Appendix H - TetraTech (2025) Inland Waters Assessment

NT to NBT 330kV Double Circuit Transmission Line

NREP Inland Water Assessment and ASS and Dewatering Management

Western Power

Reference: 754-PEREN385329-R01

9 June 2025

NT TO NBT 330KV DOUBLE CIRCUIT TRANSMISSION LINE

NREP Inland Water Assessment and ASS and Dewatering Management

Report reference number: 754-PEREN385329-R01

9 June 2025

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CONTENTS

1. INTRODUCTION 1
1.1 Project Background 1
1.2 Project Objectives 2
1.3 Scope of Works 2
2. METHODOLOGY 4
3. SITE ENVIRONMENT 5
3.1 Climate 5
3.2 Topography 6
3.3 Geology 6
3.4 Hydrogeology 8
3.5 Acid Suflate Soils 9
3.6 Vegetation Communities 10
3.7 Inland Waters 11
3.7.1 Groundwater 11
3.7.2 Wetlands 13
3.7.3 Groundwater and Surface Water Quality 14
4. IDENTIFICATION OF ENVIRONMENTAL FACTORS 17
5. PRELIMINARY RISK IMPACT ASSESSMENT 19
5.1 Design Option 19
5.2 Depth to water table 19
5.3 Acid Sulfate Soil risk mappings 19
5.4 Preliminary risk impact matrix 20
6. PRELIMINARY DEWATERING ASSESSMENT 26
6.1 Dewatering modelling calculations and assumptions 26
6.2 Methodology 26
6.3 Assumptions and Limitations 27
6.4 Results 27
7. DETAILED RISK IMPACT ASSESSMENT 29
7.1 Alternative Foundation Method Assessment 29
7.1.1 Bored pile with dewatering without hydraulic containment 29
7.1.2 Bored and cased pile with hydraulic containment and dewatering from bottom only 30
7.1.3 Driven piling with pile cap excavation and shallow dewatering 32
7.1.4 Summary of dewatering assessment 33

7.2 Revised Risk Impact Categorization 37
8. CONCLUSION 42
9. RECOMMENDED MANAGEMENT ACTIONS 43
9.1 Recommended Additional ASS Investigations 43
9.2 Recommended Soil Management Strategies 43
9.3 Recommended Dewatering Management Strategies 44
9.4 Groundwater monitoring program 44
10. REFERENCES 46

LIST OF TABLES

Table 3-1: Regional groundwater and surface water quality data 15
Table 4-1: Environmental factors for inland water assessment 17
Table 5-1: Preliminary Risk-Impact assessment matrix 21
Table 5-2: Summary tower locations with medium-high to high impact-risk category based on preliminary assessment 25
Table 6-1: Preliminary dewatering assessment 27
Table 7-1: Bored pile with dewatering without hydraulic containment 29
Table 7-2: Bored and cased pile with hydraulic containment and dewatering from bottom only 31
Table 7-3: Dewatering assessment for pile caps with foundation pad excavation and dewatering 33
Table 7-4: Summary results for dewatering assessment - foundation option 1 vs foundation option 2 35
Table 7-5: Summary results for shallow pile cap excavation and dewatering 36
Table 7-6: Risk-Impact categorisation for each tower location based on foundation construction method 37
Table 7-7: Intrusive Works Triggering ASS Investigation 41

LIST OF FIGURES

Figure 1-1: Proposed NT – NBT 330kV transmission line alignment 1
Figure 3-1: Mean monthly rainfall from Whiteman Park (station 009263) (BOM 2024) 5
Figure 3-2: Cumulative deviation from mean monthly rainfall for Whiteman Park 6
Figure 3-3: Surface geology as available on 1:50,000 Geological Series Maps 7
Figure 3-4: Regional groundwater table contours and salinity (DWER 2019) 8
Figure 3-5: Swan Coastal Plain acid sulfate soil risk mapping 10
Figure 3-6: Public drinking water source areas (DWER-033) 12
Figure 3-7: Geomorphic Wetlands of Swan Coastal Plain (dataset: DBCA-019) 13
Figure 3-8: Regional groundwater quality data search within DWER's Water Information Reporting portal 14
Figure 3-9: Available water quality data sites 15

APPENDICES

APPENDIX A : STATEMENT OF LIMITATIONS 47

APPENDIX B : NREP NT-NBT 330KV DOUBLE CIRCUIT TOWERLINE FOUNDATION NOMINATION.....48

APPENDIX C : NREP NT-NBT 330KV DOUBLE CIRCUIT TOWERLINE FOUNDATION DRAWING 49

APPENDIX D : REGIONAL GROUNDWATER QUALITY DATA AVAILABLE FROM DWER'S WATER INFORMATION REPORTING PORTAL.....50

ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
ASS	Acid Sulfate Soil
BOM	Bureau of Meteorology
CBD	Central Business District
CCW	Conservation Category Wetland
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DWER	Department of Water and Environmental Regulation
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
GDE	Groundwater Dependent Ecosystems
GIS	Geographic Information System
ha	hectares
km	kilometres
l/s	litres per second
MNES	Matters of National Environmental Significance
mAHD	metres Australian Height Datum
mbgl	metres below ground level
NREP	North Region Energy Program
PECs	Priority Ecological Communities
PDWSA	Public Drinking Water Source Areas
SOBN	State Observation Bore Network
TEC	Threatened Ecological Community
TDS	Total Dissolved Solids

1. INTRODUCTION

Tetra Tech Coffey Pty Ltd (Tetra Tech Coffey) was engaged by Western Power (Western Power) to provide an assessment of potential impacts from the proposed NT-NBT 330kV double circuit transmission line (the project). The assessment incorporates the hydrology and water quality of groundwater and wetlands along with inclusion of any proposed water management strategies to manage potential impacts. The works have been undertaken in accordance with Tetra Tech Coffey's proposal, 754-PEREN385329_P01, dated 31 January 2025. This proposal has been developed in accordance with Western Power's request for quotation, dated 15 January 2025, under Category 5 of Environmental Services Panel WS2791480386.

1.1 PROJECT BACKGROUND

Western Power has received a request from the Environmental Protection Agency (EPA) and the Department of Climate Change, Energy, the Environment and Water (DCCEEW) for further information in relation to the referral of the proposed NT – NBT 330kV line. The proposed transmission line traverses approximately 29 kilometres (km) between Northern Terminal in Malaga and Neerabup Terminal in Pinjar, approximately 11 km to 29 km north-east of the Perth Central Business District (CBD). The proposed line route is illustrated in Figure 1-1 with numbering starting from Neerabup Terminal.

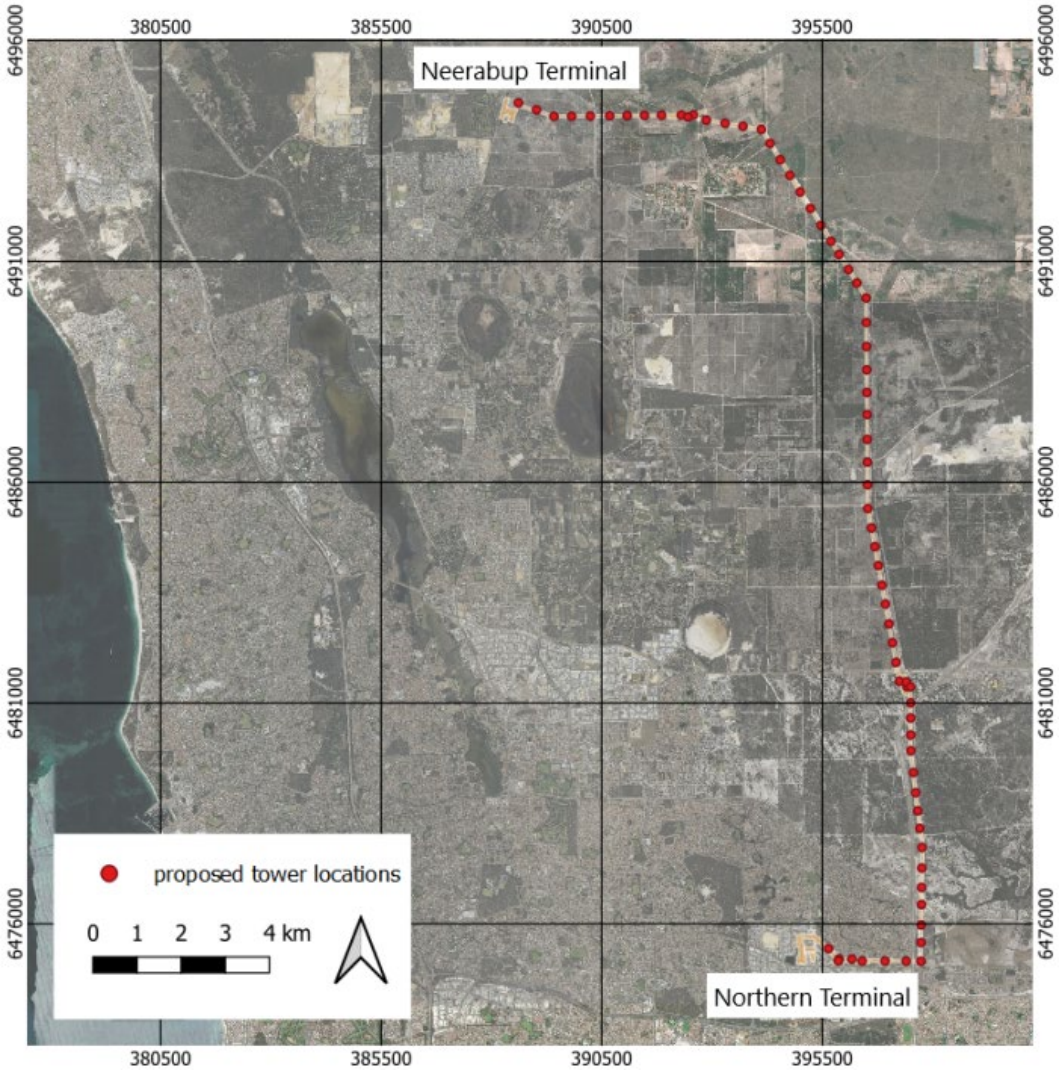

Figure 1-1: Proposed NT – NBT 330kV transmission line alignment

The project is located within the City of Swan and City of Wanneroo local government areas. The line route will run in parallel to the existing 330kV transmission line between Northern Terminal and Neerabup Terminal. Land within the development envelope is characterised by a mix of land uses, ranging from urban, recreation, transport, infrastructure and state forest. Consequently, most of the development envelope has been subject to some form of disturbance.

Previously, a geotechnical investigation report for the transmission line consisting of previously proposed 82 support structures comprising lattice towers or steel poles was prepared by WSP (2024). The investigation was undertaken at selected locations along the alignment for design considerations and cost estimates. The location of some proposed structures has shifted following the previous investigation which has resulted in some test locations being considerable distance from the proposed tower locations. The structure locations are subject to further amendments and additional investigations may be required once the alignment details are finalised.

Construction within the project area will involve a mixture of temporary and permanent clearing within a 60 m wide linear impact area. Permanent clearing is required for ongoing access and maintenance of the transmission infrastructure. Temporary clearing is required for construction machinery, material storage, break and winch sites, and access tracks for construction which will typically be 4 to 6 m wide depending on the terrain. There is allowance for temporary clearing for construction purposes within a 20 m wide corridor centred on the line route.

While the development area is mostly cleared, the area contains Banksia Woodlands of the Swan Coastal Plain Threatened Ecological Communities (TEC), Priority Ecological Communities (PECs) and geomorphic wetlands. Thus, in anticipation of formal environmental referral process, an Environmental Impact Assessment (EIA) for the project has been prepared by AECOM in 2024. The EIA report (AECOM 2024), has identified the project will result in a combination of permanent and temporary clearing of native vegetation which may include the Banksia Woodland TEC, state listed PECs and clearing of geomorphic wetlands including Conservation Category Wetland (CCW). The total clearing required for the project, both temporary and permanent, has not yet been confirmed and is understood to be updated following the EIA report.

The project was referred to the EPA and DCCEEW in February 2024. EPA and DCCEEW have asked for further information on inland waters, dewatering and Acid Sulfate Soil (ASS) management. It has been noted that the development envelope intersects the Priority 1 Gnangara Underground Water Pollution Control Area, several public drinking water supply protection zones, as well as conservation category, resource enhancement and multiple use wetlands. There are also areas of high to moderate ASS disturbance risk within the development envelop and dewatering may be necessary for tower construction.

Western Power has engaged Tetra Tech Coffey to provide an assessment of potential impacts to the hydrology and water quality of groundwater and wetlands along with proposed water management strategies to manage the potential impacts.

1.2 PROJECT OBJECTIVES

The overall project objectives include:

- identify tower locations which may have impact on the environment in relation to inland waters and ASS,
- provide high-level on-ground methods to minimize/prohibit environmental impact from the proposed activities.

1.3 SCOPE OF WORKS

The scope of works covered by this report include:

- assess the potential impacts to the hydrology and water quality of groundwater and wetlands along with proposed water management strategies to manage the potential impacts,
- assess the potential groundwater drawdown impacts from dewatering activities associated with tower construction and footings installations; these include potential hydrological and soil acidification impacts to the Banksia Woodland TEC,
- revised risk assessment of potential soil acidification and the potential impacts to wetlands and TEC.

2. METHODOLOGY

To meet the project objectives, this assessment has been undertaken in three stages. The purpose of this staged assessment is to ensure:

- establishment of a standard method to quantify the potential environmental impact (i.e. water table decline, change in recharge, ASS, dewatering requirements) across the entire traverse by developing generic assessment tools,
- categorisation and assessment of each site (tower location) is undertaken in a consistent manner, and
- impact minimisation approaches are applied to multiple similar sites rather than individual detailed assessments for each tower location.

The three staged assessment adopted here consists of the following sub-assessments:

i. Preliminary (Qualitative) risk impact assessment

As the first stage of preliminary assessment, potential risk impact assessment at each tower location is undertaken by intersecting spatial data sets with the proposed alignment. These spatial data sets include topology, geology, depth to water table, ecological communities, proclaimed water supply areas, etc. This exercise identified excavation locations and qualitative impact assessment (i.e. low, medium, high) based on review of published potential environmental risks along with development and assigning a risk ranking matrix. As part of the risk impact assessment, the potential for soil acidification has been assessed via available data online. The results from the preliminary qualitative risk impact assessment are tabulated to summarise locations which require further detailed investigation and assessment.

ii. Detailed (Quantitative) risk impact assessment

At those locations where potential environmental risk has been identified, an additional stage of risk assessment is undertaken. Note, quantitative assessment relies on existing information (no field data was collected as part of this assessment). All assumptions and data sources are cited to ensure transparency in the assessment. If available, pre-existing methods of impact assessment are utilised.

No new sources of surface water or groundwater contamination are expected from the proposed construction project. Potential impacts are limited to the construction stage and is limited to temporary dewatering for foundation excavations.

iii. Recommended Management Actions for Impact minimization

Relevant environmental guidelines (such as EPA guidelines) are followed in providing impact minimisation methods. The extend of the quantified impact guide the magnitude of site activities required.

The desktop assessment findings have been provided in one risk assessment and management report (this report) following the completion of available data collation and review. This report incorporates generic risk-based matrix for the tower construction sites, information on inland water, dewatering requirements, and ASS management.

3. SITE ENVIRONMENT

3.1 CLIMATE

The project area is approximately 12 km north of Perth CBD at the Northern Terminal (NT) and extends north to Neerabup Terminal in Pinjar, approximately 30 km north of Perth CBD. The climate is warm Mediterranean with mild wet winters and hot dry summers. Most rainfall occurs during the winter months, with some summer storms.

Rainfall data was obtained from Whiteman Park (station number 009263), located approximately 2.9 km east of the proposed transmission line alignment. The mean monthly rainfall distribution across a year with rainfall data available between the period (2004 - 2024) is shown in Figure 3-1. The mean annual rainfall reported by Bureau of Meteorology (BOM) is 735.5 mm with the highest mean rainfall reported in July (134.1 mm) and the lowest mean rainfall reported in December (12.6 mm).

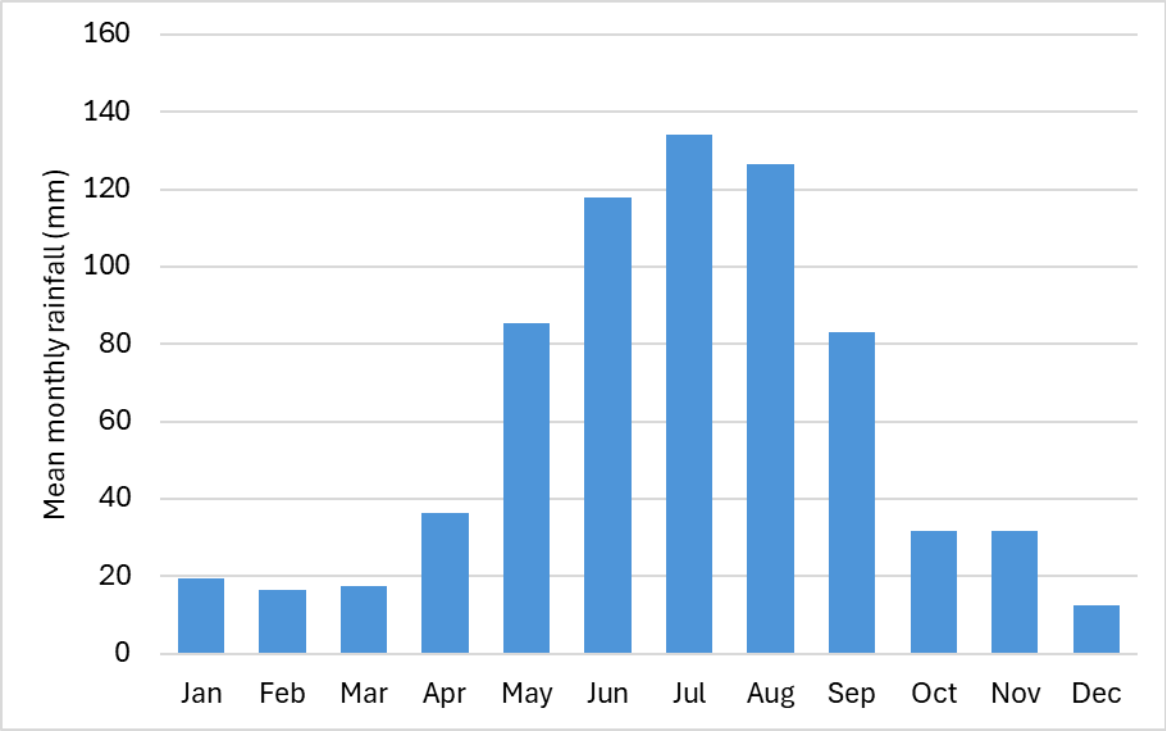

Figure 3-1: Mean monthly rainfall from Whiteman Park (station 009263) (BOM 2024)

Monthly cumulative residual rainfall departure (also cumulative deviation from mean monthly rainfall, CDFM) information at Whiteman Park weather station is presented in Figure 3-2. CDFM shows the rainfall trend over time which can be used as an indicator of likely groundwater level trends and thereby provides an indication of longer-term climatic impacts which may influence design groundwater extremes.

Rainfall data collected since 2004 shows the rainfall trend was decreasing between the years 2004 to 2011 indicating dry conditions. The rainfall trend was increasing between the years 2011 to 2018 indicating total monthly rainfall was greater than the mean monthly rainfall for the month. Since 2019, the rainfall trend is decreasing indicating dry conditions which continues to 2024.

