.8	22.2	8,117.8
Shopping	8 ha	2.0	2.3	0.2	0.1	51.3
Commercial	193 ha	85.8	97.8	7.4	5.9	2,164.3
School	3.5 ha	2.0	2.3	0.2	0.1	50.5
Parks	8 ha	8.1	9.3	0.7	0.6	205.1
Sub-total		95.9	109.3	8.3	6.6	2,471.1
Total		**417.7**	**720.7**	**36.1**	**28.9**	**10,589.0**

Table 6.4: Water demand - Noonamah Ridge – excluding rural lots

Land Use	Unit	PD Flowrate	PH Flowrate	PD Volume	MDMM Volume	MDMM Annual Volume
		(L/s)	(L/s)	(ML)	(ML)	(ML)
Single dwelling	2493 lots	110.8	210.5	9.6	7.7	2,795.7
Multiple dwelling	415 lots	11.6	22.0	1.0	0.8	292.5
Rural lot	0	0.0	0.0	0.0	0.0	0.0
Sub-total		122.4	232.6	10.6	8.5	3,088.2
Shopping	8 ha	2.0	2.3	0.2	0.1	51.3
Commercial	193 ha	85.8	97.8	7.4	5.9	2,164.3
School	3.5 ha	2.0	2.3	0.2	0.1	50.5
Parks	8 ha	8.1	9.3	0.7	0.6	205.1
Sub-total		95.9	109.3	8.3	6.6	2,471.1
Total		**218.3**	**341.9**	**18.9**	**15.1**	**5,559.4**

Table 6.5: Water demand - Noonamah Ridge – large rural lots

Land Use	Unit	PD Flowrate	PH Flowrate	PD Volume	MDMM Volume	MDMM Annual Volume
		(L/s)	(L/s)	(ML)	(ML)	(ML)
Rural lot	1246 lots	199.4	378.8	17.2	13.8	5,029.6
Rural lot (3.5EP)	1246 lots	55.4	105.2	4.8	3.8	1,397.3

7. BOREFIELD YIELD

7.1. Estimated extraction level

Cook (*Cook et al* 1998) undertook an Hydrological Investigation at Howard East NT and estimated the mean annual groundwater recharge rate as approximately 200 mm / year with the groundwater surplus estimated as 20 mm / year noting that error analysis:

> *… suggests that the groundwater surplus may be as small as zero or as large*
>
> *as 140 mm.*

Fell-Smith and Woodgate reported (2015) that:

> *Water resource regulators estimate that recharge rate in this region is in the vicinity of 200 mm/annum (based on standard recharge estimation techniques). Current regulation requires that 80 % of this is apportioned to the environment (to maintain stream and spring flows, and protect groundwater dependent ecosystems). That leaves 20 % for consumptive use. Thus, sustainable use is considered to be the 20% of estimated annual recharge, that is, 40 mm/annum.*

For the purpose of this report, estimated groundwater extraction levels have assumed that 40 mm/year is available for extraction.

The Noonamah Ridge development is comprised of 4 land parcels totalling an area of 2,641 hectares. If 40 mm / year is available to extract, then the indicative annual extraction volume is approximately 1,056 ML or just over 1 GL as shown in Table 7.1.

Table 7.1: Groundwater yield - Noonamah Ridge area - 40 mm per year

Section	Area	Extraction Depth	Annual Extraction	Annual Extraction
	(ha)	(mm/y)	(m3/y)	(ML/y)
5827	523.1	40	209,240	209.2
507	129.5	40	51,800	51.8
5758	1008	40	403,200	403.2
5761	980.8	40	392,320	392.3
Total	**2641.4**	**40**	**1,056,560**	**1,056.6**

7.2. Indicative Borefield Catchment Area

PWC Planning Guidelines indicate that Noonamah Ridge requires approximately 10,589 ML of water per year. Based on an available extraction depth of 40 mm the total borefield catchment area contributing to production bores would be required to be approximately 26,000 ha or 260 km^2, while the Noonamah Ridge area is 2,641 ha.

Table 7.2: Required borefield catchment area to provide annual water demand

Demand Component	Annual Demand (ML)	Catchment Area (ha)
Total ultimate	10,600	26,500
Reticulated supply	5,600	14,000
Rural lots (planning rate 0.16 L/s)	5,030	12,500
Rural lots (reduced rate 3.5 EP)	1,400	3,500

7.3. Surrounding Bore Yields

Bore reports for all registered bores in the area surrounding Noonamah Ridge are available from the DENR database and can be accessed on-line through *Know Your Bore 2019*. Indicated bore yields range from around 0.5 L/s (RN033374) to 7.0 L/s (RN038935). Exploration bores drilled as part of investigations on Noonamah Ridge Estate by Fell-Smith and Woodgate, found aquifers were variable in yield (0.5 -15 L/s) and limited in extent, forming localised aquifers which may extend offsite in some locations.

For the purpose of this report, sustainable bore production has been assumed as 10 L/s.

7.4. Proposed Groundwater Sources

Exploratory bore drilling at Noonamah Ridge Estate indicates there is a viable but limited supply of ground water under the Estate area. It is proposed that the 1,246 rural living lots would develop private bores to supply water to each lot as is common throughout the rural area. The rural activity centre, multiple dwellings and all single dwelling residential lots < 2 ha will be connected to a mains water supply.

For the purpose of this report, it has been assumed that the potable mains water supply will be drawn from the Koolpinyah aquifer and that sufficient groundwater is available approximately 5 km east of the Noonamah Ridge potable water reservoir.

8. WATER SUPPLY SCHEMATIC

8.1. General

Indicative headworks required to provide a potable mains water supply to the rural activity centre, multiple dwellings and all single dwelling residential lots < 2 ha are shown below in the generalised water schematic in Figure 8.1 and Attachment zz.