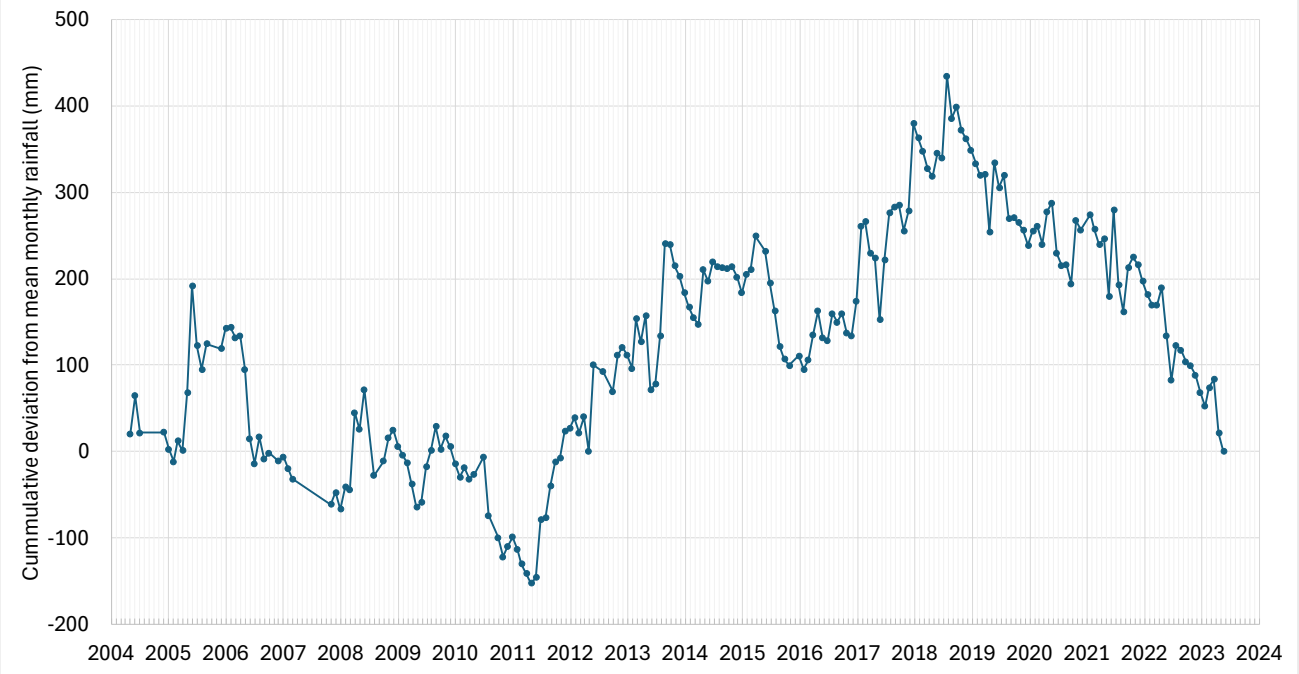

Figure 3-2: Cumulative deviation from mean monthly rainfall for Whiteman Park

3.2 TOPOGRAPHY

The topography of the surrounding areas varies from the gentle grade of Malaga to the east to the undulating remnant dunes in the Gnangara Moore River State Forest to the north. The land elevation ranges approximately between 32 metres Australian Height Datum (mAHD) in the south around Northern Terminal to about 60 mAHD around Neerabup Terminal with topographic highs of around 76 mAHD within the Gnangara Moore River State Forest.

The landform within the proposed transmission line has already been altered by the presence of the existing powerline that runs adjacent to the proposed alignment. The alteration to natural landform due to the existing powerline has been minimal (AECOM 2024)..

3.3 GEOLOGY

A review of published geological references - Muchea 1:50,000 Geological Series Maps (2034-I, 2134-IV) and Perth 1:50,000 Geological Series Maps (2034-II, 2034-III, 2134-III), 1:50,000 Environmental Geology Series, indicates the surficial geology of the project area consist predominantly of Quaternary aged Bassendean Sand (S8 & S10). The surface geology as available on 1:50,000 Geological Series Maps is presented in Figure 3-3.

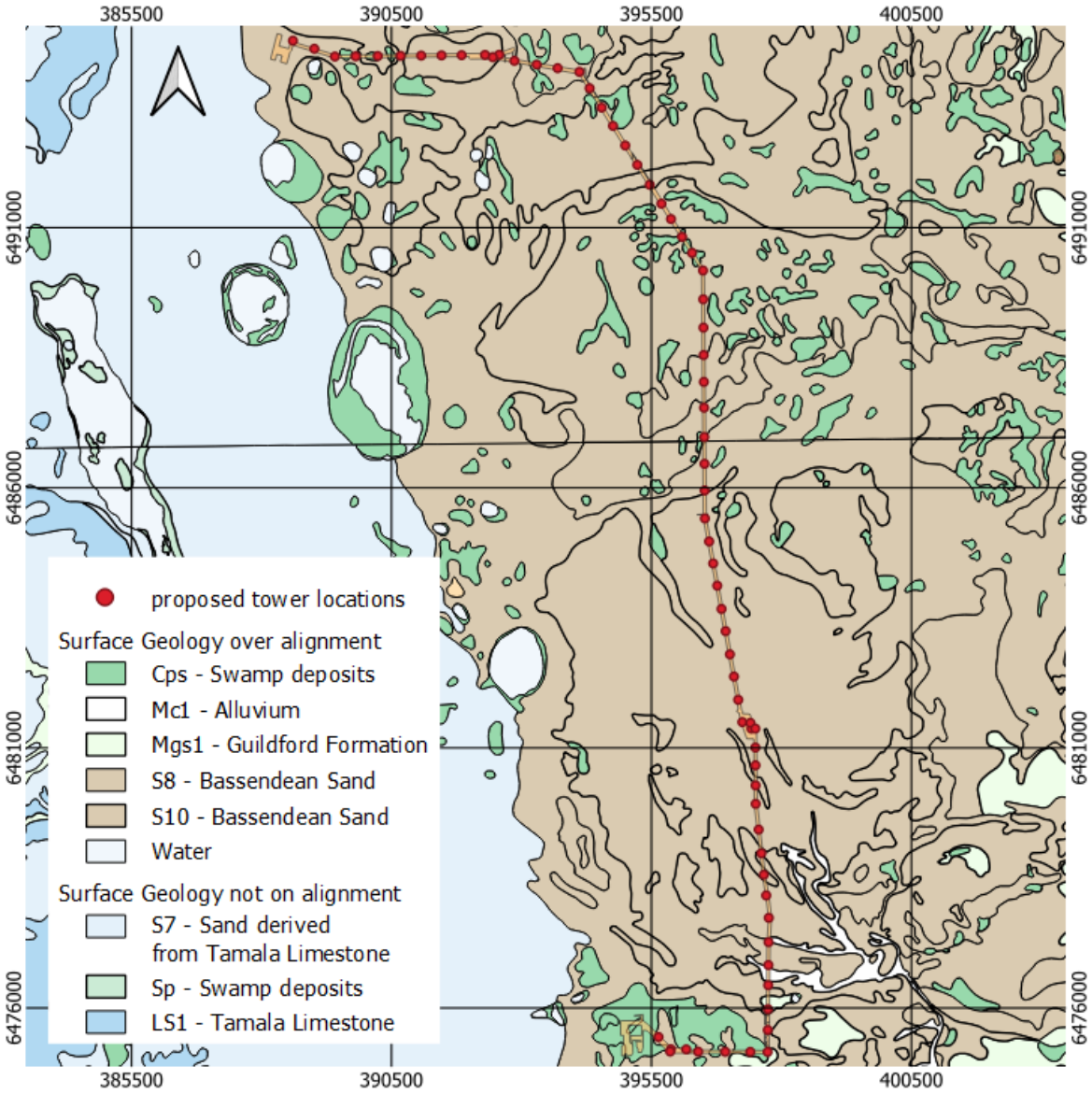

Figure 3-3: Surface geology as available on 1:50,000 Geological Series Maps

The Bassendean Sand is characterised as white to pale grey at surface, yellow at depth, fine to medium-grained, sub-angular to sub-rounded, moderately well sorted, of eolian origin. A thin layer of friable variably cemented iron and/or organic rich sands colloquially known as ‘coffee rock’ is commonly encountered within the vicinity of the water table. Coffee rock forms by the precipitation of humates and iron from groundwater, mainly in the zone of water table fluctuations, and may vary between bright orange, orange brown and dark brown to black.

The Bassendean Sand is underlain at variable depth by alluvial clayey, silty and sandy soils of the Guildford Formation (Mgs1). The Guildford Formation is characterized as pebbly silt, dark brown, fine to occasionally coarse-grained, sub-rounded laterite, weathered granite pebbles, some fine to medium-grained sand, of alluvial origin.

The low-lying surrounding areas are likely to consist of swamp deposits of peaty clay (Cps) and subject to seasonal flooding. These peaty clays are characterised as dark grey and black with variable sand content. Along gullies and creek beds, yellow to brown, mottled, soft, alluvium deposits of clayey silt (Mc1), with variable clay content are also reportedly present.

3.4 HYDROGEOLOGY

The Hydrogeological Atlas of Western Australia indicates two aquifers in the region: Perth Superficial Swan Aquifer and Leederville Aquifer. The Bassendean Sand and the Guildford Formation geological units make up a portion of the unconfined superficial aquifer within the region. The permeability of the superficial aquifer is variable and depends on sediment type, with saturated sands (Bassendean Sand) having higher permeability than clays (Guildford Formation). The Leederville Aquifer is deep relative to the proposed alignment and tower constructions and is not considered relevant to this assessment based on the provided information.

Review of the Department of Water and Environmental Regulation (DWER) Perth Groundwater Atlas provides information regarding the regional groundwater level and salinity for the project area. The Perth Groundwater Atlas historical maximum water table elevation contours along with groundwater salinity are presented on Figure 3-4.

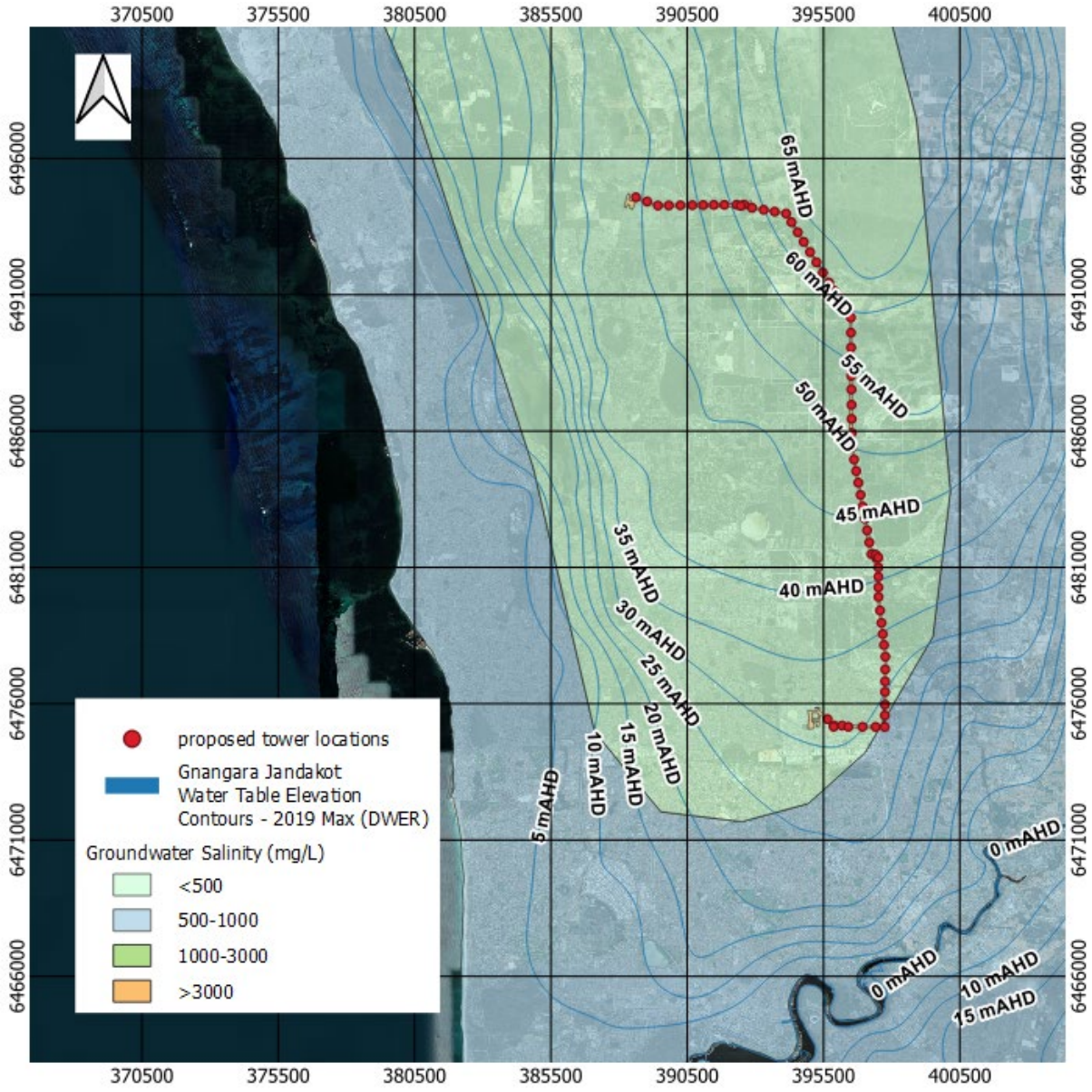

Figure 3-4: Regional groundwater table contours and salinity (DWER 2019)

The groundwater level elevation surrounding the project area ranges between 29 – 63 mAHD within the Gnangara mound. The approximate groundwater level contours range from about 29 – 32 mAHD at the

southern end of the alignment near Malaga and rises to about 42 mAHD where the transmission line alignment crosses Gnangara Road. The groundwater level contours continue to rise as the alignment heads north to maximum groundwater elevation of about 63 mAHD at the north-eastern portion of the alignment. The groundwater contours then fall to about 43 mAHD near the north-western portion of the alignment at the Neerabup Terminal.

The measured groundwater levels across the site during the WSP geotechnical investigation in December 2023 ranged between 0.8 and 5.8 metres below ground level (mbgl) where encountered. This corresponds to groundwater levels of between 30 and 64 mAHD which are relatively consistent with the Perth Groundwater Atlas data. WSP (2023) notes that given the investigation was conducted in December 2023, after what was a relatively dry winter, the groundwater levels could rise to about 1.5 m higher than the measured levels following periods of heavy rainfall.

The groundwater flow direction is reportedly towards west underneath the Neerabup Terminal while the groundwater flow direction is towards the south below the Northern Terminal in Malaga and much of the proposed north-south alignment route.

Groundwater salinity and quality within the Gnangara mound area is controlled by topographic elevation, location within the landscape, presence of drainage features and the associated groundwater residence time. At regional scale, the groundwater is generally fresh within the project area with salinity less than 500 mg/L Total Dissolved Solids (TDS).

3.5 ACID SUFLATE SOILS

The Acid Sulfate Soil risk mapping for Swan Coastal Plain is presented in Figure 3-5. The ASS risk mapping indicates that majority of the alignment overlies areas with low to moderate risk of Acid Sulfate soils occurring within 3 m of the natural surface. Additionally, there are some areas within the development envelop with high to moderate risk of ASS occurring within 3 m of the natural surface. The high-risk areas are primarily associated with wetlands in the Gnangara Moore River State Forest and wetlands surrounding Whiteman Park areas.

Acid Sulfate soils can become acidified if disturbed or dewatered, potentially contaminating groundwater with acid and heavy metals. Acidic groundwater plumes can impact on vegetation health of deep-rooted vegetation and affect the water quality of any downstream groundwater receptors including surface water bodies as well as domestic and industrial water supply bores. Acidic conditions generated by ASS can also corrode concrete and steel (such as underground pipes and services, bridge abutments, foundation piles) along with other infrastructure.

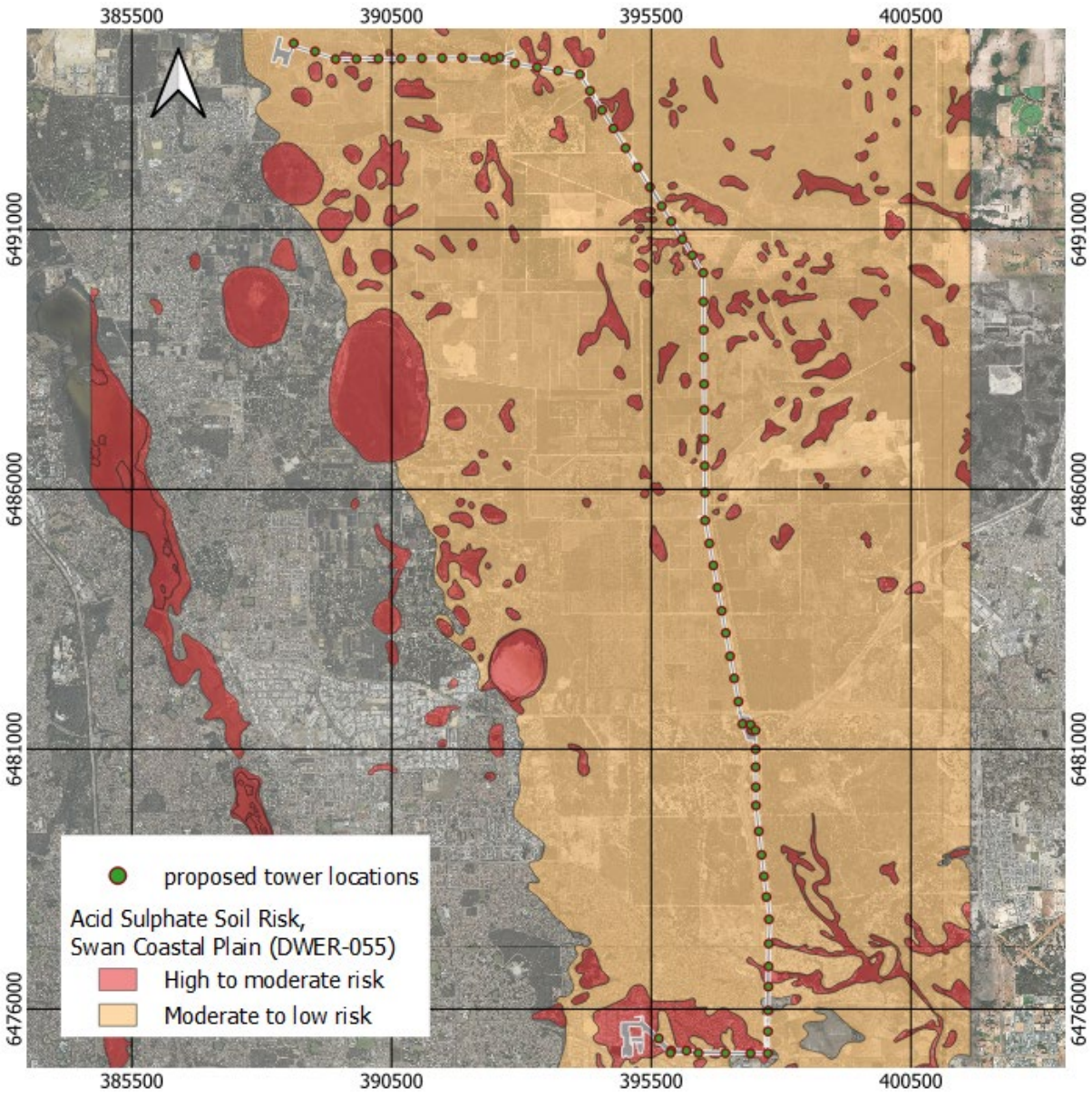

Figure 3-5: Swan Coastal Plain acid sulfate soil risk mapping

3.6 VEGETATION COMMUNITIES

The project area lies in Swan Coastal Plain bioregion which includes Perth and the outer suburbs (excluding the Hills suburbs). The Swan Coastal Plain is comprised of a narrow belt less than 30 km wide of aeolian, alluvial and colluvial deposits of Holocene or Pleistocene age. A complex series of seasonal freshwater wetlands and alluvial river flats are included in the bioregion. Sand dunes and sandplains with deep sand, semi-wet and wet soils are vegetated by Banksia-Paperbark woodlands and mixed heathlands.

One criteria suggesting groundwater dependence of vegetation as per National Atlas of groundwater dependent ecosystems (GDEs) is indicated by a shallow depth to the water table. Groundwater of less than 10 metres deep is often indicative of an ability for vegetation to access the water table if the soil conditions are conducive to root penetration to that depth (Tanya et. al. 2017). Thus, this shallow depth to water table (<10 m) criteria is adopted in this assessment as the basis for the development of ‘rules of GDE dependency’ consistent with the approach adopted in the national GDE Atlas.

The detailed vegetation communities within the wider project area and surroundings have been discussed in AECOM (2024). Of the various vegetation communities within the project area, three Banksia Woodland communities fall under the TEC categories and represents Banksia Woodland TEC. These are:

- **BaBeAn**: high diversity woodland recorded in Gnangara State Forest surrounding Neaves Road in Melaleuca area
- **BaXpPo**: high diversity woodland recorded in Gnangara State Forest surrounding Neaves Road and east of Seismic Road in Melaleuca area; supports denser understorey than *BaBeAn*
- **EtHsLb**: Banksia and Eucalypt woodland occurring sporadically in Gnangara State Forest and Whiteman area, includes areas historically cleared that floristically appear to be regenerating towards a natural state of Banksia Woodland.

It is understood that a portion of the Bankia Woodlands exists within the TEC, however, the finalised TEC area has not been confirmed.

3.7 INLAND WATERS

3.7.1 Groundwater

The project area is located on the Gnangara Mound, a basin of water-holding sands and gravels that forms aquifers used for drinking and irrigation waters. It underlies Perth between the Hills and the coast and the area from the Swan River to Gingin Brook. The development envelop is predominantly located in areas used for public drinking water abstraction and passes through proclaimed Priority 1 to Priority 3 Public Drinking Water Source Areas (PDWSA) as presented in Figure 3-6.