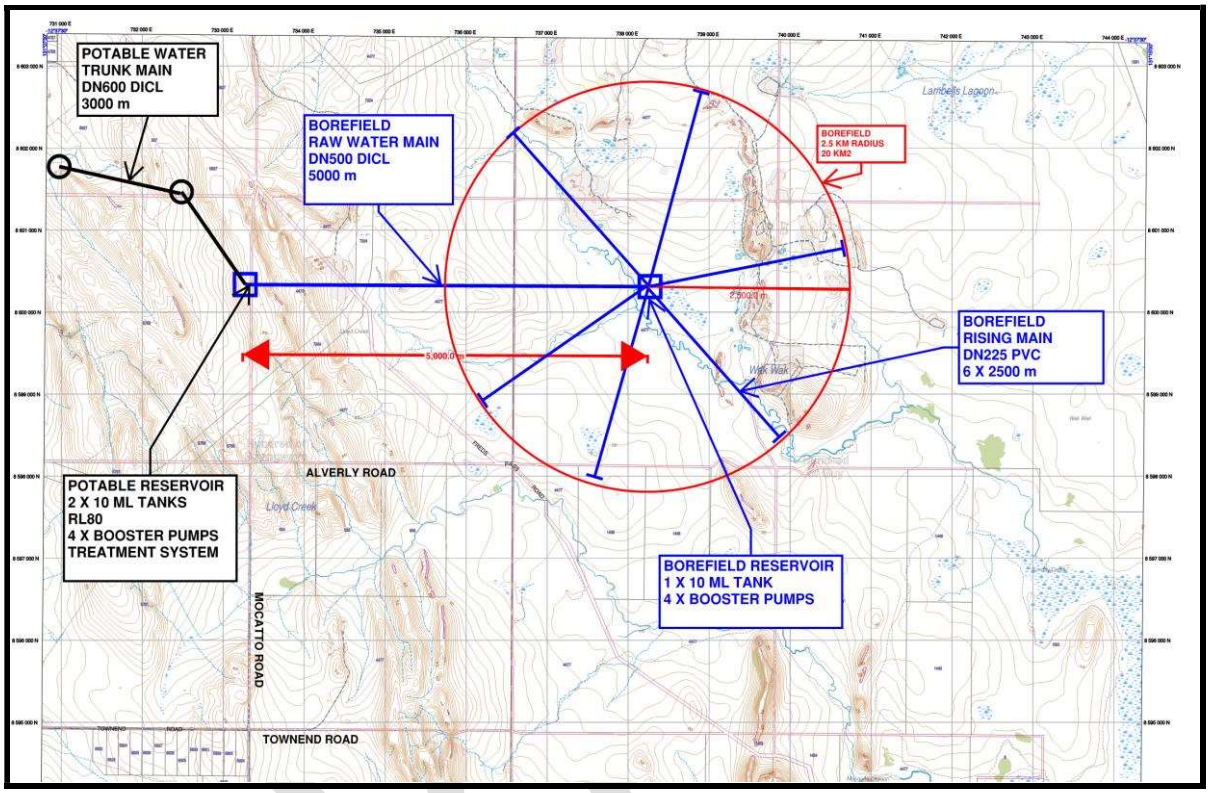


Figure 8.1: Noonamah Ridge water schematic

8.2. Bores

The bore network has been assumed to:

- meet peak day demand of 18.9 ML
- 4 bores being unserviceable (n-4)
- Bores pump 20 hours / day
- sustainable pumping rate 10 L/s each bore
- Bore production 0.72 ML/day

The required number of bores is 30.

8.3. Borefield Rising Mains

It has been assumed that the borefield will be developed on a hub and spoke layout with around 5 bores spaced at approximately 500 m and located along 6 borefield rising mains.

The borefield rising mains will deliver raw water to a borefield ground level reservoir. Five bores per main will pump a flowrate of around 50 L/s.

The 6 x 2.5 km long borefield rising mains have been nominally sized as DN225 PVC.

8.4. Borefield Ground Level Reservoir

The 30 bores will pump to a borefield ground level reservoir. The borefield reservoir has been nominally sized at 12 hour storage to provide some storage redundancy in the water network and to reduce the number of daily pumping cycles.

The borefield reservoir has been nominally sized as 1 x 10 ML concrete tank.

8.5. Raw Water Transfer Pumps

PWC guidelines require raw water transfer pumps to be capable of pumping 1.5 times the ultimate MDMM or approximately 265 L/s. A minimum number of 4 duty pumps are required. To minimise water system components, raw water transfer pumps have been assumed to be the same as the potable water booster pumps.

The 4 x raw water transfer pumps have been nominally sized at 120 L/s.

8.6. Raw Water Rising Main

PWC guidelines require raw water rising mains to be capable of conveying a flowrate of 1.5 x MDMM with a maximum velocity of 1.4 m/s.

The 5 km long raw water rising main has been nominally sized as DN500 DICL.

8.7. Water Treatment System

It is assumed the raw water will be sterilised with an ultraviolet light or similar system before being chlorinated and stored in the potable water reservoir. PWC guidelines require a treatment system to be capable of treating a flow rate of 1.5 times the ultimate MDMM or approximately 265 L/s. No allowance has been made for a fluoridation system.

8.8. Ground Level Reservoirs

Following treatment, the potable water will be stored in a ground level reservoir on the high point of the development at approximate AHD of 80 m. For communities located within 50 km of a major centre PWC guidelines require a ground level reservoir to hold one day supply at peak day demand. Peak day demand has been estimated as 18.9 ML.

The potable water reservoir has been sized as 2 x 10 ML concrete tanks.

8.9. SCADA System

The water supply network will be required to be automatically controlled and monitored. A system control and data acquisition system based at the potable water reservoir compound will communicate with the borefield bores and raw water booster pumps.

8.10. Potable Water Booster Pumps

While the potable water reservoir will be located on the highest point of Noonamah Ridge other high ground (AHD 70 m) located thoughout the development is expected to require pressure in the trunk main. PWC guidelines require booster pumps to be able to deliver ultimate peak hour flows with an allowance for fire fighting flows with one pump out of service (n-1). Booster pumps should be variable speed.

The 4 x potable water booster pumps have been nominally sized at 120 L/s.

No allowance has been made for pressure reduction valves within lower areas of the network.

8.11. Potable Water Trunk Main

A potable water trunk main is proposed to deliver potable water to the rural activity centre as part of the water supply network. PWC guidelines require trunk mains to be capable of conveying the ultimate peak hour flowrate and fire-fighting flows with a maximum velocity of 1.4 m/s.

The 3 km long potable water trunk main has been nominally sized as DN600 DICL.

8.12. Electricity Supply

It has been assumed that high voltage electricity will be available in the vicinity of the rural activity centre. An allowance has been made for to run a high voltage overhead supply from the rural activity centre to the potable water reservoir and on to the borefield.