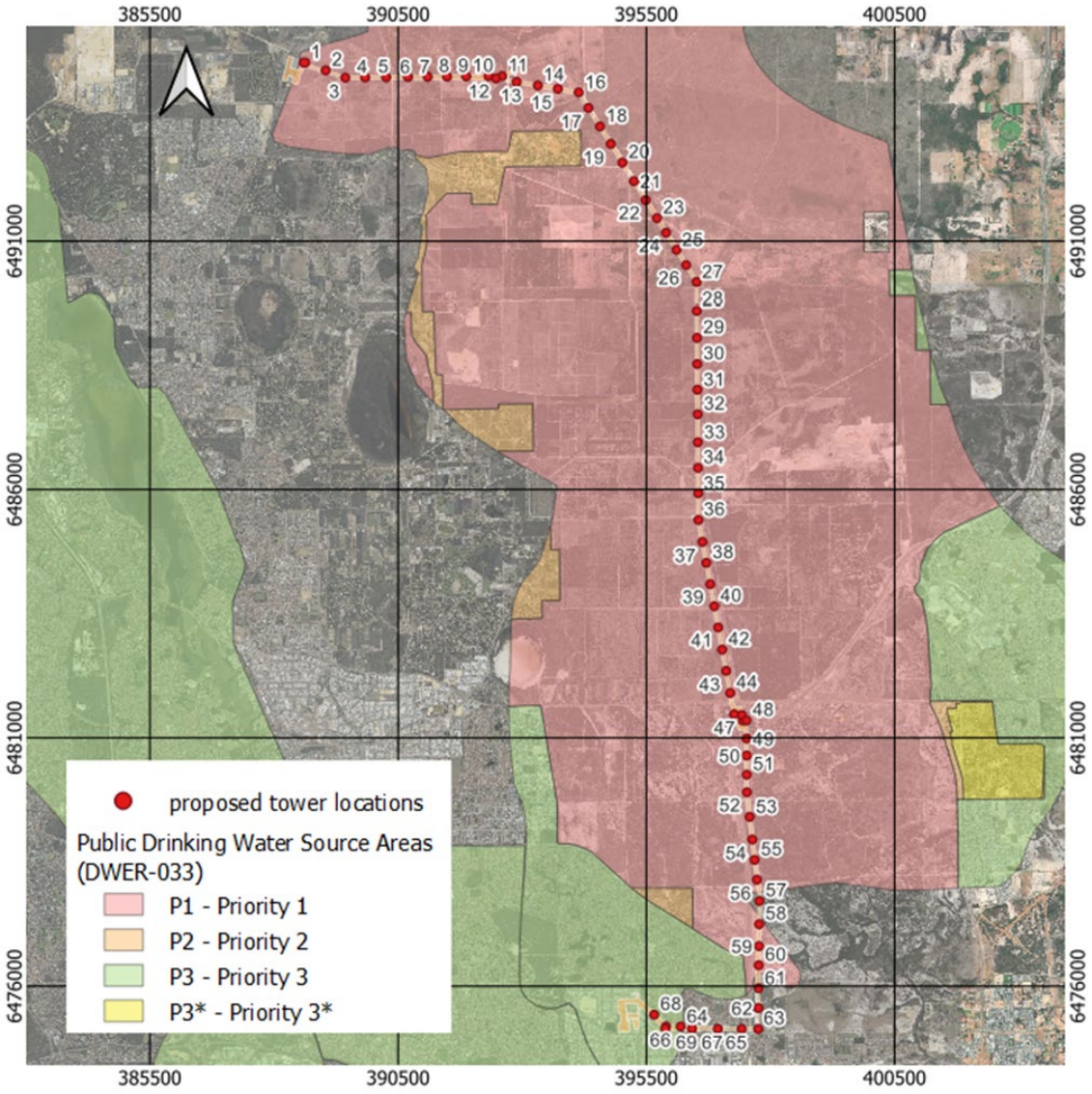

Figure 3-6: Public drinking water source areas (DWER-033)

The PDWSAs are identified as:

Priority 1 (P1) source protection areas are defined to ensure that there is no degradation of the water source. P1 areas are declared over land where the provision of high-quality public drinking water is the prime beneficial land use. These areas are generally located over land under government ownership with native vegetation, such as state forests.

Priority 2 (P2) source protection areas are defined to ensure that there is no increased risk of pollution to the water source. These areas are located on land zoned rural, such as farmland and rural-residential lots.

Priority 3 (P3) source protection areas are defined where it is necessary to manage the risk of pollution to the water source, and where water supply sources need to co-exist with other existing land uses such as residential, commercial and light industrial developments. These areas are located on land zoned urban, commercial and light industrial.

These PDWSAs protect surface and groundwater sources from contamination, including chemicals, nutrients, fuels, waste, litter, turbidity, and harmful microbes. Works in PDWSA are required to be undertaken in a manner that maintains drinking water quality through conditions on local government Development Applications.

3.7.2 Wetlands

A review of the Geomorphic Wetlands of Swan Coastal Plain dataset published by Department of Biodiversity, Conservation and Attractions (DBCA) identified that a total of 15 geomorphic wetlands is intersected by the proposed development envelop. These wetlands are shown in Figure 3-7 and comprise all three types of geomorphic wetland (Resource Enhancement, Multiple Use Wetland, and Conservation Category Wetland).

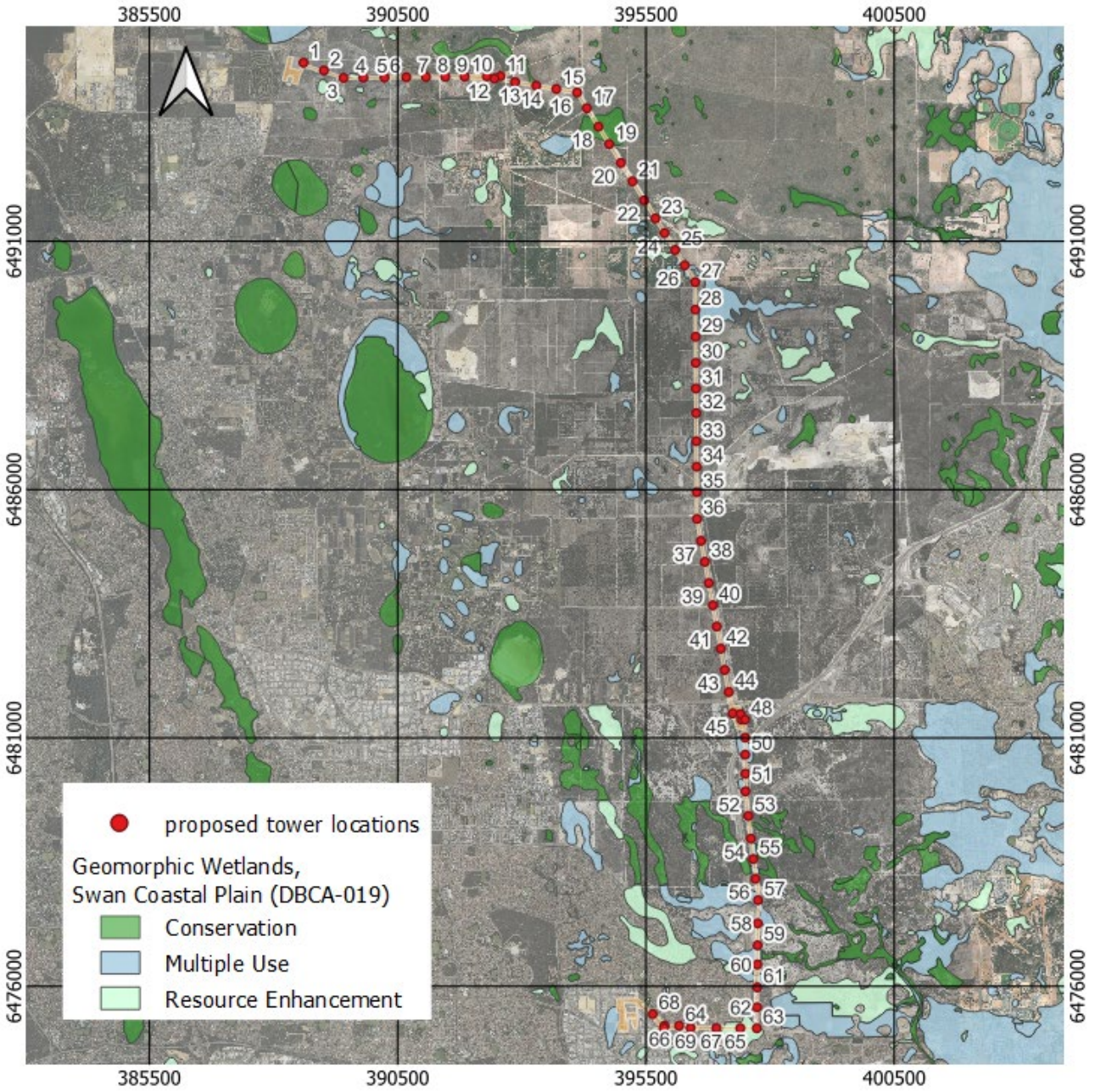

Figure 3-7: Geomorphic Wetlands of Swan Coastal Plain (dataset: DBCA-019)

Three of the wetlands are Conservation Category wetlands. This category of wetland supports a high level of attributes and functions therefore requires the highest level of protection. No development or clearing is considered appropriate. These are the most valuable wetlands and any activity that may lead to further loss or degradation is inappropriate.

Four of the wetlands are Resource Enhancement Category wetlands. This category of wetland may have been partially modified but still support substantial ecological attributes and functions therefore are priority

wetlands. The ultimate objective of this category of wetland is to manage, restore and protect towards improving their conservation value. These wetlands have the potential to be restored to Conservation category. This can be achieved by restoring wetland function, structure and biodiversity. Protection is recommended through a number of mechanisms.

Eight of the wetlands are Multiple Use Category wetlands. This category of wetland has few ecological attributes and functions remaining. Use, development and management should be considered in the context of ecologically sustainable development and best management practice through land care.

3.7.3 Groundwater and Surface Water Quality

Groundwater quality data was sourced from groundwater wells monitored under the State Observation Bore Network (SOBN). The available groundwater and surface water quality data was searched within DWER's Water Information Reporting portal. Search criteria included sites that were sampled within the last 5 years surrounding the project alignment region drawn within the portal as shown in Figure 3-8.

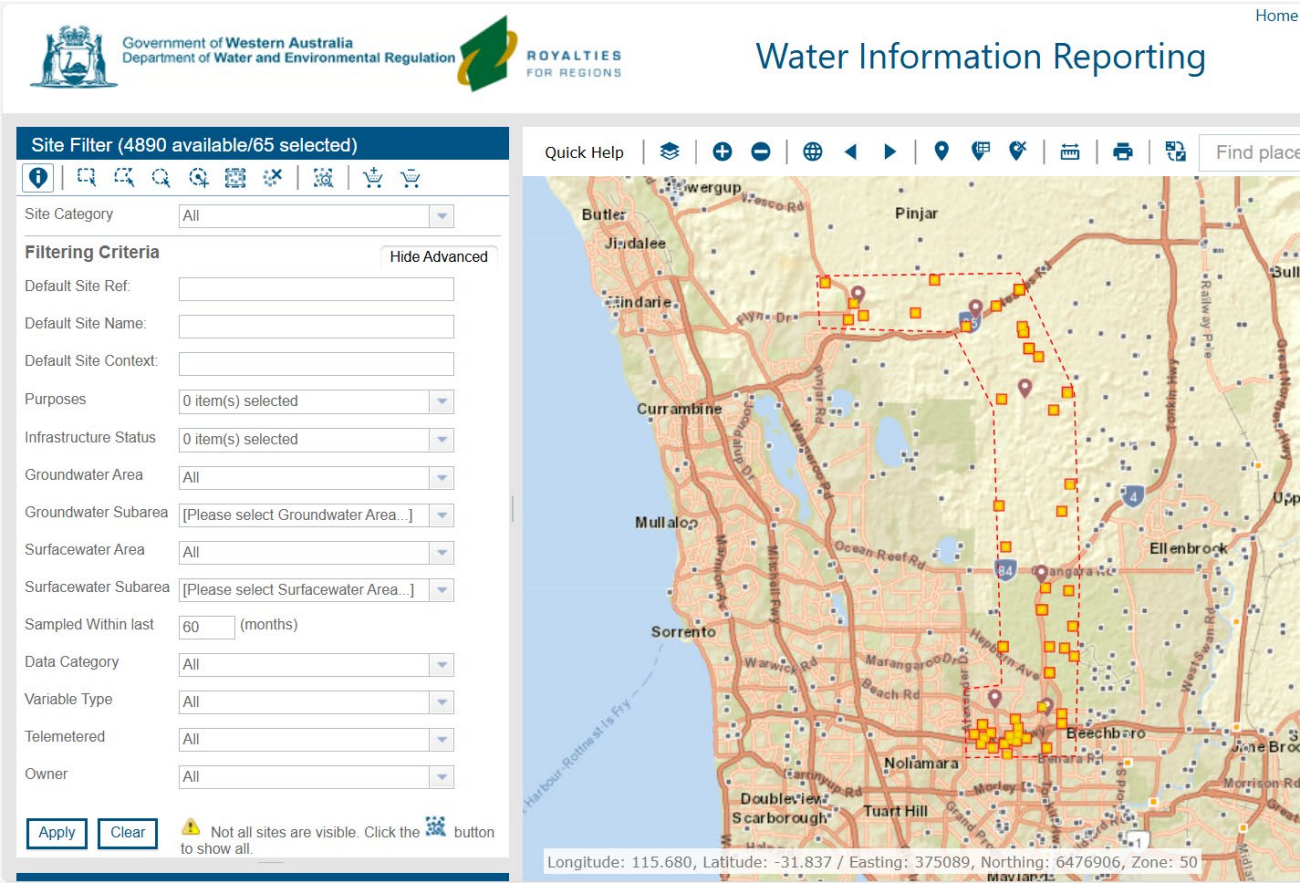

Figure 3-8: Regional groundwater quality data search within DWER's Water Information Reporting portal

Sixty-five monitoring sites were filtered for water quality data that included physiochemical parameters, metals, and nutrients concentrations. The subsequent sites were grouped into groundwater observation or surface water observation. The bores screening deeper aquifers other than superficial aquifer was excluded and the surface water sites were further filtered to include only natural channels. This resulted in available water quality data for eight groundwater bores and three surface water locations as presented in Figure 3-9. The compiled groundwater quality data is attached in Appendix D.

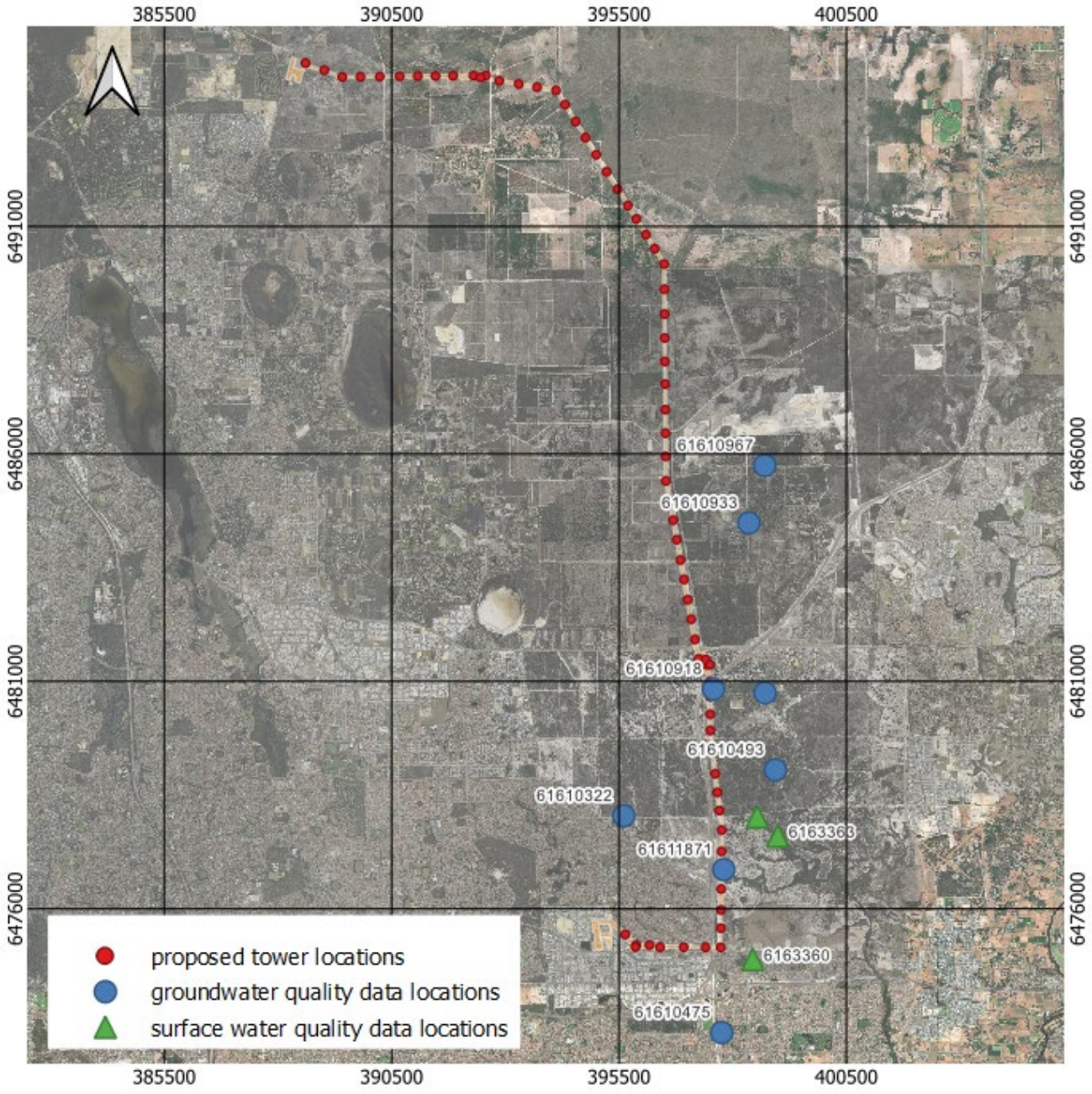

Figure 3-9: Available water quality data sites

Table 3-1 presents the result of the available online physiochemical parameters and compares to the ANZECC water quality guidelines for wetlands.

Table 3-1: Regional groundwater and surface water quality data

Parameters	Average groundwater quality	Average surface water quality	ANZECC Guidelines
pH	5.4	5.1	7.0-8.5
Electrical Conductivity (mS/cm)	0.41	1.45	0.3-1.5
Fe (mg/L)	4.9	5.8	N/A
NH4+ (mg/L)	-	-	0.04

NO_2 (mg/L)	<0.01	-	N/A
NO_x (mg/L)	<0.04	0.07	0.1
Total Nitrogen (mg/L)	0.73	0.84	1.5
Reactive Phosphorus (mg/L)	0.04	<0.05	0.03
Total Phosphorus (mg/L)	0.04	0.01	0.06

Analysis of the monitored physical parameters indicates that groundwater and surface water is fresh, acidic with low level of oxygen, and the results are consisted with the nature of the soils in the region. The total nitrogen is mainly in the organic form as expected due to the extent of native vegetation on-site and limited agricultural activities.

4. IDENTIFICATION OF ENVIRONMENTAL FACTORS

For the purpose of undertaking preliminary and detailed risk impact assessment, environmental factors relevant to the project have been identified. Environmental factors are aspects of the environment that may be impacted by the project. Table 4-1 presents the environmental factors relevant to this project and this section outlines the overall assessment methodology adopted.

Table 4-1: Environmental factors for inland water assessment

Environmental factor within the proposed tower locations	Objectives	Relevance to project
Potential ASS mapping	To maintain the quality of land and groundwater so that environmental values are protected by avoiding unnecessary disturbance which could result in soil acidification and leaching of heavy metals.	Potential dewatering for footings installation may impact ASS within the tower footprints. Should dewatering be necessary, this should be managed in accordance with DWER guidance on *Treatment and management of soil and water in acid sulfate soil landscapes* (DER 2015b).
Presence of TECs	To protect vegetation communities so that biological diversity and ecological integrity is maintained.	Establishment of no clearing zones within the development envelop.
Presence of wetlands	To protect groundwater dependent ecosystems (GDEs), wetland communities and habitat so that biological diversity and ecological integrity is maintained.	Avoiding land clearance within the wetland areas as well as avoiding potential dewatering for footings installation within a buffer distance from mapped wetlands that could impact GDE health.
Shallow depth to water table (<10 metres)	To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.	No new sources of surface water or groundwater contamination. Potential impacts are limited to the construction stage and will be limited to temporary dewatering.

The project area consists of a mixture of low-lying areas, sand dunes of the Bassendean Formation, and undulating terrain of Gnangara Moore River State Forest. The development envelop intersects Conservation category, Multiple Use, and Resource Enhancement wetlands. The project area is located in PDWSA as part of the Gnangara Mound, including areas of Priority 1 PDWSA. As a consequence, risks to groundwater quality need to be considered within the area.

Based on the information reviewed as part of this assessment the potential impacts from the project to the environment include but are not limited to:

- Potential for increased groundwater quality risk in PDWSA and Bennett Brook due to spills and leaks of potential contaminants during construction and operation.
- Potential for increased recreational access to PDWSA.
- Risk of groundwater acidification and leaching of metals if ASS is not properly managed during construction excavations including potential dewatering requirements during footings installations.
- Potential hydrological and soil acidification impacts to the Banksia Woodland TEC leading to degradation of vegetation health if adequate dewatering management is not undertaken.
- Geomorphic wetlands will be impacted by permanent clearing and temporary clearing resulting in the loss of habitat, degradation of surrounding vegetation and habitat, and potential contamination of waterways (AECOM 2024).
- Excessive propagation of drawdown cone arising from temporary dewatering during tower constructions could lead to changes in existing groundwater levels as well as alter groundwater geochemistry. These

could potentially cause changes to water quality which may have detrimental impact to the health and condition of existing wetlands along with Banksia TECs.

There is potential for direct and indirect impacts to wetlands and vegetation from this project and if dewatering is undertaken for tower foundation excavations using uncontained dewatering. Direct impacts are considered those within the impact area resulting from wetlands and vegetation clearing. Indirect impacts are considered those within 50 metres of the impact area, as potential impacts from dust, spills, altered surface and groundwater regimes such as drawdown and changes in inland water chemistry that could occur within this distance. The 50 metres distance is based on the *DWER Clearing Regulation Fact Sheet 24: Environmentally Sensitive Areas (*(DER 2014*)*, whereby a declared Environmentally Sensitive Areas are considered as :

- a defined wetland and the area within 50 metres of the wetland. Defined wetlands include Ramsar wetlands, conservation category wetlands, and nationally important wetlands;
- the area covered by vegetation within 50 metres of rare flora, to the extent to which the vegetation is continuous with the vegetation in which the rare flora is located;
- the area covered by a threatened ecological community.

5. PRELIMINARY RISK IMPACT ASSESSMENT

The likelihood of environmental risk surrounding the project area are assessed with reference to environmental factors relevant to the project by overlaying the geospatial datasets discussed in Section 3 with the proposed tower locations. The tower locations adopted in this assessment are based on Western Power supplied spreadsheet '*NREP NT-NBT 330kV double circuit tower line foundation nomination v0.2*' received via email on 26th March 2025. The proposed 70 tower locations including draft foundation nomination are attached in Appendix B. The tower locations have been numbered starting from Neerabup Terminal (1). Each tower location has been buffered by up to 30 metres to align with the allowance for temporary clearing for construction purposes within a 30 m wide corridor centred on the line route.

5.1 DESIGN OPTION

Western Power has adopted a flexible approach to project design and procurement; thus, the type of transmission infrastructure (e.g. steel poles or steel lattice towers) will depend on material availability and suitably qualified contractors. For this assessment, lattice towers are assumed, which require a larger overall footprint. This ensures the maximum potential footprint is adequately assessed.

Alternate method of foundation construction could be driven piles where piles are driven into the ground using piling rigs with no dewatering requirement other than potentially for the pile cap. These driven piles support concrete foundation pads at the surface where the tower legs sit upon.

The foundation drawing details preliminary design piling depths for each tower locations which ranges between approximately 10 to 20 metres below ground depending on location of tower structure along the line route. The current set of foundation drawings as provided by Western Power are attached in Appendix C. Each lattice tower has four foundation piles ranging between 1.8 to 2.1 m in diameter. For preliminary assessment, we have averaged and assumed that each foundation pile is approximately two metres in diameter and 15 metres in depth.

Given the nature of this project with potential design and excavation method changes, we have conservatively adopted construction method requiring dewatering for preliminary assessment. This approach allows for assessing the maximum extent of impact to Inland Waters for the initial stage.

5.2 DEPTH TO WATER TABLE

The depth to water table has been rasterized from the DWER's online available dataset – *Gnangara Jandakot Depth to Groundwater (Contours) – 2019 Max (DWER-096).* The approximate depth to water table at each tower location has been estimated using zonal statistics over the 20m buffered tower location polygon through geospatial analysis.

5.3 ACID SULFATE SOIL RISK MAPPINGS

Acid Sulfate Soils (ASS) may present a risk when completing development work which involve ground disturbances or changes of groundwater levels within land classified as at risk of ASS. Risk mapping is a preliminary risk assessment method and may provide a preliminary indication that ASS may be present at the site. Risk maps do not describe the actual severity of ASS in a particular area and identifies the type of works likely to present an environmental risk. Further investigation is required to determine the presence of ASS and if concentrations pose a risk to the environment.

5.4 PRELIMINARY RISK IMPACT MATRIX

The preliminary assessment of likelihood of risk to the environment factors based on geospatial analysis of the available datasets with reference to approximate depth to water table at each tower location is presented in Table 5-1.

The presence or absence of environmental factors at each tower location are scored as 0 (absent) or 1 (present). ASS is ranked from 1 to 2 based on ASS risk category: 2 – Class I ASS mapping, 1 – Class I ASS mapping. Wetlands are ranked from 1 to 3 based on importance: 3 – conservation category, 2 – resource enhancement, and 1 – multiple use. This scoring approach resulted in preliminary likelihood of risk scores ranging from 0 to 6, with higher scores indicating greater impact-risk. The impact-risk scores are categorised as follows:

- **risk score 1** – risk category low; presence of Class II ASS mapping with depth to water table greater than 10 m, other environmental factors are absent; thus low risk to environment
- **risk score 2** – risk category medium; presence of Class II ASS mapping with depth to water table less than 10 m, other environmental factors are absent; thus medium risk to environment
- **risk score 3** – risk category medium-high; presence of Class I ASS mapping with shallow depth to water table (<10 m) or presence of Class II ASS along with presence of additional environmental factors; further assessment is required
- **risk score 4-6** – risk category high; shallow depth to water table (<10 m) along with presence of two or more environmental factors, or a higher category of wetland; further assessment is required

Table 5-1: Preliminary Risk-Impact assessment matrix

Tower / Structure Number	Coordinates (GDA94)		Draft foundation type[1]	Approx. depth to water table[2] (mbgl)	Environmental Factor presence and scores[3]				Risk Score	Risk Category
	Easting	Northing			ASS[4]	Wetlands[5]	TEC	DTW < 10m		
1	388615.34	6494580.62	AS	13.8	0	0	0	0	0	Low
2	389026.91	6494425.39	AS	20.0	0	0	0	0	0	Low
3	389422.03	6494276.36	AS	20.3	0	0	0	0	0	Low
4	389822.30	6494280.64	AS	10.8	0	0	0	0	0	Low
5	**390246.33**	**6494285.18**	**AS**	**7.4**	**1**	**0**	**0**	**1**	**2**	**med-high**
6	390685.26	6494289.88	AS	9.3	0	0	0	1	1	med
7	391081.45	6494294.13	AS	6.7	0	0	0	1	1	med
8	391472.21	6494298.31	AS	6.0	0	0	0	1	1	med
9	391859.06	6494302.45	G, RP	5.9	0	0	0	1	1	med
10	392308.44	6494307.26	G, RP	5.5	0	0	0	1	1	med
11	392581.41	6494310.19	G, RP	5.8	0	0	0	1	1	med
12	392459.00	6494263.21	G, RP	5.7	0	0	0	1	1	med
13	392874.36	6494193.09	G, RP	6.3	0	0	0	1	1	med
14	**393301.62**	**6494120.96**	**G, RP**	**4.0**	**1**	**3**	**0**	**1**	**5**	**High**
15	393704.61	6494052.93	AS	4.1	0	0	0	1	1	med
16	394123.51	6493982.21	AS	6.0	0	0	0	1	1	med
17	**394319.87**	**6493666.76**	**AS**	**4.8**	**0**	**0**	**1**	**1**	**2**	**med-high**
18	**394551.64**	**6493294.40**	**AS**	**2.8**	**0**	**3**	**0**	**1**	**4**	**high**
19	394770.31	6492943.10	DS	3.5	0	0	0	1	1	med
20	395004.71	6492566.53	DS	7.0	0	0	0	1	1	med
21	**395236.65**	**6492193.90**	**DS**	**7.9**	**0**	**0**	**1**	**1**	**2**	**med-high**
22	395474.45	6491811.87	DS	10.2	0	0	0	0	0	none

Tower / Structure Number	Coordinates (GDA94)		Draft foundation type[1]	Approx. depth to water table[2] (mbgl)	Environmental Factor presence and scores[3]				Risk Score	Risk Category
	Easting	Northing			ASS[4]	Wetlands[5]	TEC	DTW < 10m		
23	395700.48	6491448.73	DS	5.4	0	0	0	1	1	med
24	395884.08	6491153.77	G, RP	2.9	0	0	0	1	1	med
25	**396097.07**	**6490811.59**	**G, RP**	**1.1**	**1**	**2**	**0**	**1**	**4**	**high**
26	**396289.24**	**6490502.85**	**G, RP**	**1.7**	**1**	**1**	**0**	**1**	**3**	**high**
27	396499.91	6490164.41	G, RP	2.3	0	0	0	1	1	med
28	396504.13	6489611.76	G, RP	3.2	0	0	0	1	1	med
29	396508.29	6489066.88	AS	4.0	0	0	0	1	1	med
30	396512.31	6488540.26	AS	6.0	0	0	0	1	1	med
31	396516.25	6488024.04	AS	17.0	0	0	0	0	0	none
32	396520.03	6487528.00	AS	6.0	0	0	0	1	1	med
33	396524.33	6486964.79	G, RP	11.0	0	0	0	0	0	none
34	396528.26	6486449.87	G, RP	8.0	0	0	0	1	1	med
35	396532.17	6485937.69	G, RP	7.3	0	0	0	1	1	med
36	396536.27	6485400.06	G, RP	5.3	0	0	0	1	1	med
37	396617.49	6484958.44	G, RP	5.2	0	0	0	1	1	med
38	396695.24	6484535.69	DS	5.0	0	0	0	1	1	med
39	396773.78	6484108.66	DS	4.9	0	0	0	1	1	med
40	396855.99	6483661.63	DS	5.0	0	0	0	1	1	med
41	396934.51	6483234.74	DS	5.1	0	0	0	1	1	med
42	397016.51	6482788.88	DS	6.9	0	0	0	1	1	med
43	397095.07	6482361.71	G, RP	4.9	0	0	0	1	1	med
44	397177.11	6481915.61	G, RP	4.5	0	0	0	1	1	med
45	397255.93	6481487.09	G, RP	4.5	0	0	0	1	1	med

Tower / Structure Number	Coordinates (GDA94)		Draft foundation type[1]	Approx. depth to water table[2] (mbgl)	Environmental Factor presence and scores[3]				Risk Score	Risk Category
	Easting	Northing			ASS[4]	Wetlands[5]	TEC	DTW < 10m		
46	397430.44	6481360.80	G, RP	4.0	0	0	0	1	1	med
47	397411.35	6481471.16	G, RP	4.0	0	0	0	1	1	med
48	397505.45	6481362.24	G, RP	4.1	0	0	0	1	1	med
49	397507.37	6480997.72	G, RP	4.1	0	0	0	1	1	med
50	**397509.16**	**6480656.78**	**RP-W**	**3.7**	**0**	**1**	**0**	**1**	**2**	**med-high**
51	397511.19	6480270.65	RP-W	4.0	0	0	0	1	1	med
52	**397513.06**	**6479916.10**	**RP-W**	**3.9**	**0**	**1**	**0**	**1**	**2**	**med-high**
53	397569.88	6479421.33	G, RP	3.1	0	0	0	1	1	med
54	397622.21	6478965.72	G, RP	3.8	0	0	0	1	1	med
55	397669.47	6478554.22	G, RP	3.5	0	0	0	1	1	med
56	397715.15	6478156.45	G, RP	3.4	0	0	0	1	1	med
57	**397764.61**	**6477725.83**	**G, RP**	**3.7**	**0**	**1**	**0**	**1**	**2**	**med-high**
58	397760.45	6477258.76	G, RP	4.0	0	0	0	1	1	med
59	397756.54	6476818.54	RP-W	5.3	0	0	0	1	1	med
60	**397753.10**	**6476431.78**	**RP-W**	**3.9**	**0**	**1**	**0**	**1**	**2**	**med-high**
61	397748.99	6475969.80	RP-W	3.0	0	0	0	1	1	med
62	397745.44	6475570.50	RP-W	4.0	0	0	0	1	1	med
63	**397741.69**	**6475148.31**	**RP-W**	**2.3**	**1**	**2**	**0**	**1**	**4**	**high**
64	**396177.51**	**6475198.70**	**RP-W**	**3.4**	**1**	**0**	**0**	**1**	**2**	**med-high**
65	**397409.01**	**6475149.80**	**RP-W**	**3.4**	**1**	**2**	**0**	**1**	**4**	**high**
66	395883.78	6475200.50	RP-W	3.7	0	0	0	1	1	med
67	396927.63	6475151.95	G, RP	4.2	0	0	0	1	1	med
68	395644.19	6475435.75	RP-W	3.3	0	0	0	1	1	med

Tower / Structure Number	Coordinates (GDA94)		Draft foundation type[1]	Approx. depth to water table[2] (mbgl)	Environmental Factor presence and scores[3]				Risk Score	Risk Category
	Easting	Northing			ASS[4]	Wetlands[5]	TEC	DTW < 10m		
69	396407.22	6475154.27	G, RP	3.0	0	0	0	1	1	med
70	395868.44	6475156.68	AS	5.2	0	0	0	1	1	med

[1]foundation types are based on Western Power supplied foundation nomination spreadsheet, defined as:

Type AS – bored dry straight foundation
Type DS – bored wet straight foundation
Type G – driven pile foundation
Type RP – replacement pile foundation
Type RP-W - replacement wet pile foundation

[2]depth to water table at each tower location is approximated from DWER's dataset – Gnangara Jandakot Depth to Groundwater (Contours) – 2019 Max (DWER-096)
ASS – presence of Acid Sulfate Soil
TEC – presence of Banksia Threatened Ecological Communities
DTW – depth to water table
[3]environmental factor presence are represented by '0' as not present and '1' as environmental factor present
[4]ASS mapping are ranked on their category as 2 – class I ASS mapping, and 1 – class II ASS mapping
[5]wetlands are ranked on their priority as 3 – conservation category, 2 – resource enhancement, and 1 – multiple use category

The preliminary risk-impact scoring has resulted in categorising fourteen tower locations as having preliminary impact-risk of 'medium-high' and 'high'. These fourteen locations are summarized in Table 5-2 and these locations have been selected for preliminary dewatering assessment.

Table 5-2: Summary tower locations with medium-high to high impact-risk category based on preliminary assessment

Tower / Structure Number	Coordinates (GDA94)		Draft foundation type[1]	approx. depth to water table[2] (mbgl)	Environmental Factors				Risk category
	Easting	Northing			ASS	Wetlands	TEC	DTW <10m	
14	393301.6	6494121.0	G, RP	4	Class I	CC	-	yes	**high**
18	394551.6	6493294.4	AS	2.8	Class II	CC	-	yes	**high**
25	396097.1	6490811.6	G, RP	1.1	Class I	RE	-	yes	**high**
26	396289.2	6490502.9	G, RP	1.7	Class I	MU	-	yes	**high**
63	397741.7	6475148.3	RP-W	2.3	Class I	RE	-	yes	**high**
65	397409.0	6475149.8	RP-W	3.4	Class I	RE	-	yes	**high**
5	390246.3	6494285.2	AS	7.4	Class I	-	-	yes	**med-high**
17	394319.9	6493666.8	AS	4.8	Class II	-	Banksia TEC	yes	**med-high**
21	395236.7	6492193.9	DS	7.9	Class II	-	Banksia TEC	yes	**med-high**
50	397509.2	6480656.8	RP-W	3.7	Class II	MU	-	yes	**med-high**
52	397513.1	6479916.1	RP-W	3.9	Class II	MU	-	yes	**med-high**
57	397764.6	6477725.8	G, RP	3.7	Class II	MU	-	yes	**med-high**
60	397753.1	6476431.8	RP-W	3.9	Class II	MU	-	yes	**med-high**
64	396177.5	6475198.7	RP-W	3.4	Class I	-	-	yes	**med-high**

[1]foundation types are based on Western Power supplied foundation nomination spreadsheet

[2]depth to water table at each tower location is approximated from DWER's dataset – Gnangara Jandakot Depth to Groundwater (Contours) – 2019 Max (DWER-096)

ASS – presence of Acid Sulfate Soil risk mapping

Class I – high to moderate risk of ASS occurring within 3m of natural soil surface

Class II – moderate to low risk of ASS occurring within 3m of natural soil surface

CC – Conservation category wetland

RE – Resource enhancement category wetland

MU – Multiple use category wetland

TEC – Banksia Threatened Ecological Communities

DTW – depth to water table

6. PRELIMINARY DEWATERING ASSESSMENT

The preliminary risk-impact assessment has outlined tower locations which have been identified as potentially requiring dewatering. These tower locations are presented in Table 5-1.

Tower locations with a preliminary risk-impact category of 'medium-high' to 'high' summarised in Table 5-2 have been used to estimate dewatering impact at these locations. These locations have been identified as having shallow depth to water table (<10 m) with presence of at least one other environmental factor.

6.1 DEWATERING MODELLING CALCULATIONS AND ASSUMPTIONS

The required abstraction rates and the potential extent of drawdown from dewatering of the foundation excavations have been estimated using an empirical modelling method. This groundwater modelling is based on open-cut trench excavation methods with no hydraulic containment.

Review of the Department of Water's Perth Groundwater Atlas spatial data sets provided information regarding the historical maximum groundwater levels for the proposed alignment. It is to be noted that no site-specific groundwater level data has been collected as field investigation is excluded from this assessment.

6.2 METHODOLOGY

Estimations of groundwater abstraction and the likely cone of depression have been calculated in accordance with the *DER ASS Series Guidelines* (DER, 2015a).

The radius of influence can be estimated utilising Sichardt's equation:

$$R_0 = 3000 \times s \times \sqrt{K}$$

where, R_0 = radius of influence of equivalent pumping bore (m)
s = maximum groundwater drawdown (m)
K = hydraulic conductivity of aquifer matrix (m/s)

Groundwater elevation resulting from dewatering activities is related to pumping rate, hydraulic conductivity of aquifer matrix, and radius of influence of pumping by following equation:

$$H^2 - h^2 = \frac{nq}{\pi k} (\ln R_0 - \ln r_e)$$

where, H = saturated thickness of the aquifer undisturbed by pumping (m)
h = saturated thickness of the aquifer at maximum drawdown (m)
R_0 = radius of influence of an equivalent pumping bore (m)
r_e = effective radius of an equivalent pumping bore (m)
q = pumping rate of individual dewatering well points (m^3/s)
n = number of well points used to dewater the excavation

The pumping time required for the cone of depression to reach the full extent of water table drawdown is calculated utilising the Cooper-Jacob empirical relationship:

$$R_0 = \left((2.25\ k\ h\ t)/S\right)^{0.5}$$

where, t = pumping time (seconds)
S = specific yield of aquifer sediments
other parameters as previously defined

The *DER ASS Series Guidelines* (DER, 2015a) suggest as a minimum, a preliminary assessment of radial extent of cone of depression for dewatering operations in environmentally sensitive areas should be undertaken.

6.3 ASSUMPTIONS AND LIMITATIONS

The scale of dewatering is subject to many assumptions such as trench dimensions (i.e. length, width, depth of excavation) and local hydrogeological conditions (i.e. connectivity to surficial aquifer, proximity of surface water bodies, precipitation).

For this assessment, trench length and width of 3.5 x 3.5 metres is assumed. This dimension is approximately equivalent to trench excavation dimension of four individual pile foundation excavations each with a diameter of 2 metres. The foundation excavations are each assumed to be 15 metres deep for this preliminary assessment.

The superficial aquifer is assumed to be homogeneous and isotropic with following properties:

- The average saturated thickness of the aquifer is assumed as 30 metres (Davidson & Yu, 2006).
- The average hydraulic conductivity of the aquifer matrix is taken as 15 m/day (Davidson & Yu, 2006).
- The average specific yield of the aquifer matrix is taken as 0.2 (Davidson & Yu, 2006).

6.4 RESULTS

The results of the preliminary dewatering assessment are presented in Table 6-1.

Table 6-1: Preliminary dewatering assessment

Tower / Structure Number	Preliminary Risk Category	approx. depth to water table (mbgl)	Drawdown (m)	Cone of Depression Radius^ (m)	Estimated Abstraction Rate (L/s)	Time to establish required drawdown (hours)
14	**high**	4	11	430	53	708
18	**high**	2.8	12.2	477	57	929
25	**high**	1.1	13.9	544	61	1333
26	**high**	1.7	13.3	520	59	1177
63	**high**	2.3	12.7	497	58	1036
65	**high**	3.4	11.6	454	55	813
5	**med-high**	7.4	7.6	297	42	287
17	**med-high**	4.8	10.2	399	51	584
21	**med-high**	7.9	7.1	278	41	245
50	**med-high**	3.7	11.3	442	54	759
52	**med-high**	3.9	11.1	434	54	724
57	**med-high**	3.7	11.3	442	54	759
60	**med-high**	3.9	11.1	434	54	724
64	**med-high**	3.4	11.6	454	55	813

^the radius of cone of depression is estimated in comparison to the ASS and DWER guidance which states 100 mm maximum within 100m.