9. COST ESTIMATE

9.1. General

Key components of the water supply headworks were considered and costs of supplying and installing the headworks were estimated based on indicative industry costs. No allowance has been made in the costs for water reticulation within the subdivision. No contingency amount has been included.

It should be noted that Byrne Consultants are not quantity surveyors. The order of cost is expected to be ± 50%.

9.2. Cost Estimate

A cost estimate of key water headworks components indicates the overall cost of providing potable water to Noonamah Ridge is in the order of $83.7M. This overall cost is comprised of:

- Borefield development $10.4M
- Raw water transfer $8.9M
- Potable water $12.7M
- Private bores to rural lots $51.7M

Indicative costs are shown in Table 9.2.

Table 9.2: Indicative costs - water supply headworks.

Component	Quantity	Rate	Amount
Borefield			**$10,370,000**
Drill bores	30	$70,000	$2,100,000
Equip bores - staged turbine pumps	30	$30,000	$900,000
Bore collection main - DN225 PVC	15000	$300	$4,500,000
Borefield HV supply	20000	$100	$2,000,000
Borefield Transformers - 25 kVA	30	$25,000	$750,000
Borefield LV supply	3000	$40	$120,000
Raw water			**$8,900,000**
Raw water reservoir - 10 ML concrete tank	1	$3,000,000	$3,000,000
Raw water trunk main - DN500 DICL	5000	$1,100	$5,500,000
Raw water transformer - 500 kVA	1	$200,000	$200,000
Booster pumps - 120 L/s	4	$50,000	$200,000
Potable water			**$12,702,500**
Reservoir - 10 ML concrete tank	2	$3,000,000	$6,000,000
Booster pumps - 120 L/s variable speed	4	$50,000	$200,000
Treatment system	1	$2,000,000	$2,000,000
Potable water trunk main - DN600 DICL	3000	$1,300	$3,900,000
HV supply	3000	$100	$300,000
Transformer - 500 kVA	1	$200,000	$200,000
LV supply	100	$25	$2,500
SCADA system	1	$100,000	$100,000
Rural lots			**$51,709,000**
Drill bores	1246	$15,000	$18,690,000
Equip bores - submersible pumps	1246	$10,000	$12,460,000
Bore Transformers - 25 kVA	623	$25,000	$15,575,000
Bore LV supply – 100 m per bore	124600	$40	$4,984,000

Appendix D
Power and Communications Infrastructure EIA report by Byrne Design

2 ELECTRICAL SERVICES

2.1 EXISTING INFRASTRUCTURE

Power and Water Corporation (PWC) are responsible for approving the electrical infrastructure works required to service the development.

The existing PWC network in the rural area is 22kV (overhead) along Redcliffe. There is minimal spare capacity in the existing PWC network in the area of the proposed subdivision and as such is not adequate to service the proposed subdivision.

2.2 PROPOSED WORKS

PWC were consulted to obtain information on existing electrical infrastructure and possible interconnection requirements with existing reticulation.

The estimate load allocations across the site are classified as basic supply which is the loads to be used as part of the subdivision design for lot servicing.

PWC load allocations standards are as follows:

- Single Dwelling (SD) lot : 10kVA Single Phase
- Rural Residential (RR) lot : 10 kVA 3 Phase
- Rural Living (RL) lot : 25kVA 3 Phase
- Multiple Dwelling MD Lot: 22VA per sqm

Based on above, the load allocations are estimated as follows:

- SD lots (1155 lots) – 3.81MVA
- RR lots (3000 lots) - 30MVA
- Multiple Dwelling (MD) lots (50 lots) - 1.65MVA (based on average lot size of 1500sqm for MD lot
- School/Commercial precinct – 2.5MVA (estimated)

Based on the above load allocations the total basic supply equates to approximately 37.96MVA. This is loading that would be used to size reticulation throughout subdivision including substation sizing. For sizing of feeders to the subdivision, diversity is used and diversified total load is 21.11MVA

The following will also impact the design:

- Lot zoning and lot zone distribution
    - Urban areas will require underground 22kV and rural overhead 22kV.
    - The load allocations are based on an estimate of the lot zone distribution. As the project progresses these estimates will be updated.
    - Street lighting will need to be provided in urban areas, but not generally in rural (except in high traffic intersections).
- Size of school & commercial precinct
    - Currently an estimate is available.