The results indicate groundwater level drawdown of between approximately 7 to 14 metres in these selected fourteen tower locations will result in cone of depression with radius ranging approximately between 278 to 544 metres with groundwater abstraction rate ranging between 41 to 61 litres per second.

These radius of cones of depression and groundwater abstraction rate estimates are approximations only and will vary according to (but are not limited) the following:

- actual groundwater levels (subject to seasonal variations from rainfall events, abstraction from nearby bores, mounding caused by onsite re-infiltration);
- changes in ground conditions which affect the hydraulic conductivity of the soil profile;
- changes in saturated thickness of the superficial aquifer along the alignment; as well as
- any construction schedule changes.

From this preliminary dewatering assessment, it is evident that complete dewatering for foundation excavation with no hydraulic containment is not feasible or practical as this construction method results in a large cone of depression and large abstraction rates. It is evident that preliminary risk-impact mapping undertaken by buffering each tower location by 20 metres in line with temporary clearing for construction purpose is not adequate as this severely underestimates the extent of cone of depression should complete dewatering be undertaken. Thus, the geospatial risk-impact mapping needs to be re-assessed with revised estimates for radius of cones of depression for tower locations based on differing groundwater levels along the alignment.

The disturbance of ASS material or dewatering in ASS mapped areas can lead to the release of acid and mobilisation of metals, causing contamination of groundwater which may cause offsite impacts to groundwater and other environmental receptors such as groundwater dependent ecosystems. There is potential for direct and indirect impacts to wetlands and vegetation from this project and if dewatering is undertaken for tower foundation excavations using uncontained dewatering.

7. DETAILED RISK IMPACT ASSESSMENT

7.1 ALTERNATIVE FOUNDATION METHOD ASSESSMENT

For the purposes of this assessment, we have considered dewatering impact from three different foundation methods:

1. Bored pile with dewatering without hydraulic containment
2. Bored and cased pile with hydraulic containment and dewatering from bottom only
3. Driven piling with limited pile cap excavation and shallow dewatering as required

In absence of site-specific groundwater levels and seasonal water table fluctuation data at each tower location, it was considered unnecessary to estimate the dewatering impact at each tower location individually. Doing so would result in estimation of radius of cone of depression and dewatering abstraction rate at each tower location with high uncertainty given the absence of finer resolution of groundwater level data. Instead, the 70 tower locations have been grouped into three classes with varying depth to water table to provide ranges of dewatering estimates at each of the group. The tower locations have been grouped into three classes based on depth to water table: 0-5 mbgl, 5-10 mbgl, and 10-15 mbgl.

7.1.1 Bored pile with dewatering without hydraulic containment

The excavation with dewatering without hydraulic containment is estimated based upon empirical modelling method in-line with the DER ASS Series Guidelines. This method has been described in Section 6.

Results

The results of the dewatering assessment for bored pile with dewatering without hydraulic containment is presented in Table 7-1.

Table 7-1: Bored pile with dewatering without hydraulic containment

Depth to water table	Tower/ Structure numbers	number of locations	assumed average foundation depth (m)	maximum drawdown outside excavation (m)	cone of depression radius (m)	estimated abstraction rate (l/s)
0 – 5 mbgl	14, 15, 17, 18, 19, 24, 25, 26, 27, 28, 29, 38, 39, 40, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69	40	15	10 – 15	391 – 587	50 – 63
5 – 10 mbgl	5, 6, 7, 8, 9, 10, 11, 12, 13, 16, 20, 21, 23, 30, 32, 34, 35, 36, 37, 41, 42, 59, 70	23	15	5 – 10	196 – 391	32 – 50
10 – 15 mbgl	1, 4, 22, 33	4	15	0 – 5	0 – 196	0 – 32
> 15 mbgl	2, 3, 31	3	15	-	-	-

risk ranking for medium-high and high category has been colour coded with red as below:

high	*presence of Class I or Class II ASS mapping with drawdown greater than 10 m extending over 100 m*
med-high	*presence of Class I or Class II ASS mapping with drawdown between 5 to 10 m extending over 100 m*

The results from dewatering assessment for bored pile with dewatering without hydraulic containment is summarised below:

- at locations where depth to water table is between 0-5 mbgl, the radius of cone of depression extends to about 391 to 587 metres with estimated abstraction rate ranging between 50 to 63 l/s
- at locations where depth to water table is between 5-10 mbgl, the radius of cone of depression extends to about 196 to 391 metres with estimated abstraction rate ranging between 32 to 50 l/s
- at locations where depth to water table is between 10-15 mbgl, the radius of cone of depression extends between none to 196 metres with estimated abstraction rate up to 35 l/s

These are based on assumptions of average foundation depth of 15 metres and aquifer parameters as discussed above. The revised environmental risk impact categorisation based on these dewatering estimates are discussed in section 7.2.

7.1.2 Bored and cased pile with hydraulic containment and dewatering from bottom only

The foundation excavation method consisting of bored and cased pile followed by dewatering with hydraulic containment such that groundwater inflow is from bottom of casing only is estimated used numerical modelling (i.e. sheet pile wall).

The simulation program used for modelling the groundwater inflow was Modflow USG (Panday et al. 2017) coupled with the pre- and post-processor Groundwater Vistas Version 9 (ESI, 2024). The groundwater model is comprised of two layers, covering an area with dimensions approximately 800 metres north–south by 800 metres east–west.

The model layers are summarised as:

- Layer 1 – Bassendean Sand of the superficial aquifer. The layer top elevation was set as 30 metres assuming arbitrary ground surface. The layer bottom elevation was set at 15 metres corresponding to the adopted average depth of tower foundation 15 metres below ground.
- Layer 2 – Bassendean Sand of the superficial aquifer. The layer top elevation was set at 15 metres corresponding to the base elevation of adopted depth of tower foundation. The layer bottom was set to achieve assumed saturated depth of superficial aquifer as 30 metres.

The groundwater model was developed with constant head boundary conditions set to each of the corresponding depth to water table: 0 mbgl, 5 mbgl, and 10 mbgl; under the different dewatering scenarios. The base of the model was set as no flow boundary and recharge along with evapotranspiration were set to zero, i.e. the effect of these climatic factors have been excluded.

The model grid size ranges from 12.5 cm within the foundation excavation to 4 metres across the general model domain. This corresponds to six levels of mesh discretisation.

The foundation excavation was modelled as drain cells which allow water to be extracted from the model. The drain cells have a total area of 12.25 sq. metres corresponding to adopted foundation excavation dimensions of 3.5 metres by 3.5 metres. The effect of hydraulic containment (casing) was modelled by defining a zone of low permeability material immediately outside the excavation area. This casing around the excavation has permeability three orders of magnitude lower than the general permeability of the superficial aquifer.

The model was run as a transient simulation with hourly stress periods for total time duration of five days. This time period is deemed sufficient to establish the effect of foundation excavation and concreting which is proposed to be competed within two days of foundation construction.

Results

The results of the dewatering assessment for bored and cased pile with hydraulic containment and dewatering from bottom only is presented in Table 7-2.

Table 7-2: Bored and cased pile with hydraulic containment and dewatering from bottom only

Depth to water table	Tower/ Structure numbers	number of locations	assumed average foundation depth (m)	maximum drawdown outside excavation (m)	cone of depression radius (m)	estimated abstraction rate (l/s)
0 – 5 mbgl	14, 15, 17, 18, 19, 24, 25, 26, 27, 28, 29, 38, 39, 40, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69	40	15	10 – 15	6 – 12	4.9 – 9.6
5 – 10 mbgl	5, 6, 7, 8, 9, 10, 11, 12, 13, 16, 20, 21, 23, 30, 32, 34, 35, 36, 37, 41, 42, 59, 70	23	15	5 – 10	4 – 6	1.7 – 4.9
10 – 15 mbgl	1, 4, 22, 33	4	15	0 – 5	0 – 4	0 – 1.7
> 15 mbgl	2, 3, 31	3	15	-	-	-

risk ranking has been colour coded as below:

medium	*presence of Class I or Class II ASS mapping with drawdown greater than 10 m and cone of depression <100 m >20 m*
low	*presence of Class I or Class II ASS mapping with drawdown less than 10 m and limited cone of depression*

The results from dewatering assessment for bored and cased pile with hydraulic containment and dewatering from bottom only is summarised below:

- at locations where depth to water table is between 0-5 mbgl, the radius of cone of depression extends to about 6 to 12 metres with estimated abstraction rate ranging between 4.9 to 9.6 l/s
- at locations where depth to water table is between 5-10 mbgl, the radius of cone of depression extends to about 4 to 6 metres with estimated abstraction rate ranging between 1.7 to 4.9 l/s
- at locations where depth to water table is between 10-15 mbgl, the radius of cone of depression extends between none to 4 metres with estimated abstraction rate up to 1.7 l/s

These are based on assumptions of average foundation depth of 15 metres and aquifer parameters as discussed above. The revised environmental risk impact categorisation based on these dewatering estimates are discussed in section 7.2.

7.1.3 Driven piling with pile cap excavation and shallow dewatering

The third method of tower foundation construction is piles driven into the ground with no dewatering requirement other than potentially for the pile cap excavation. These driven piles support concrete foundation pads at the surface where the tower legs sit upon.

In this method, foundation pad excavation with dimensions 2 metres by 2 metres and 2.5 metres depth is excavated with dewatering as required. The piles are then driven into the ground to required depth and concrete is poured into the excavations to complete the pile caps which tie onto the top of the piles. The tower legs are supported on these pile caps once the concrete is cured.
It is noted that each piling method will require a pile cap. This assessment covers all caps in addition to the other pile methods if utilised.

For this assessment, an equivalent foundation excavation for the footing pads with trench length and width of 8 metres is considered. This is equivalent to trench excavation dimension of four individual footing pad excavations each with length and width of 2 metres. The depth of foundation pad excavation is adopted to be 2.5 metres. Dewatering is required where water table is shallower than 2.5 metres.

The required abstraction rates and the potential extent of drawdown from dewatering of the foundation pad excavations have been estimated using empirical modelling method. This groundwater modelling is based on open-cut trench excavation method with no hydraulic containment in accordance with the *DER ASS Series Guidelines* (DER, 2015a). This method has been described in Section 6.

Results

The results of the dewatering assessment for pile caps with foundation pad excavation and dewatering is presented in Table 7-3.

Table 7-3: Dewatering assessment for pile caps with foundation pad excavation and dewatering

Depth to water table	Tower/ Structure numbers	number of locations	depth of footing pad excavation (m)	maximum drawdown outside excavation (m)	cone of depression radius (m)	estimated abstraction rate (l/s)
0 – 1.5 mbgl	25	1	2.5	1.5 – 2.5	59 – 98	18 – 25
1.5 – 2.5 mbgl	26, 27, 63	3	2.5	0 – 1.5	0 – 59	0 – 18
2.5 – 4 mbgl	14, 18, 19, 24, 28, 29, 46, 47, 50, 51, 52, 53, 54, 55, 56, 57, 58, 60, 61, 62, 64, 65, 66, 68, 69	25	2.5	-	-	-
> 4 mbgl	all other locations	41		not applicable		

risk ranking has been colour coded as below:

medium	*presence of Class I or Class II ASS mapping with drawdown greater than 10 m and cone of depression <100 m >20 m*
low	*presence of Class I or Class II ASS mapping with drawdown less than 10 m and limited cone of depression*

The results from dewatering assessment for driven piles with shallow pile cap excavation and dewatering without hydraulic containment indicates following:

- at locations where depth to water table is between 0-1.5 mbgl, the radius of cone of depression extends to about 59 to 98 metres with estimated abstraction rate ranging between 18 to 25 l/s
- at locations where depth to water table is between 1.5-2.5 mbgl, the radius of cone of depression extends between none to 59 metres with estimated abstraction rate up to 18 l/s
- at locations where depth to water table is between 2.5 to 4 metres, no dewatering impact is observed based upon DWER's historical groundwater levels. However, actual groundwater levels at these locations may be up to 1.5 metres higher due to seasonal groundwater level fluctuation and following periods of heavy rainfall. Thus, the current estimates should be interpreted with caution.
  If the groundwater levels at such locations rises by up to 1.5 metres, the radius of cone of depression may potentially extends up to 59 metres with estimated abstraction rate up to 18 l/s.

7.1.4 Summary of dewatering assessment

The preliminary dewatering assessment based on open-cut trench excavation method with no hydraulic containment indicated substantial radius of cones of depression and groundwater abstraction rates. Three methods of foundation construction were assessed to quantify the extent of dewatering impact.

The three different foundation methods assessed in this report are:

1. Bored pile with dewatering without hydraulic containment
2. Bored and cased pile with hydraulic containment and dewatering from bottom only
3. Driven piling with limited pile cap excavation and shallow dewatering as required

In absence of site-specific groundwater levels and seasonal water table fluctuation data at each tower location, it was considered unnecessary to estimate the dewatering impact at each tower location. Instead, the tower locations have been grouped based on regional depth to water table and the dewatering impact estimated for each group. The historical maximum groundwater levels for the proposed alignment was obtained by reviewing DWER's spatial data sets. No site-specific groundwater level data has been collected as field investigation is excluded in this assessment.

The excavation and dewatering without hydraulic containment is estimated based upon empirical modelling method in-line with the DER ASS Series Guidelines. The excavation method with casing and dewatering with hydraulic containment such that groundwater inflow is from bottom of casing only is estimated based upon numerical modelling. The results of these dewatering assessment for the different foundation methods are presented in Table 7-4 and Table 7-5.

The dewatering assessment indicated 40 tower locations have a depth to water table ranging between 0–5 mbgl. At these locations, bored pile with dewatering without hydraulic containment presents high risk to environment due drawdown exceeding 10 m and cones of depression extending greater than 100 m with potential abstraction rates exceeding 50 l/s. There are 23 tower locations having a depth to water table ranging between 5–10 mbgl. At these locations, bored pile with dewatering without hydraulic containment presents medium-high risk to environment due drawdown ranging between 5-10 m and cones of depression extending greater than 100 m with potential abstraction rates exceeding 30 l/s. Thus, where depth to water table is shallower than 10 metres, the construction method needs to adopt excavation with casing and dewatering with hydraulic containment to minimize the impact. This approach of bored and cased pile with hydraulic containment and dewatering from bottom only would result cones of depression extending up to 15 m with abstraction rates up to 9.6 m/s.

For tower locations where depth to water table is shallower than 5 metres, 4 locations were identified as having depth to water table between 0-2.5 mbgl and 25 locations were identified as having depth to water table between 2.5 to 4 mbgl. At these locations, construction for shallow pile cap excavation (2.5 metres depth) with dewatering was estimated to result in cones of depression extending up to 59 metres with estimated abstraction rates up to 18 l/s. These estimates replied upon DWER's historical groundwater levels and consideration that actual groundwater levels may be up to 1.5 metres higher than DWER's regional estimates due to seasonal groundwater level fluctuation and following periods of heavy rainfall.

Table 7-4: Summary results for dewatering assessment - foundation option 1 vs foundation option 2

depth to water table	Tower/ Structure numbers	number of locations	assumed average foundation depth (m)	Foundation option 1 – bored pile with dewatering without hydraulic containment			Foundation option 2 – bored and cased pile with hydraulic containment and dewatering from bottom only		
				drawdown (m)	cone of depression radius (m)	flow rate (l/s)	drawdown (m)	cone of depression radius (m)	flow rate (l/s)
0 – 5 mbgl	14, 15, 17, 18, 19, 24, 25, 26, 27, 28, 29, 38, 39, 40, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69	40	15	10 – 15	391 – 587	50 – 63	10 – 15	10 – 15	4.9 – 9.6
5 – 10 mbgl	5, 6, 7, 8, 9, 10, 11, 12, 13, 16, 20, 21, 23, 30, 32, 34, 35, 36, 37, 41, 42, 59, 70	23	15	5 – 10	196 – 391	32 – 50	5 – 10	5 – 10	1.7 – 4.9
10 – 15 mbgl	1, 4, 22, 33	4	15	0 – 5	0 – 196	0 – 32	0 – 5	0 – 5	0 – 1.7

risk ranking has been colour coded as below:

high	*presence of Class I or Class II ASS mapping with drawdown greater than 10 m extending over 100 m*
med-high	*presence of Class I or Class II ASS mapping with drawdown between 5 to 10 m extending over 100 m*
medium	*presence of Class I or Class II ASS mapping with drawdown greater than 10 m and cone of depression <100 m >20 m*
low	*presence of Class I or Class II ASS mapping with drawdown less than 10 m and limited cone of depression*

Table 7-5: Summary results for shallow pile cap excavation and dewatering

Depth to water table	Tower/ Structure numbers	number of locations	depth of footing pad excavation (m)	drawdown (m)	cone of depression radius (m)	estimated abstraction rate (l/s)
0 – 1.5 mbgl	25	1	2.5	1.5 – 2.5	59 – 98	18 – 25
1.5 – 2.5 mbgl	26, 27, 63	3	2.5	0 – 1.5	0 – 59	0 – 18
2.5 – 4 mbgl	14, 18, 19, 24, 28, 29, 46, 47, 50, 51, 52, 53, 54, 55, 56, 57, 58, 60, 61, 62, 64, 65, 66, 68, 69	25	2.5	up to 1.5[1]	up to 59[2]	up to 18[3]
> 4 mbgl	all other locations	41		not applicable		

risk ranking has been colour coded as below:

medium	***presence of Class I or Class II ASS mapping with drawdown greater than 10 m and cone of depression <100 >20***
low	*presence of Class I or Class II ASS mapping with drawdown less than 10 m and limited cone of depression*

[1,2,3]*at locations where regional depth to water is greater than 2.5 mbgl, consideration is given that actual groundwater levels may be up to 1.5 metres higher than DWER's regional estimates due to seasonal groundwater level fluctuation and following periods of heavy rainfall*

These radius of cones of depression and groundwater abstraction rate estimates are approximations only and will vary according to (but are not limited) the following:

- actual groundwater levels (subject to seasonal variations from rainfall events, abstraction from nearby bores, mounding caused by onsite re-infiltration);
- changes in ground conditions which affect the hydraulic conductivity of the soil profile;
- changes in saturated thickness of the superficial aquifer along the alignment; as well as any construction schedule changes.

The result from dewatering assessment indicates that dewatering for foundation excavation without hydraulic containment is not feasible or practical if undertaken because it results in cones of depression greater than 100 m and requires substantial abstraction rates. It is evident that preliminary risk-impact mapping and categorisation undertaken in section 5 by buffering each tower location by 20 metres in line with temporary clearing for construction purpose severely underestimates the extent of cone of depression.

Thus, the geospatial risk-impact mapping has been re-assessed with revised estimates for possible radius of cones of depression for tower locations based on differing groundwater levels along the alignment in consideration with alternate methods of foundation construction. These are discussed in section 7.2.

7.2 REVISED RISK IMPACT CATEGORIZATION

The preliminary risk impact categorisation for each of the tower locations presented in section 5 have been reassessed with updated risk impact categorisation based on the detailed risk impact assessment and revised dewatering estimates for the three different methods of foundation construction. These risk-impact are categorisation is presented in Table 7-6.