As there is currently no spare capacity in the existing PWC network to service proposed subdivisions the option to provide the additional capacity is as summarised below:

2.2.1 Proposed Electrical Infrastructure

The proposed subdivision can be serviced with the provision of up to three dedicated feeders, one overhead and two underground, with the second underground feeder requirement to be assessed during the later stages of development. These are minimum requirements for the development; it may be possible that during preliminary design the higher requirement will be imposed on the development.

The feeders would be connected to the new Strangways Zone Substation (adjacent to the existing McMinns Zone Substation); the zone substation is located at the Stuart Hwy-Arnhem Hwy intersection. The proposed dedicated feeders will have the following approximate ratings:

- 22kV Overhead (Neon): 8.8MVA - 11km route
- 22kV Underground (Aluminium 400sqmm): 12.8MVA - 14.2km route
- 22kV Underground (Aluminium 400sqmn): 11.2 MVA – 17.1Km route

PWC have advised that a new substation (Strangways Zone Substation) is currently under construction and due to be commissioned in the next 12 months and that there is capacity to allow for at least two feeders to be connected. This solution is preferred by PWC and would provide the required capacity for the proposed subdivision. Due to the higher cost of the underground feeder, it is recommended that the overhead feeder is provided before the underground and the underground feeder to be provided once the load on the overhead feeder reaches a maximum acceptable level to PWC as a single dedicated feeder, around 70%. Based on assumed 200 lots per year (150 RR and 50 SD) it is expected that the underground feeder would to be required in the 7^{th} or 8^{th} year of the development.

It should be noted that an approximate 4km section of Redcliffe Road currently has no HV reticulation and that as part of this development it is expected that new overhead 22 kV will be required to be constructed.

Also a section of Goode Road is currently only a road reserve with no actual road and as part of the work a new access road along the new 22kV overhead will need to be constructed.

Details of all proposed headworks are shown on Appendix A Sketch 14055 SK220 Electrical Headworks.

The third feeder (if required) would be in the later stages of the development and needs to be assessed in relation the actual load on the first two feeders. It should be noted that based on first 2 feeders being dedicated to this development that once constructed they become PWC assets and as such the developer will no longer have “control” over what load are actually connected.

The proposed reticulation within the subdivision would consist of a combination of 22kV underground and overhead supply.

2.2.2 Solar and other sources of energy.

The aim of the project is to challenge the traditional ways of servicing developments and find viable solutions to reduce the emission of greenhouse gasses and the dependency on fossil fuel.

The project will look for opportunities to use solar energy to reduce the demand for electricity across the project. As solar technology improves and becomes more efficient the project will involve the community, PWC and Litchfield Council to identify areas where solar technology can be efficiently used to service schools, dwellings, commercial buildings and recreational areas.

Energy can also be sourced from the sewerage system; the projects will also assess new products and suppliers to determine which technology can be adopted and in which stage of the project these technologies can be implemented.

As in any significant project the implementation of new green technology will require a strong collaboration with the authorities and a full assessment of the entire life cycle. The development would also consider managing the supply of energy to the site if feasible and approved by the authorities.

2.2.3 Future Considerations

The establishment of a Zone Substation which would be interconnected to existing 66kV transmission line via new 66kV transmission line extension might be considered by PWC in the long term. The Zone Substation would ideally be located close to the main/high load area, with a recommended location being in the vicinity of Alverly Rd/Redcliffe Rd intersection. Allocation of land for this substation within the development may be needed.

3 COMMUNICATIONS

3.1 RESPONSIBLE AUTHORITIES

Telstra and NBN Corporation are responsible for approving the telecommunication infrastructure works required to service the development.

3.2 EXISTING CONDITIONS

An existing underground Telstra cable runs along Alverly Rd and services the Jorn Radar.

3.3 PROPOSED WORKS

The project will coordinate with the authorities to provide a system of pipe and pit throughout the subdivision area to enable NBN Corporation to pull through fibre optic cable as part of individual stage of works.