Table 7-6: Risk-Impact categorisation for each tower location based on foundation construction method

Tower Number	Coordinates (GDA94)		approx. depth to water table[1] (mbgl)	Environmental Factors within 50 metres			Environmental Risk Impact based on three different foundation construction methods		
	Easting	Northing		ASS[2]	Wetlands	DTW <10m	Bored pile with dewatering without hydraulic containment	Bored and cased pile with hydraulic containment and dewatering from bottom	Driven pile with pile cap excavation and shallow dewatering
1	388615.34	6494580.62	13.8	Class II	-	no	medium	very low	very low
2	389026.91	6494425.39	20.0	Class II	-	no	very low	very low	very low
3	389422.03	6494276.36	20.3	Class II	-	no	very low	very low	very low
4	389822.30	6494280.64	10.8	Class II	-	possibly	medium	very low	very low
5	390246.33	6494285.18	7.4	Class I	-	yes	high	low	very low
6	390685.26	6494289.88	9.3	Class II	-	yes	high	low	very low
7	391081.45	6494294.13	6.7	Class II	-	yes	high	low	very low
8	391472.21	6494298.31	6.0	Class II	-	yes	high	low	very low
9	391859.06	6494302.45	5.9	Class II	-	yes	high	low	very low
10	392308.44	6494307.26	5.5	Class II	-	yes	high	low	very low
11	392581.41	6494310.19	5.8	Class II	-	yes	high	low	very low
12	392459.00	6494263.21	5.7	Class II	-	yes	high	low	very low
13	392874.36	6494193.09	6.3	Class II	-	yes	high	low	very low
14	393301.62	6494120.96	4.0	Class I	CCW	yes	high	low	low
15	393704.61	6494052.93	4.1	Class II	-	yes	high	low	very low
16	394123.51	6493982.21	6.0	Class II	-	yes	high	low	very low

Tower Number	Coordinates (GDA94)		approx. depth to water table[1] (mbgl)	Environmental Factors within 50 metres			Environmental Risk Impact based on three different foundation construction methods		
	Easting	Northing		ASS[2]	Wetlands	DTW <10m	Bored pile with dewatering without hydraulic containment	Bored and cased pile with hydraulic containment and dewatering from bottom	Driven pile with pile cap excavation and shallow dewatering
17	394319.87	6493666.76	4.8	Class II	-	yes	high	low	very low
18	394551.64	6493294.40	2.8	Class II	CCW	yes	high	medium	medium
19	394770.31	6492943.10	3.5	Class I	CCW	yes	high	medium	medium
20	395004.71	6492566.53	7.0	Class II	-	yes	high	low	very low
21	395236.65	6492193.90	7.9	Class II	-	yes	high	low	very low
22	395474.45	6491811.87	10.2	Class II	-	possibly	medium	very low	very low
23	395700.48	6491448.73	5.4	Class II	-	yes	high	low	very low
24	395884.08	6491153.77	2.9	Class II	-	yes	high	medium	medium
25	396097.07	6490811.59	1.1	Class I	RE	yes	high	high	high
26	396289.24	6490502.85	1.7	Class I	MU	yes	high	high	high
27	396499.91	6490164.41	2.3	Class II	-	yes	high	medium	medium
28	396504.13	6489611.76	3.2	Class II	-	yes	high	medium	medium
29	396508.29	6489066.88	4.0	Class II	-	yes	high	low	low
30	396512.31	6488540.26	6.0	Class II	-	yes	high	low	very low
31	396516.25	6488024.04	17.0	Class II	-	no	none	very low	very low
32	396520.03	6487528.00	6.0	Class II	-	yes	high	low	very low
33	396524.33	6486964.79	11.0	Class II	-	possibly	medium	very low	very low
34	396528.26	6486449.87	8.0	Class II	-	yes	high	low	very low
35	396532.17	6485937.69	7.3	Class II	-	yes	high	low	very low
36	396536.27	6485400.06	5.3	Class II	-	yes	high	low	very low
37	396617.49	6484958.44	5.2	Class II	-	yes	high	low	very low

Tower Number	Coordinates (GDA94)		approx. depth to water table[1] (mbgl)	Environmental Factors within 50 metres			Environmental Risk Impact based on three different foundation construction methods		
	Easting	Northing		ASS[2]	Wetlands	DTW <10m	Bored pile with dewatering without hydraulic containment	Bored and cased pile with hydraulic containment and dewatering from bottom	Driven pile with pile cap excavation and shallow dewatering
38	396695.24	6484535.69	5.0	Class II	-	yes	high	low	very low
39	396773.78	6484108.66	4.9	Class II	-	yes	high	low	very low
40	396855.99	6483661.63	5.0	Class II	-	yes	high	low	very low
41	396934.51	6483234.74	5.1	Class II	-	yes	high	low	very low
42	397016.51	6482788.88	6.9	Class II	-	yes	high	low	very low
43	397095.07	6482361.71	4.9	Class II	-	yes	high	low	very low
44	397177.11	6481915.61	4.5	Class II	-	yes	high	low	very low
45	397255.93	6481487.09	4.5	Class II	-	yes	high	low	very low
46	397430.44	6481360.80	4.0	Class II	-	yes	high	low	low
47	397411.35	6481471.16	4.0	Class II	-	yes	high	low	low
48	397505.45	6481362.24	4.1	Class II	-	yes	high	low	very low
49	397507.37	6480997.72	4.1	Class II	-	yes	high	low	very low
50	397509.16	6480656.78	3.7	Class II	MU	yes	high	medium	medium
51	397511.19	6480270.65	4.0	Class II	-	yes	high	low	low
52	397513.06	6479916.10	3.9	Class II	MU	yes	high	low	low
53	397569.88	6479421.33	3.1	Class II	-	yes	high	medium	medium
54	397622.21	6478965.72	3.8	Class II	-	yes	high	medium	medium
55	397669.47	6478554.22	3.5	Class II	-	yes	high	medium	medium
56	397715.15	6478156.45	3.4	Class II	-	yes	high	medium	medium
57	397764.61	6477725.83	3.7	Class II	MU	yes	high	medium	medium
58	397760.45	6477258.76	4.0	Class I	MU	yes	high	low	low

Tower Number	Coordinates (GDA94)		approx. depth to water table[1] (mbgl)	Environmental Factors within 50 metres			Environmental Risk Impact based on three different foundation construction methods		
	Easting	Northing		ASS[2]	Wetlands	DTW <10m	Bored pile with dewatering without hydraulic containment	Bored and cased pile with hydraulic containment and dewatering from bottom	Driven pile with pile cap excavation and shallow dewatering
59	397756.54	6476818.54	5.3	Class I	MU	yes	high	low	very low
60	397753.10	6476431.78	3.9	Class II	MU	yes	high	low	low
61	397748.99	6475969.80	3.0	Class I	-	yes	high	medium	medium
62	397745.44	6475570.50	4.0	Class II	-	yes	high	low	low
63	397741.69	6475148.31	2.3	Class I	RE	yes	high	medium	medium
64	396177.51	6475198.70	3.4	Class I	-	yes	high	medium	medium
65	397409.01	6475149.80	3.4	Class I	RE	yes	high	medium	medium
66	395883.78	6475200.50	3.7	Class II	-	yes	high	medium	medium
67	396927.63	6475151.95	4.2	Class II	-	yes	high	low	very low
68	395644.19	6475435.75	3.3	Class II	-	yes	high	medium	medium
69	396407.22	6475154.27	3.0	Class II	-	yes	high	medium	medium
70	395868.44	6475156.68	5.2	Class II	-	yes	high	low	very low

[1]depth to water table at each tower location is approximated from DWER's dataset – Gnangara Jandakot Depth to Groundwater (Contours) – 2019 Max (DWER-096)

[2]ASS – presence of Acid Sulfate Soil risk mapping

Class I – high to moderate risk of ASS occurring within 3m of natural soil surface

Class II – moderate to low risk of ASS occurring within 3m of natural soil surface

CC – Conservation category wetland

RE – Resource enhancement category wetland

MU – Multiple use category wetland

DTW – depth to water table

The risk categories are defined as below:

- high - cone of depression >100m and interacting with one or more environmental factors
  - (wetlands or ASS), damage to environment very likely
- medium - cone of depression >50m and interacting with one or more environmental factors
  - (wetlands or ASS), damage to environment likely
- low - cone of depression between 5-10 m and limited interaction with one or more environmental factors
  - wetlands or ASS), damage to environment minimal
- very low - cone of depression less than 5 m and minimal interaction with environmental factors
  - (wetlands or ASS), damage to environment unlikely

The assessment has identified every tower location being mapped under either Class I or Class II ASS risk mapping. Under the ASS risk mapping, sites should be investigated for ASS if the following works are proposed, as listed below and outlined in Table 7-7.

- For land classified as Class I under ASS risk mapping, any soil or sediment disturbances of greater than 100 m^3, including construction of roads, foundations, installation of underground infrastructures, drainage works and land forming works triggers further investigation.
- For land classified as Class II under ASS risk mapping, soil or sediment disturbances of greater than 100 m^3 from below the water table triggers further investigation.
- For land classified as both Class I and Class II under ASS risk mapping, lowering of the water table, either temporarily or permanently (e.g. for groundwater abstraction, dewatering, installation of new drainage, modification to existing drainage) triggers further investigation.

Table 7-7: Intrusive Works Triggering ASS Investigation

Class of land, as shown on ASS risk mapping	Nature of disturbance that triggers further ASS investigation
Class 1 – high to moderate risk of ASS occurring within 3m of natural soil surface	• Earthworks that will disturb more than 100m^3 of soil • Dewatering or soil draining activity
Class 2 – moderate to low risk of ASS occurring within 3m of natural soil surface but high to moderate risk of ASS beyond 3m of natural soil surface	• Works involving lowering of water table (temporary or permanent) • Earthworks extending to beyond 3 metres below natural ground surface • Earthworks that will disturb more than 100m^3 of soil below the water table • Works within 500m of wetlands

If the above disturbance is proposed, a targeted ASS investigation of the area is required, in accordance with the DWER guideline *'Investigation and Identification of Acid Sulfate Soils and Acidic Landscapes'* (DER, 2015a). Based on the risk-impact matrix, any tower locations with shallow depth to water table of less than 10 metres and requiring excavation or dewatering needs to be further investigated to determine the magnitude and extent of ASS in the site area.

8. CONCLUSION

This report presents a desktop evaluation of potential impacts to the hydrology and water quality of groundwater and wetlands along the alignment of proposed NT-NBT 330kV double circuit transmission line. The environmental risk-impact assessment across the proposed tower construction locations was undertaken by identifying and mapping the environmental factors: presence of acid sulfate soils, vegetation communities and geomorphic wetlands, with reference to shallow depth to water table across the region.

The regional depth to water table varies along the alignment ranging between 1 to 20 metres based on DWER's historical datasets. These groundwater levels could rise to about 1.5 m higher than average following periods of heavy rainfall. The groundwater quality within the area is fresh with salinity less than 500 mg/L of total dissolved solids as expected for the Priority 1 public drinking water source areas protection zone.

Western Power has adopted a flexible approach to design and construction, allowing contractors to nominate alternate foundation methods. The current foundation design drawings indicate piling depths for each tower locations ranging between approximately 10 to 20 metres depending on location of tower structure along the line route. For this assessment, Tetra Tech Coffey has assumed average foundation piles with a diameter of two metres and a depth of 15 metres.

This assessment considered the dewatering impacts of three different foundation methods:

1. Bored pile with dewatering without hydraulic containment
2. Bored and cased pile with hydraulic containment and dewatering from bottom only
3. Driven piling with pile cap excavation and shallow dewatering

Excavation and dewatering without hydraulic containment were estimated based upon empirical modelling method in-line with the DER ASS Series Guidelines. The foundation excavation method with casing and dewatering with hydraulic containment was estimated based upon synthetic numerical modelling.

Results indicate the dry construction method – bored pile with dewatering without hydraulic containment would result in radial drawdown extending between 100 to 500 metres with estimated abstraction rates of 30 to 60 litres per second. This suggests construction relying only on dry method with dewatering without hydraulic containment is not feasible or practical due to the extensive groundwater impact.

In areas where GDEs are affected by dewatering and depth to water is shallow, the construction method should adopt excavation with casing and dewatering with hydraulic containment. This approach would result in radial drawdown of 4 to 12 metres with estimated abstraction rates of 1.7 to 9.6 litres per second. Alternatively, where depth to water table exceeds 2.5 metres, driven piling with foundation pad excavations can be undertaken.

Before commencing excavations, it is essential to establish groundwater levels and assess the potential for acid sulfate soils at each tower location to identify potential environmental impacts and implement appropriate mitigation measures. Disturbance of ASS materials and unnecessary dewatering can lead to the release of acid and mobilisation of metals, causing groundwater contamination which may cause offsite impacts to groundwater and other environmental receptors such as groundwater dependent ecosystems. Provided ASS areas and dewatering requirements are appropriately managed during construction, the project is not expected to cause significant impact to terrestrial and groundwater environmental quality.

9. RECOMMENDED MANAGEMENT ACTIONS

The project area consists of a mixture of low-lying areas and sand dunes of the Bassendean Formation within Swan Coastal Plain. Most the alignment overlies areas with Class II - low to moderate risk of ASS occurring within 3 m of the natural surface, with some areas mapped as Class I - high to moderate risk of ASS occurring within 3 m of the natural surface. The high-risk areas are primarily associated with wetlands in the Gnangara Moore River State Forest and wetlands surrounding Whiteman Park areas.

The Project is also located in PDWSA as part of the Gnangara Mound, including areas of Priority 1 PDWSA. Consequently, risks to groundwater quality need to be considered within the area. This is particularly the case during construction where equipment and machinery requires refuelling. The project area also passes over the upper reaches of a tributary of Bennett Brook. Measures should be undertaken to avoid altering the flow path of the tributary and minimising the risk of spills and leaks in this area.

The mitigation and management actions required for the project includes:

- Development of water quality management measures as part of the Construction Environmental Management Plan (CEMP), including procedures for refuelling and chemical handling.
- Investigating measures to avoid and/or minimise clearing in wetlands, particularly the clearing of Conservation Category wetlands, through detailed design process.
- Designing tracks with access gates to minimise recreational access to PDWSA.
- Dewatering is expected to be required where shallow groundwater levels are observed. Given the nature of seasonal fluctuation of groundwater, scheduling work for drier periods of the year will reduce the requirement for dewatering.

9.1 RECOMMENDED ADDITIONAL ASS INVESTIGATIONS

Additional investigation is required for the project in relation to the potential presence of ASS. Tower locations require additional ASS investigation if located within a Class I risk area, or if lowering of the water table (temporary or permanently) is expected as a part of intrusive works.

Based on the proposed foundation methods, the following towers require additional investigation:

- For bored piles, with dewatering, without hydraulic containment, all towers, with the exception of 2, 3, and 31, require additional investigation.
- For bored and cased piles, with hydraulic containment and dewatering from bottom only, all towers, with the exception of 2, 3, and 31, require additional investigation.
- For driven piles with pile cap excavation and shallow dewatering, tower numbers 5, 14, 18, 19, 24, 25, 26, 27, 58, 61, 63, 64, and 65, require additional investigation.

9.2 RECOMMENDED SOIL MANAGEMENT STRATEGIES

The following soil management strategies are recommended to minimise the risk of ASS impacts:

- Topsoil and subsoil (where available) should be stripped to a combined depth of ~300mm and stockpiled prior to use in progressive rehabilitation. In accordance with DWER (2015b), topsoil will not require neutralisation if the pH of surface soils (0-300mm) is less than pH4.0. Should the pH of this material be less than pH4.0, neutralisation should be undertaken using suitable alkaline material to ensure a revised validation criterion of pH5.0 is achieved.
- For excavations within ASS soil, a guard layer of alkaline material should initially be added to the base and walls (where practical) of the excavation void to limit potential for oxidation.

- Excavated soil (overburden) that has been identified as ASS should be stockpiled on a treatment pad, treated with a suitable neutralising alkaline material at an appropriate rate to account for the acidity, and verified. The treated soil that will be used for site construction purposes (i.e. roads, pads, bunds, etc) should either be:
- Neutralised and verified for re-use within 70 hours of excavation; or
- Stockpiled on a treatment pad for up to 21 days prior to neutralisation, verification and re-use.
- Treatment pads to store any form of ASS material should be constructed of compacted crushed limestone of not less than 300mm thickness, be graded to ensure good drainage, and all sides bunded with limestone or similar alkaline material to a minimum height of approximately 150mm above the surface of the pad to prevent lateral run-off. A leachate collection system should also be present to manage run-off from rainfall events.
- Documentation of soil management should be maintained for:
- Source and volume of ASS material requiring neutralization;
- Source and volume of neutralising material used;
- Verification sampling undertaken;
- Final location of treated material.

9.3 RECOMMENDED DEWATERING MANAGEMENT STRATEGIES

The following dewatering management strategies are recommended to minimise the risk of groundwater acidification due to ASS impacts:

- Dewatering to the required depth of excavation should be undertaken passively as groundwater enters the foundation excavation. The groundwater should be pumped from the excavation using a suction pump set at a level to maintain a 0.5m saturated sump pit floor. The use of passive dewatering reduces the extent of groundwater drawdown as far as practical.
- High to medium risk tower locations (dependant on proposed foundation solution) will require at least one groundwater sampling well where dewatering is required to monitor the groundwater quality before, during, and after the construction.
- Groundwater should be field tested weekly for pH, electrical conductivity, total titratable acidity and total alkalinity.
- Monthly laboratory analysis should be undertaken for pH, electrical conductivity, total dissolved solids, total acidity, total alkalinity, dissolved aluminium, dissolved iron and dissolved manganese.
- DER (2015b) guidelines require that dewatering effluent with a pH of less than pH 6.0 or total acidity of >40mgCaCO3/L or total alkalinity < 30mgCaCO3/L, be treated via addition of a neutralising agent prior to re-infiltration.
- Groundwater trigger values should be established from baseline groundwater quality prior to commencement of construction or dewatering activities.

9.4 GROUNDWATER MONITORING PROGRAM

The following groundwater monitoring program is recommended during dewatering operations for the superficial groundwater monitoring well network:

- Weekly monitoring of groundwater levels;
- Monthly laboratory analysis for pH, electrical conductivity, total dissolved solids, total acidity, total alkalinity, chloride, sulfate, dissolved iron, dissolved aluminium, and dissolved manganese. (*If concentration of Al >1 mg/L then the additional analysing for As, Cd, Cr, Cu, Pb, Hb, Ni, Se, Zn*)

The groundwater monitoring results should be compared to site-specific trigger criteria developed based on existing baseline monitoring results. At the completion of dewatering operations, groundwater monitoring should continue as above for six months (or until any adverse trends have stabilised) then on a quarterly basis for an additional 12 months (18 months in total post works).

10. REFERENCES

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ESI (2024) Groundwater Vistas Version 9, Environmental Simulations Inc Software Release, 1 June 2024, https://www.groundwatermodels.com

Panday S., Langevin, C.D., Niswonger, R.G., Ibaraki M., and Hughes, J.D. (2017), MODFLOW USG version 1.4.00: An unstructured grid version of MODFLOW for simulating groundwater flow and tightly coupled processes using a control volume finite-difference formulation: U.S. Geological Survey Software Release, 27 October 2017, https://dx.doi.org/10.5066/F7R20ZFJ

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WSP (2024) Geotechnical Investigation – 330 kV Transmission Line between Northern Terminal and Neerabup Terminal, dated June 2024.

APPENDIX A: STATEMENT OF LIMITATIONS

IMPORTANT INFORMATION ABOUT YOUR TETRA TECH COFFEY ENVIRONMENTAL REPORT

Introduction

This report has been prepared by Tetra Tech Coffey for you, as Tetra Tech Coffey's client, in accordance with our agreed purpose, scope, schedule and budget.

The report has been prepared using accepted procedures and practices of the consulting profession at the time it was prepared, and the opinions, recommendations and conclusions set out in the report are made in accordance with generally accepted principles and practices of that profession.

The report is based on information gained from environmental conditions (including assessment of some or all of soil, groundwater, vapour and surface water) and supplemented by reported data of the local area and professional experience. Assessment has been scoped with consideration to industry standards, regulations, guidelines and your specific requirements, including budget and timing. The characterisation of site conditions is an interpretation of information collected during assessment, in accordance with industry practice.

This interpretation is not a complete description of all material on or in the vicinity of the site, due to the inherent variation in spatial and temporal patterns of contaminant presence and impact in the natural environment. Tetra Tech Coffey may have also relied on data and other information provided by you and other qualified individuals in preparing this report. Tetra Tech Coffey has not verified the accuracy or completeness of such data or information except as otherwise stated in the report. For these reasons the report must be regarded as interpretative, in accordance with industry standards and practice, rather than being a definitive record.

Your report has been written for a specific purpose

Your report has been developed for a specific purpose as agreed by us and applies only to the site or area investigated. Unless otherwise stated in the report, this report cannot be applied to an adjacent site or area, nor can it be used when the nature of the specific purpose changes from that which we agreed.

For each purpose, a tailored approach to the assessment of potential soil and groundwater contamination is required. In most cases, a key objective is to identify, and if possible quantify, risks that both recognised and potential contamination pose in the context of the agreed purpose. Such risks may be financial (for example, clean up costs or constraints on site use) and/or physical (for example, potential health risks to users of the site or the general public).

Limitations of the Report

The work was conducted, and the report has been prepared, in response to an agreed purpose and scope, within time and budgetary constraints, and in reliance on certain data and information made available to Tetra Tech Coffey.

The analyses, evaluations, opinions and conclusions presented in this report are based on that purpose and scope, requirements, data or information, and they could change if such requirements or data are inaccurate or incomplete.

This report is valid as of the date of preparation. The condition of the site (including subsurface conditions) and extent or nature of contamination or other environmental hazards can change over time, as a result of either natural processes or human influence. Tetra Tech Coffey should be kept appraised of any such events and should be consulted for further investigations if any changes are noted, particularly during construction activities where excavations often reveal subsurface conditions.

In addition, advancements in professional practice regarding contaminated land and changes in applicable statues and/or guidelines may affect the validity of this report. Consequently, the currency of conclusions and recommendations in this report should be verified if you propose to use this report more than 6 months after its date of issue.

The report does not include the evaluation or assessment of potential geotechnical engineering constraints of the site.