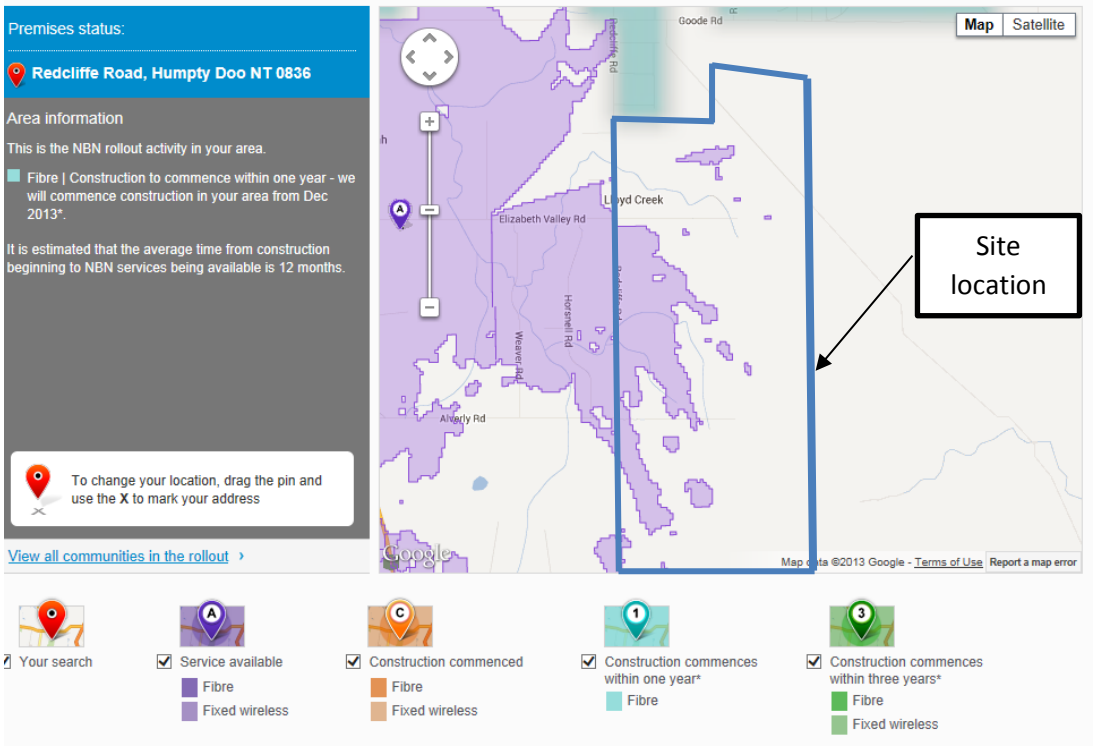


Figure 3 Proposed NBN roll out plan

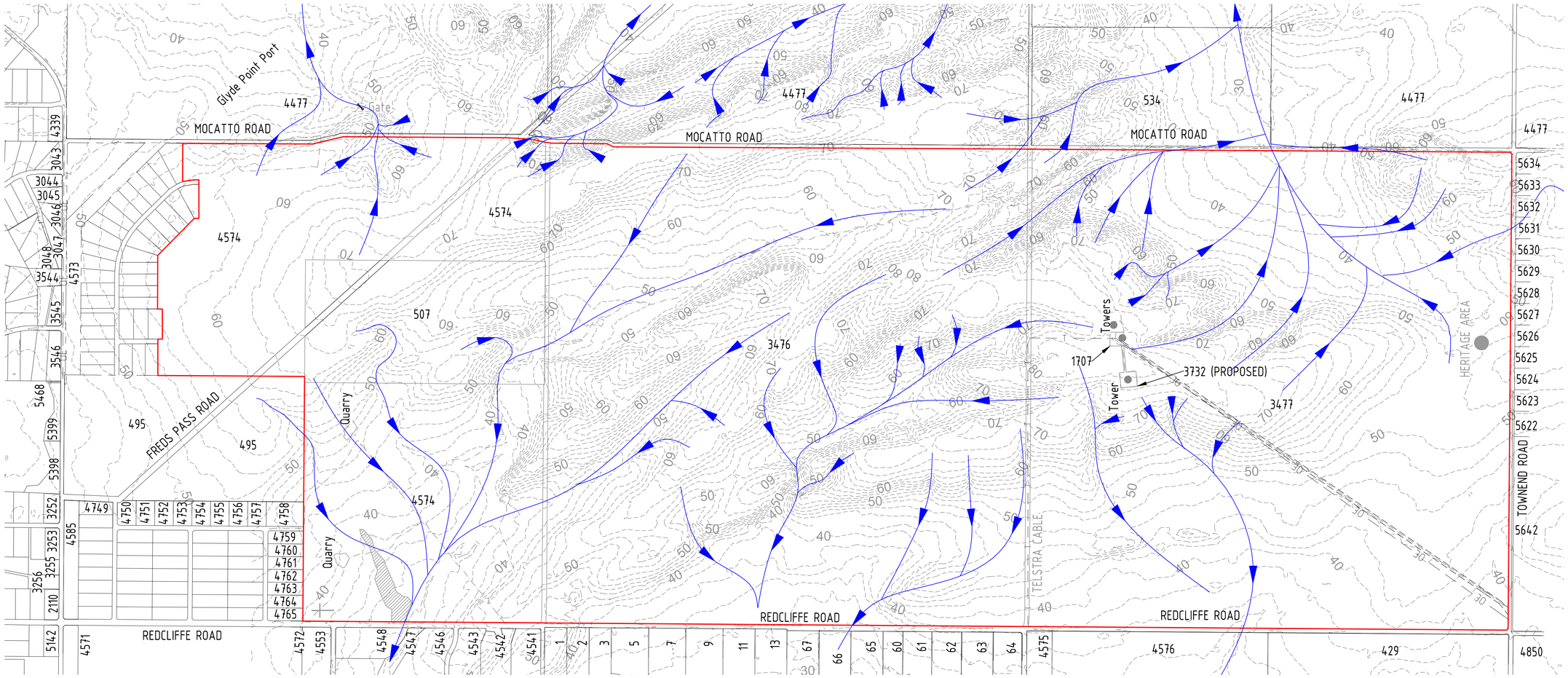
Appendix E
Contour Plan

LEGEND

- EXISTING SURFACE CONTOURS
- SITE BOUNDARY
- EXISTING PROPERTY BOUNDARY
- EXISTING EASEMENT BOUNDARY
- EXISTING NOMINAL KERB LINE / EDGE OF ROAD
- EXISTING ROAD CENTERLINE
- EXISTING WATER
- EXISTING OVERHEAD ELECTRICITY
- EXISTING GAS
- EXISTING TELECOMMUNICATIONS
- EXISTING OVERHEAD ELECTRICAL
- EXISTING WATER FLOW

CAUTION

THE LOCATION AND DEPTH OF EXISTING SERVICES AS SHOWN IS BASED ON INFORMATION OBTAINED FROM CROSS SOLUTIONS DATED 2013 AND COUNCIL RECORDS. IT IS THE CONTRACTOR'S RESPONSIBILITY TO CONFIRM THE ACTUAL LOCATION AND DEPTH OF EXISTING SERVICES PRIOR TO CARRYING OUT ANY EXCAVATION, TRENCHING OR TUNNELING WORKS.



LAYOUT PLAN

SCALE: 1:15000

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PRELIMINARY

NOT FOR CONSTRUCTION

Rev	Date	Description	By	Chk
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SCALE 1:15000
AT ORIGINAL SIZE (A1)

T:1300 657 402 E: info@adgce.com W: www.adgce.com
Quality Assurance ISO 9001:2015 | Work Health Safety ISO 45001:2018
Environmental Management ISO 14001:2015

Client: INTRAPAC	Discipline: CIVIL		Status: PRELIMINARY
Project Name: LLOYD CREEK NOONAMAH	Designed By: AB	Checked By: HD	Approved By: SW
	Project No.: 24572	Drawn By: AB	Scale at A1: 1:15000

Title: CONTOURS LAYOUT PLAN

Drawing No.: SK01 | Revision: 01

PLOT DATE: 7/17/2023 5:25 PM FILENAME: J:\24000\24572\CIVIL\DWG\24572_SK01_CONTOURS LAYOUT PLAN.DWG

FULL SIZE ON ORIGINAL 0 10 20 30 40 50 60 70 80 90 100mm

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