Interpretation of factual data

Environmental site assessments identify actual conditions only at those points where samples are taken and on the date collected. Data derived from indirect field measurements, and sometimes other reports on the site, are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact with respect to the report purpose and recommended actions.

Variations in soil and groundwater conditions may occur between test or sample locations and actual conditions may differ from those inferred to exist. No environmental assessment program, no matter how comprehensive, can reveal all subsurface details and anomalies. Similarly, no professional, no matter how well qualified, can reveal what is hidden by earth, rock or changed through time.

The actual interface between different materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions.

For this reason, parties involved with land acquisition, management and/or redevelopment should retain the services of a suitably qualified and experienced environmental consultant through the development and use of the site to identify variances, conduct additional tests if required, and recommend solutions to unexpected conditions or other unrecognised features encountered on site. Tetra Tech Coffey would be pleased to assist with any investigation or advice in such circumstances.

Recommendations in this report

This report assumes, in accordance with industry practice, that the site conditions recognised through discrete sampling are representative of actual conditions throughout the investigation area. Recommendations are based on the resulting interpretation.

Should further data be obtained that differs from the data on which the report recommendations are based (such as through excavation or other additional assessment), then the recommendations would need to be reviewed and may need to be revised.

Report for benefit of client

Unless otherwise agreed between us, the report has been prepared for your benefit and no other party. Other parties should not rely upon the report or the accuracy or completeness of any recommendation and should make their own enquiries and obtain independent advice in relation to such matters.

Tetra Tech Coffey assumes no responsibility and will not be liable to any other person or organisation for, or in relation to, any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report.

To avoid misuse of the information presented in your report, we recommend that Tetra Tech Coffey be consulted before the report is provided to another party who may not be familiar with the background and the purpose of the report. In particular, an environmental disclosure report for a property vendor may not be suitable for satisfying the needs of that property's purchaser. This report should not be applied for any purpose other than that stated in the report.

Interpretation by other professionals

Costly problems can occur when other professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, a suitably qualified and experienced environmental consultant should be retained to explain the implications of the report to other professionals referring to the report and then review plans and specifications produced to see how other professionals have incorporated the report findings.

Given Tetra Tech Coffey prepared the report and has familiarity with the site, Tetra Tech Coffey is well placed to provide such assistance. If another party is engaged to interpret the recommendations of the report, there is a risk that the contents of the report may be misinterpreted and Tetra Tech Coffey disowns any responsibility for such misinterpretation.

Data should not be separated from the report

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way. Logs, figures, laboratory data, drawings, etc. are customarily included in our reports and are developed by scientists or engineers based on their interpretation of field logs, field testing and laboratory evaluation of samples. This information should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

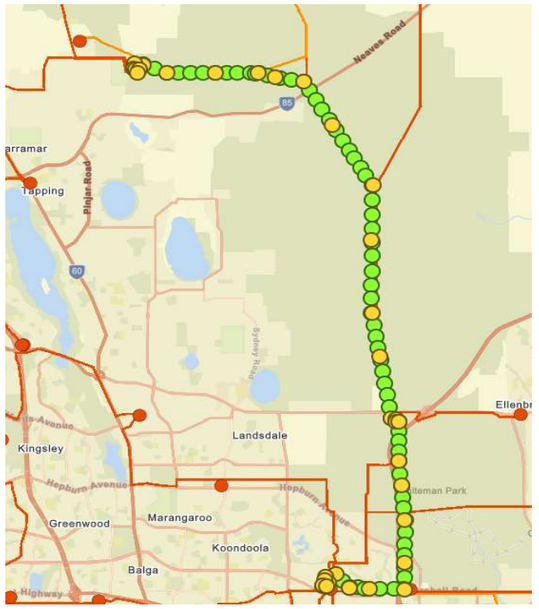
This report should be reproduced in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties.

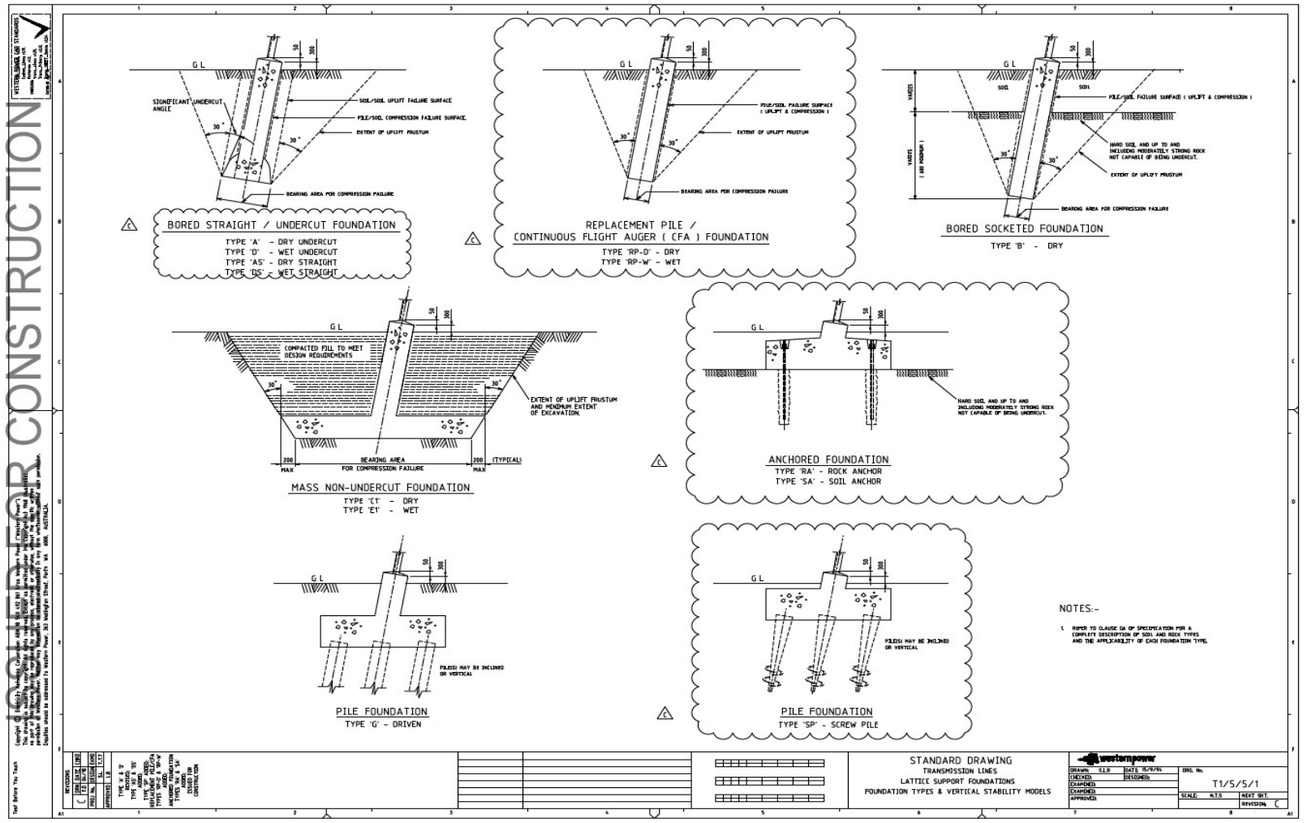
Responsibility

Environmental reporting relies on interpretation of factual information using professional judgement and opinion and has a level of uncertainty attached to it, which is much less exact than other design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. As noted earlier, the recommendations and findings set out in this report should only be regarded as interpretive and should not be taken as accurate and complete information about all environmental media at all depths and locations across the site.

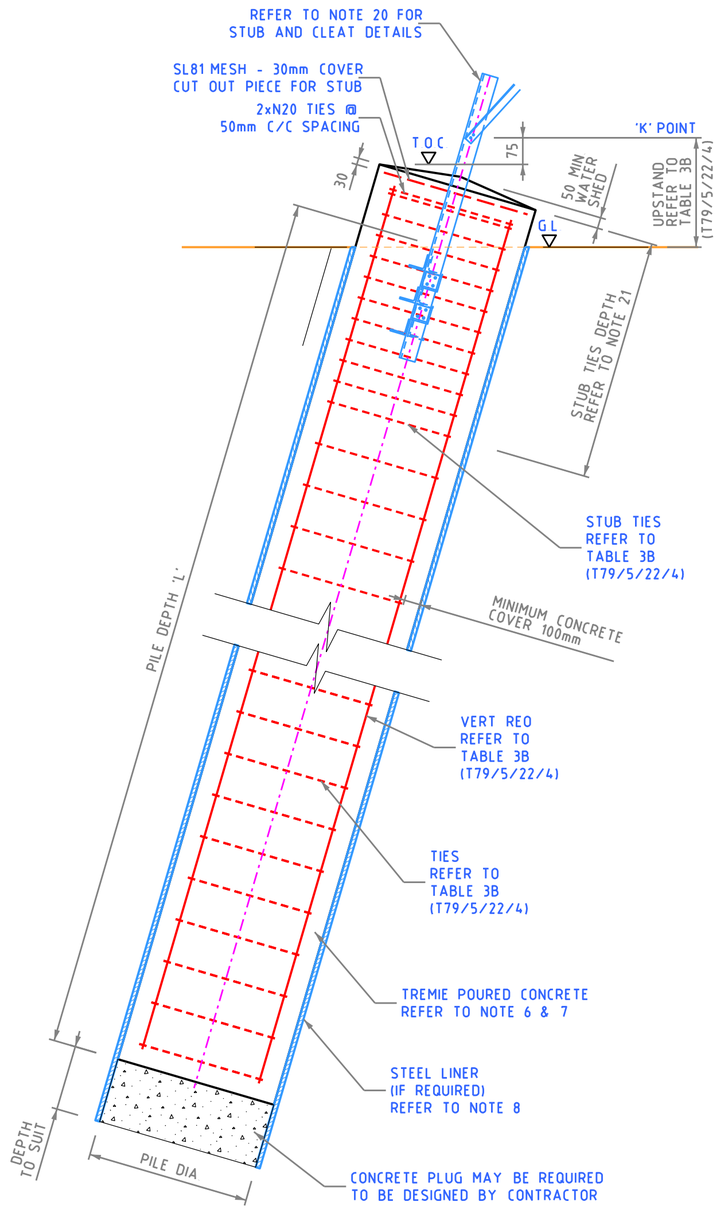
APPENDIX B: NREP NT-NBT 330KV DOUBLE CIRCUIT TOWERLINE FOUNDATION NOMINATION

Key Components	New Structure Locations Option 2 - Tower				Darft Foundation Nomination v0.1		
	Structure Number	Structure Type	GDA 94 EASTING COORDINATES	GDA 94 NORTHING COORDINATES	Option 1	Option 2	Option 3
NT to NBT 330kV double circuit line	1		388615.34	6494580.62	AS	G	SP
	2		389026.91	6494425.39	AS	G	SP
	3		389422.03	6494276.36	AS	G	SP
	4		389822.3	6494280.64	AS	G	SP
	5		390246.33	6494285.18	AS	G	SP
	6		390685.26	6494289.88	AS	G	SP
	7		391081.45	6494294.13	AS	G	SP
	8		391472.21	6494298.31	AS	G	SP
	9		391859.06	6494302.45	G, RP	SP	DS
	10		392308.44	6494307.26	G, RP	SP	DS
	11		392581.41	6494310.19	G, RP	SP	DS
	12		392459	6494263.21	G, RP	SP	DS
	13		392874.36	6494193.09	G, RP	SP	DS
	14		393301.62	6494120.96	G, RP	SP	DS
	15		393704.61	6494052.93	AS	G	SP
	16		394123.51	6493982.21	AS	G	SP
	17		394319.87	6493666.76	AS	G	SP
	18		394551.64	6493294.4	AS	G	SP
	19		394770.31	6492943.1	DS	G	SP
	20		395004.71	6492566.53	DS	G	SP
	21		395236.65	6492193.9	DS	G	SP
	22		395474.45	6491811.87	DS	G	SP
	23	330kV tower	395700.48	6491448.73	DS	G	SP
	24		395884.08	6491153.77	G, RP	SP	DS
	25		396097.07	6490811.59	G, RP	SP	DS
	26		396289.24	6490502.85	G, RP	SP	DS
	27		396499.91	6490164.41	G, RP	SP	DS
	28		396504.13	6489611.76	G, RP	SP	DS
	29		396508.29	6489066.88	AS	G	SP
	30		396512.31	6488540.26	AS	G	SP
	31		396516.25	6488024.04	AS	G	SP
	32		396520.03	6487528	AS	G	SP
	33		396524.33	6486964.79	G, RP	SP	DS
	34		396528.26	6486449.87	G, RP	SP	DS
	35		396532.17	6485937.69	G, RP	SP	DS
	36		396536.27	6485400.06	G, RP	SP	DS
	37		396617.49	6484958.44	G, RP	SP	DS
	38		396695.24	6484535.69	DS	G	SP
	39		396773.78	6484108.66	DS	G	SP
	40		396855.99	6483661.63	DS	G	SP
	41		396934.51	6483234.74	DS	G	SP
	42		397016.51	6482788.88	DS	G	SP
	43		397095.07	6482361.71	G, RP	SP	DS
	44		397177.11	6481915.61	G, RP	SP	DS
	45		397255.93	6481487.09	G, RP	SP	DS
	46	330kV tower	397430.44	6481360.8	G, RP	SP	DS
	47	330kV tower	397411.35	6481471.16	G, RP	SP	DS
	48		397505.45	6481362.24	G, RP	SP	DS
	49		397507.37	6480997.72	G, RP	SP	DS
	50		397509.16	6480656.78	RP-W	G	SP
	51		397511.19	6480270.65	RP-W	G	SP
	52		397513.06	6479916.1	RP-W	G	SP
	53		397569.88	6479421.33	G, RP	SP	DS
	54		397622.21	6478965.72	G, RP	SP	DS
	55	330kV tower	397669.47	6478554.22	G, RP	SP	DS
	56		397715.15	6478156.45	G, RP	SP	DS
	57		397764.61	6477725.83	G, RP	SP	DS
	58		397760.45	6477258.76	G, RP	SP	DS
	59		397756.54	6476818.54	RP-W	G	SP
	60		397753.1	6476431.78	RP-W	G	SP
	61		397748.99	6475969.8	RP-W	G	SP
	62		397745.44	6475570.5	RP-W	G	SP
	63	Steel Poles	397741.69	6475148.31	RP-W	G	SP
	64		396177.51	6475198.7	RP-W	G	SP
	65		397409.01	6475149.8	RP-W	G	SP
	66		395883.78	6475200.5	RP-W	G	SP
	67	330kV tower	396927.63	6475151.95	G, RP	SP	DS
	68		395644.19	6475435.75	RP-W	G	SP
	69		396407.22	6475154.27	G, RP	SP	DS
	70		395868.44	6475156.68	AS	G	SP

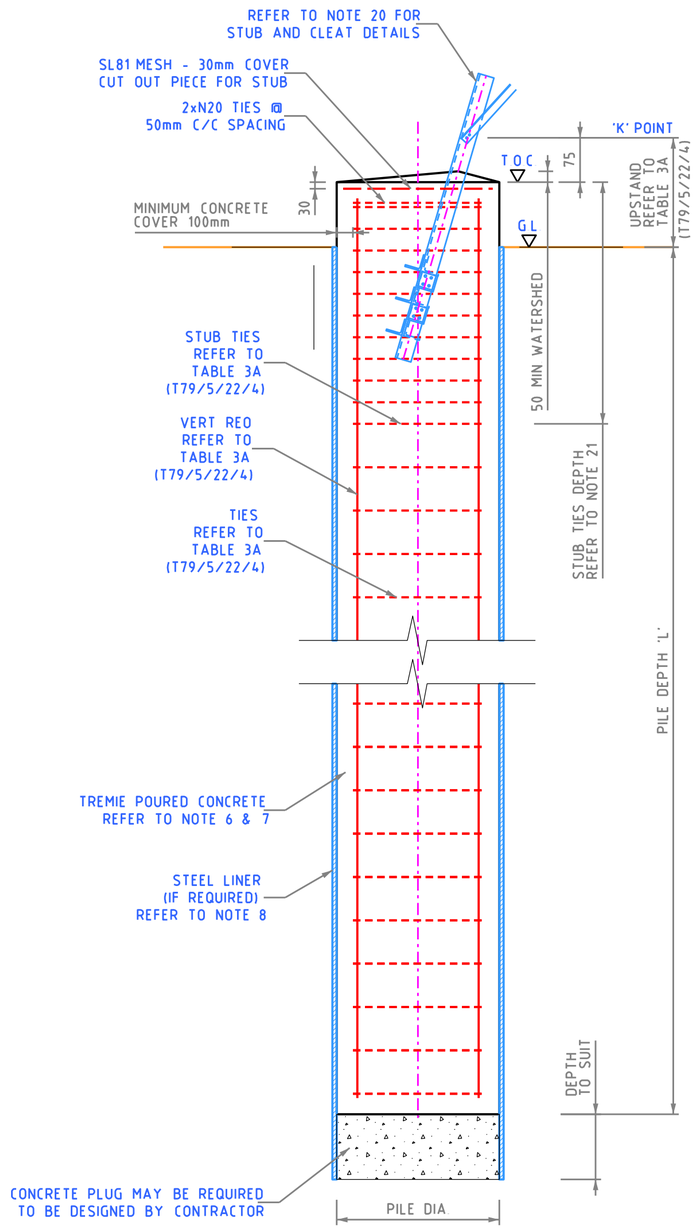




APPENDIX C: NREP NT-NBT 330KV DOUBLE CIRCUIT TOWERLINE FOUNDATION DRAWING



INCLINED PILE FOUNDATION
NOT TO SCALE



VERTICAL PILE FOUNDATION
NOT TO SCALE

GENERAL NOTES

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL OTHER DRAWINGS, SPECIFICATIONS AND WITH SUCH OTHER WRITTEN INSTRUCTIONS AS MAY BE ISSUED DURING THE COURSE OF THE CONTRACT ANY DISCREPANCY SHALL BE REFERRED TO THE SUPERINTENDENT FOR DECISION BEFORE PROCEEDING WITH THE WORK
2. REFER TO CONSTRUCTION SCHEDULES T79/4/24/1 TO 4 AND T79/4/32/1 TO 4 FOR STRUCTURE LOCATIONS REFER TO DRAWING T5003/6/0/3/1 FOR ADDITIONAL NOTES
3. ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE SAA CODES AND THE BY-LAWS AND ORDINANCES OF THE RELEVANT AUTHORITIES

FOUNDATION NOTES

4. FOUNDATIONS HAVE BEEN DESIGNED IN ACCORDANCE WITH AS/NZS 7000 AND WESTERN POWER ENGINEERING AND DESIGN STANDARD - TRANSMISSION LINE GEOTECHNICAL INVESTIGATIONS (EDM £28483277) WITH A GEOTECHNICAL REDUCTION FACTOR OF 0 65 THE SOIL PROPERTIES SHOWN IN TABLES 2 1 TO 2 9 (REFER TO SHEET 2 - T79/5/22/2) ARE AS PER "PS203357-WSP-PER-GEO-REP-00025 Rev0" (EDM£69907160) IF SOIL IS FOUND TO BE SIGNIFICANTLY DIFFERENT, IT SHALL BE REPORTED TO THE ENGINEER FOR GUIDANCE PRIOR TO CONSTRUCTION
5. ALL STRUCTURAL CONCRETE SHALL BE SPECIAL CLASS CONCRETE IT SHALL HAVE A CEMENTITIOUS CONTENT AND COMPOSITION SO THAT PEAK TEMPERATURE SHALL NOT EXCEED 70°C AND THE TEMPERATURE DIFFERENCE SHALL NOT EXCEED 20°C FORMWORK MAY NOT BE STRIPPED EARLIER THAN 3 DAYS FROM POURING
6. ALL STRUCTURAL CONCRETE SHALL BE GRADE S32 MINIMUM AND TREMIE POURED CONCRETE MIX AND CURING REQUIREMENTS TO BE IN ACCORDANCE WITH AS 3600 AND AS 1379
7. FOR FOUNDATION IN AGGRESSIVE SOIL AND/OR GROUNDWATER CONDITION, CONCRETE GRADE SHALL BE S40 WITH SULFATE-RESISTING CEMENT IN ACCORDANCE WITH AS 3972
8. A STEEL LINER MAY BE REQUIRED FOR FOUNDATION CONSTRUCTION IN COLLAPSIBLE SOIL LINER TO BE KEPT IN INTIMATE CONTACT WITH UNDISTURBED SOIL LINER AND CONCRETE PLUG SHALL BE DESIGNED BY THE CONTRACTOR AND TO BE CONFIRMED WITH WESTERN POWER PRIOR TO PROCUREMENT
9. THE PILE SHAFT AND BASE SHALL BE CLEANED OF LOOSE MATERIAL AND DEBRIS TO ENSURE THAT THE DESIGN STRENGTH CAN BE MOBILISED
10. ANY EXCAVATIONS IN CLOSE PROXIMITY TO EXISTING POLES CAN ONLY BE DONE AFTER SUPPORTING THE EXISTING POLE WITH ADDITIONAL TEMPORARY STAYS IN THE OPPOSITE SIDE OF THE EXCAVATION
11. CONCRETE TO BE USED UNDER THE GENERAL ACCEPTABLE TRANSPORT TIMES FOR DELIVERY
    - 60 MINUTES FOR CONCRETE AT OR BELOW 32°C
    - 45 MINUTES FOR CONCRETE ABOVE 32°C BUT NOT EXCEEDING 35°C
12. ALL BORED PILES SHALL BE CONSTRUCTED IN ACCORDANCE WITH AS 2159 FORMED EXPOSED SURFACE FINISHED TO AS 3610 CLASS 3 ALL UNFORMED EXPOSED SURFACES TO BE SMOOTH STEEL TROWELLED FINISHED BEFORE THE CONCRETE HARDENS EDGES TO HAVE A R10 BULLNOSE U N O
13. CONCRETE SHOULD CURE FOR AT LEAST 14 DAYS BEFORE ERECTING TOWERS STRINGING OF THE CONDUCTORS SHOULD ONLY COMMENCE 28 DAYS AFTER THE CONCRETE PLACEMENT
14. EARTHING SHALL BE INSTALLED IN ACCORDANCE TO T5000/7/8/15/1
15. CONTRACTOR SHALL ENSURE THE STABILITY OF THE EXCAVATION AT ALL TIMES DURING CONSTRUCTION SHORING OR BATTERED EXCAVATIONS MAY BE REQUIRED DURING INSTALLATION
16. CONTRACTOR TO SUBMIT THE PROPOSED ITP AND METHODOLOGY FOR REVIEW BY DESIGNER PRIOR TO MOBILISATION TO CONFIRM DESIGN INTENT IS ACHIEVED
17. REFER TO EDM £70576346 FOR CELN NBT-NT 92 93 FOUNDATIONS CONSTRUCTABILITY REPORT

STUB AND CLEAT NOTES

18. MAXIMUM TOLERANCE FOR CORRECT LOCATION OF STUB LEG TO CENTRE OF BORED SHAFT IS 50mm
19. THE CENTROID OF THE CLEAT GROUP SHALL INTERSECT WITH THE CENTRE OF THE PILE
20. FOR STUB AND CLEAT DETAILS, REFER TO T201/6/12/132 FOR 9DS0A STRUCTURES AND T201/6/13/70 FOR 9DA50A (9DT25A) STRUCTURES
21. STUB TIES SHALL START AT THE TOP OF THE PILE AND FINISH AT A MINIMUM DEPTH AS BELOW:

TOWER TYPE	STUB TIES DEPTH (mm)
9DS0A	2900
9DA50A (9DT25A)	3500

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TL-T79
I:79-05-022-003.dgn

REVISIONS	DRN	DATE	CHKD
0	HC	11/24	KA
	PROJ No	DESIGN	EXMD
	T0618140	KA	ABM
	APPROVED	EC	
ISSUED FOR REVIEW			
1	DRN	DATE	CHKD
	HC	12/24	KA
	PROJ No	DESIGN	EXMD
	T0618140	KA	ABM
	APPROVED	EC	
NOTE 17 ADDED			

T5000/7/8/15/1	STRUCTURE EARTHING ASSEMBLY
T5003/6/0/3/1	CIVIL AND STRUCTURAL NOTES
T79/4/24/1 TO 4	NBT-NT 91 LINE CONSTRUCTION SCHEDULE
T79/4/32/1 TO 4	NBT-NT 92 LINE CONSTRUCTION SCHEDULE
T79/5/17/1 & 2	NBT-NT 91 & 92 LINE - FOUNDATIONS - POLE SUITE
T79/5/22/4	NBT-NT 91 & 92 LINE - TOWER FOUNDATIONS - SHEET 4
T201/6/12/132	STUB DETAILS - SUSPENSION TOWER TYPE 9DS0A
T201/6/13/70	STUB DETAILS - STRAIN TOWER TYPE 9DA50A (9DT25A)

NBT-NT 91 & 92 LINE
FOUNDATIONS
D/C TOWER SUITE
TOWER 11 TO 43 AND 68 & 69
SHEET 3

westernpower

DRAWN: APD HC	DATE: 12/24	DRG No	T79/5/22/3
CHECKED: APD KA	DESIGNED: APD KA		
EXAMINED: APD ABM			
EXAMINED		SCALE: N T S	NEXT SHT: 4
APPROVED: APD EC			REVISION: 1

A2

WESTERN POWER CAD STANDARDS
Cell Libraries v4.0.
VERSION Trans Lines v4.0.
Trans SHEET Space v4.0
DATE 03 Dec 24

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TABLE 3A FOUNDATION SUMMARY TABLE - VERTICAL PILE

TOWER TYPE	TOWER NUMBER	ULTIMATE FOUNDATION REACTION			WITHOUT LINER		WITH LINER		REINFORCEMENTS			UPSTAND (mm) REFER NOTE 7	SOIL PROFILE
		UPLIFT (kN)	COMPRESSION FORCE (kN)	SHEAR FORCE (kN)	PILE DIA (mm)	PILE DEPTH 'L' (m)	PILE DIA (mm)	PILE DEPTH 'L' (m)	VERT REO	STUB TIES	TIES		
9DA50A (9DT25A)	NBT-NT 91/92 Tower 11	2227	2558	654	2100	15 4	2100	21 2	44-N32	N16-100	N16-200	300	WBH10
9DA50A (9DT25A)	NBT-NT 91/92 Tower 12	2102	2439	625	2100	14 8	2100	20 3	44-N32	N16-100	N16-200	300	WBH10
9DS0A	NBT-NT 91/92 Tower 13	1269	1073	186	1800	11 5	1800	15 8	44-N28	N16-100	N16-200	300	BH4
9DS0A	NBT-NT 91/92 Tower 14	1269	1073	187	1800	11 5	1800	15 8	44-N28	N16-100	N16-200	300	BH4
9DA50A (9DT25A)	NBT-NT 91/92 Tower 15	1958	2343	588	2100	13 2	2100	18 1	44-N32	N16-100	N16-200	300	FloodBH5
9DS0A	NBT-NT 91/92 Tower 16	1269	1073	178	1800	11 4	1800	15 5	44-N28	N16-100	N16-200	300	FloodBH5
9DS0A	NBT-NT 91/92 Tower 17	1269	1073	192	1800	11 4	1800	15 5	44-N28	N16-100	N16-200	300	FloodBH5
9DS0A	NBT-NT 91/92 Tower 18	1269	1073	197	1800	11 4	1800	15 5	44-N28	N16-100	N16-200	300	FloodBH5
9DS0A	NBT-NT 91/92 Tower 19	1269	1073	202	1800	11 4	1800	15 5	44-N28	N16-100	N16-200	300	FloodBH5
9DS0A	NBT-NT 91/92 Tower 20	1269	1073	205	1800	11 4	1800	15 5	44-N28	N16-100	N16-200	300	FloodBH5
9DS0A	NBT-NT 91/92 Tower 21	1269	1073	208	1800	13 2	1800	17 7	44-N28	N16-100	N16-200	300	FloodWBH2
9DS0A	NBT-NT 91/92 Tower 22	1269	1073	204	1800	13 2	1800	17 7	44-N28	N16-100	N16-200	300	FloodWBH2
9DS0A	NBT-NT 91/92 Tower 23	1269	1073	204	1800	13 2	1800	17 7	44-N28	N16-100	N16-200	300	FloodWBH2
9DS0A	NBT-NT 91/92 Tower 24	1269	1073	204	1800	13 2	1800	17 7	44-N28	N16-100	N16-200	300	FloodWBH2
9DA50A (9DT25A)	NBT-NT 91/92 Tower 25	1578	1965	499	2100	13 1	2100	17 4	44-N32	N16-100	N16-200	300	WBH2
9DS0A	NBT-NT 91/92 Tower 26	1269	1073	188	1800	13 1	1800	17 6	44-N28	N16-100	N16-200	300	WBH2
9DS0A	NBT-NT 91/92 Tower 27	1269	1073	190	1800	13 1	1800	17 6	44-N28	N16-100	N16-200	300	WBH2
9DS0A	NBT-NT 91/92 Tower 28	1269	1073	186	1800	13 1	1800	17 6	44-N28	N16-100	N16-200	300	WBH2
9DS0A	NBT-NT 91/92 Tower 29	1269	1073	180	1800	13 1	1800	17 6	44-N28	N16-100	N16-200	400	WBH2
9DS0A	NBT-NT 91/92 Tower 30	1269	1073	186	1800	12 4	1800	16 8	44-N28	N16-100	N16-200	300	WBH3
9DS0A	NBT-NT 91/92 Tower 31	1269	1073	188	1800	12 4	1800	16 8	44-N28	N16-100	N16-200	300	WBH3
9DS0A	NBT-NT 91/92 Tower 32	1269	1073	185	1800	12 4	1800	16 8	44-N28	N16-100	N16-200	300	WBH3
9DS0A	NBT-NT 91/92 Tower 33	1269	1073	187	1800	12 4	1800	16 8	44-N28	N16-100	N16-200	300	WBH3
9DA50A (9DT25A)	NBT-NT 91/92 Tower 34	1047	1440	384	2100	9 4	2100	12 2	44-N32	N16-100	N16-200	400	WBH3
9DS0A	NBT-NT 91/92 Tower 35	1269	1073	195	1800	12 4	1800	16 8	44-N28	N16-100	N16-200	300	WBH3
9DS0A	NBT-NT 91/92 Tower 36	1269	1073	191	1800	12 4	1800	16 8	44-N28	N16-100	N16-200	400	WBH3
9DS0A	NBT-NT 91/92 Tower 37	1269	1073	196	1800	12 4	1800	16 8	44-N28	N16-100	N16-200	400	WBH3
9DS0A	NBT-NT 91/92 Tower 38	1269	1073	195	1800	12 4	1800	16 8	44-N28	N16-100	N16-200	400	WBH3
9DS0A	NBT-NT 91/92 Tower 39	1269	1073	194	1800	13 5	1800	18	44-N28	N16-100	N16-200	300	WBH4
9DS0A	NBT-NT 91/92 Tower 40	1269	1073	194	1800	13 5	1800	18	44-N28	N16-100	N16-200	300	WBH4
9DS0A	NBT-NT 91/92 Tower 41	1269	1073	199	1800	13 5	1800	18	44-N28	N16-100	N16-200	300	WBH4
9DA50A (9DT25A)	NBT-NT 91/92 Tower 42	2121	2454	628	2100	16 3	2100	21 9	44-N32	N16-100	N16-200	300	WBH4
9DA50A (9DT25A)	NBT-NT 91/92 Tower 43	2458	2796	701	2100	17 9	2100	24 2	44-N32	N16-100	N16-200	400	WBH4
9DS0A	NBT-NT 91/92 Tower 68	1269	1073	147	1800	14 9	1800	19 5	44-N28	N16-100	N16-200	300	WBH7
9DA50A (9DT25A)	NBT-NT 91/92 Tower 69	1749	2053	530	2100	15 8	2100	20 6	44-N32	N16-100	N16-200	300	WBH7

TABLE 3B FOUNDATION SUMMARY TABLE - INCLINED PILE

TOWER TYPE	TOWER NUMBER	PILE RAKE ANGLE (°)	ULTIMATE FOUNDATION REACTION IN LEG DIRECTION			WITHOUT LINER		WITH LINER		REINFORCEMENTS			UPSTAND (mm) REFER NOTE 7	SOIL PROFILE
			UPLIFT (kN)	COMPRESSION FORCE (kN)	SHEAR FORCE (kN)	PILE DIA (mm)	PILE DEPTH 'L' (m)	PILE DIA (mm)	PILE DEPTH 'L' (m)	VERT REO	STUB TIES	TIES		
9DA50A (9DT25A)	NBT-NT 91/92 Tower 11	16 3	2323	2675	52	1800	18	1800	25 3	44-N32	N16-100	N16-200	300	WBH10
9DA50A (9DT25A)	NBT-NT 91/92 Tower 12	16 3	2192	2551	52	1800	17 3	1800	24 4	44-N32	N16-100	N16-200	300	WBH10
9DS0A	NBT-NT 91/92 Tower 13	9 3	1073	1269	30	1800	10 3	1800	13 9	44-N28	N16-100	N16-200	300	BH4
9DS0A	NBT-NT 91/92 Tower 14	9 3	1073	1269	30	1800	10 3	1800	13 9	44-N28	N16-100	N16-200	300	BH4
9DA50A (9DT25A)	NBT-NT 91/92 Tower 15	16 3	2038	2446	49	1800	15 5	1800	21 9	44-N32	N16-100	N16-200	300	FloodBH5
9DS0A	NBT-NT 91/92 Tower 16	9 3	1073	1269	30	1800	10 2	1800	13 7	44-N28	N16-100	N16-200	300	FloodBH5
9DS0A	NBT-NT 91/92 Tower 17	9 3	1073	1269	30	1800	10 2	1800	13 7	44-N28	N16-100	N16-200	300	FloodBH5
9DS0A	NBT-NT 91/92 Tower 18	9 3	1073	1269	30	1800	10 2	1800	13 7	44-N28	N16-100	N16-200	300	FloodBH5
9DS0A	NBT-NT 91/92 Tower 19	9 3	1073	1269	30	1800	10 2	1800	13 7	44-N28	N16-100	N16-200	300	FloodBH5
9DS0A	NBT-NT 91/92 Tower 20	9 3	1073	1269	30	1800	10 2	1800	13 7	44-N28	N16-100	N16-200	300	FloodBH5
9DS0A	NBT-NT 91/92 Tower 21	9 3	1073	1269	31	1800	11 9	1800	15 7	44-N28	N16-100	N16-200	300	FloodWBH2
9DS0A	NBT-NT 91/92 Tower 22	9 3	1073	1269	30	1800	11 9	1800	15 7	44-N28	N16-100	N16-200	300	FloodWBH2
9DS0A	NBT-NT 91/92 Tower 23	9 3	1073	1269	30	1800	11 9	1800	15 7	44-N28	N16-100	N16-200	300	FloodWBH2
9DS0A	NBT-NT 91/92 Tower 24	9 3	1073	1269	31	1800	11 9	1800	15 7	44-N28	N16-100	N16-200	300	FloodWBH2
9DA50A (9DT25A)	NBT-NT 91/92 Tower 25	16 3	1643	2054	49	1800	15 4	1800	21	44-N32	N16-100	N16-200	300	WBH2
9DS0A	NBT-NT 91/92 Tower 26	9 3	1073	1269	31	1800	11 8	1800	15 6	44-N28	N16-100	N16-200	300	WBH2
9DS0A	NBT-NT 91/92 Tower 27	9 3	1073	1269	30	1800	11 8	1800	15 6	44-N28	N16-100	N16-200	300	WBH2
9DS0A	NBT-NT 91/92 Tower 28	9 3	1073	1269	30	1800	11 8	1800	15 6	44-N28	N16-100	N16-200	300	WBH2
9DS0A	NBT-NT 91/92 Tower 29	9 3	1073	1269	30	1800	11 8	1800	15 6	44-N28	N16-100	N16-200	400	WBH2
9DS0A	NBT-NT 91/92 Tower 30	9 3	1073	1269	30	1800	11 1	1800	14 9	44-N28	N16-100	N16-200	300	WBH3
9DS0A	NBT-NT 91/92 Tower 31	9 3	1073	1269	31	1800	11 1	1800	14 9	44-N28	N16-100	N16-200	300	WBH3
9DS0A	NBT-NT 91/92 Tower 32	9 3	1073	1269	30	1800	11 1	1800	14 9	44-N28	N16-100	N16-200	300	WBH3
9DS0A	NBT-NT 91/92 Tower 33	9 3	1073	1269	30	1800	11 1	1800	14 9	44-N28	N16-100	N16-200	300	WBH3
9DA50A (9DT25A)	NBT-NT 91/92 Tower 34	16 3	1095	1512	49	1800	11 2	1800	15 1	44-N32	N16-100	N16-200	400	WBH3
9DS0A	NBT-NT 91/92 Tower 35	9 3	1073	1269	30	1800	11 1	1800	14 9	44-N28	N16-100	N16-200	300	WBH3
9DS0A	NBT-NT 91/92 Tower 36	9 3	1073	1269	30	1800	11 1	1800	14 9	44-N28	N16-100	N16-200	400	WBH3
9DS0A	NBT-NT 91/92 Tower 37	9 3	1073	1269	30	1800	11 1	1800	14 9	44-N28	N16-100	N16-200	400	WBH3
9DS0A	NBT-NT 91/92 Tower 38	9 3	1073	1269	30	1800	11 1	1800	14 9	44-N28	N16-100	N16-200	400	WBH3
9DS0A	NBT-NT 91/92 Tower 39	9 3	1073	1269	30	1800	12 2	1800	16	44-N28	N16-100	N16-200	300	WBH4
9DS0A	NBT-NT 91/92 Tower 40	9 3	1073	1269	30	1800	12 2	1800	16	44-N28	N16-100	N16-200	300	WBH4
9DS0A	NBT-NT 91/92 Tower 41	9 3	1073	1269	30	1800	12 2	1800	16	44-N28	N16-100	N16-200	300	WBH4
9DA50A (9DT25A)	NBT-NT 91/92 Tower 42	16 3	2212	2567	52	1800	19	1800	26 2	44-N32	N16-100	N16-200	300	WBH4
9DA50A (9DT25A)	NBT-NT 91/92 Tower 43	16 3	2560	2920	52	1800	20 8	1800	28 7	44-N32	N16-100	N16-200	400	WBH4
9DS0A	NBT-NT 91/92 Tower 68	9 3	1073	1269	30	1800	13 5	1800	17 5	44-N28	N16-100	N16-200	300	WBH7
9DA50A (9DT25A)	NBT-NT 91/92 Tower 69	16 3	1824	2149	52	1800	18 4	1800	24 6	44-N32	N16-100	N16-200	300	WBH7

GENERAL NOTES

1 REFER TO SHEET 3 FOR GENERAL AND FOUNDATION DESIGN NOTES

STEEL REINFORCEMENT NOTES

2 ALL REINFORCING STEEL TO BE GRADE 500MPa ALL STEELWORK TO BE HOT DIP GALVANISED TO AS/NZS 4680 OR AS/NZS 4792 (WHICHEVER IS APPLICABLE)

3 BORED FOUNDATION FITMENTS TO BE EITHER CONTINUOUS SPIRAL OR TIES WITH 160mm LONG SINGLE SPLICE WELD IN ACCORDANCE WITH AS/NZS 1554 3

4 IN ADDITION TO FITMENT REINFORCEMENT SHOWN, TWO N20 WELDED TIES @ 50mm C/C REQUIRED AT THE TOP OF THE REINFORCEMENT CAGE FOR ALL FOUNDATION TYPES

5 TACK WELDING OF TIES TO THE MAIN REINFORCEMENT SHALL BE STRICTLY UNDERTAKEN IN ACCORDANCE WITH AS/NZS 1554 3 ANY OTHER REINFORCEMENT WELDING IS SUBJECT TO APPROVAL BY WESTERN POWER'S ON SITE FOUNDATION REPRESENTATIVE

6 PILE REINFORCEMENT TO BE FULL LENGTH UNLESS NOTED OTHERWISE WHERE THIS IS NOT POSSIBLE, REINFORCEMENT TO BE LAPPED 50x BAR DIAMETER IN MIDDLE OF PILE

7 UPSTAND TO BE AT LEAST 200mm AND NOT MORE THAN 600mm

8 ALL SUSPENSION STRUCTURE (9DS0A) ARE DESIGNED TO THEIR STRUCTURAL CAPACITY

REVISIONS

	DRN	DATE	CHKD
0	HC	11/24	KA
PROJ No	DESIGN	EXMD	ABM
T0618140	KA		
APPROVED	EC		
ISSUED FOR REVIEW			

	DRN	DATE	CHKD
1	HC	12/24	KA
PROJ No	DESIGN	EXMD	ABM
T0618140	KA		
APPROVED	EC		
TABLE LAYOUT UPDATED			

T5000/7/8/15/1	STRUCTURE EARTHING ASSEMBLY
T5003/6/0/3/1	CIVIL AND STRUCTURAL NOTES
T79/4/24/1 TO 4	NBT-NT 91 LINE CONSTRUCTION SCHEDULE
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T79/5/17/1 & 2	NBT-NT 91 & 92 LINE - FOUNDATIONS - POLE SUITE
T79/5/22/3	NBT-NT 91 & 92 LINE - TOWER FOUNDATIONS - SHEET 3
T79/5/22/5	NBT-NT 91 & 92 LINE - TOWER FOUNDATIONS - SHEET 5

NBT-NT 91 & 92 LINE
FOUNDATIONS
D/C TOWER SUITE
TOWER 11 TO 43 AND 68 & 69
SHEET 4

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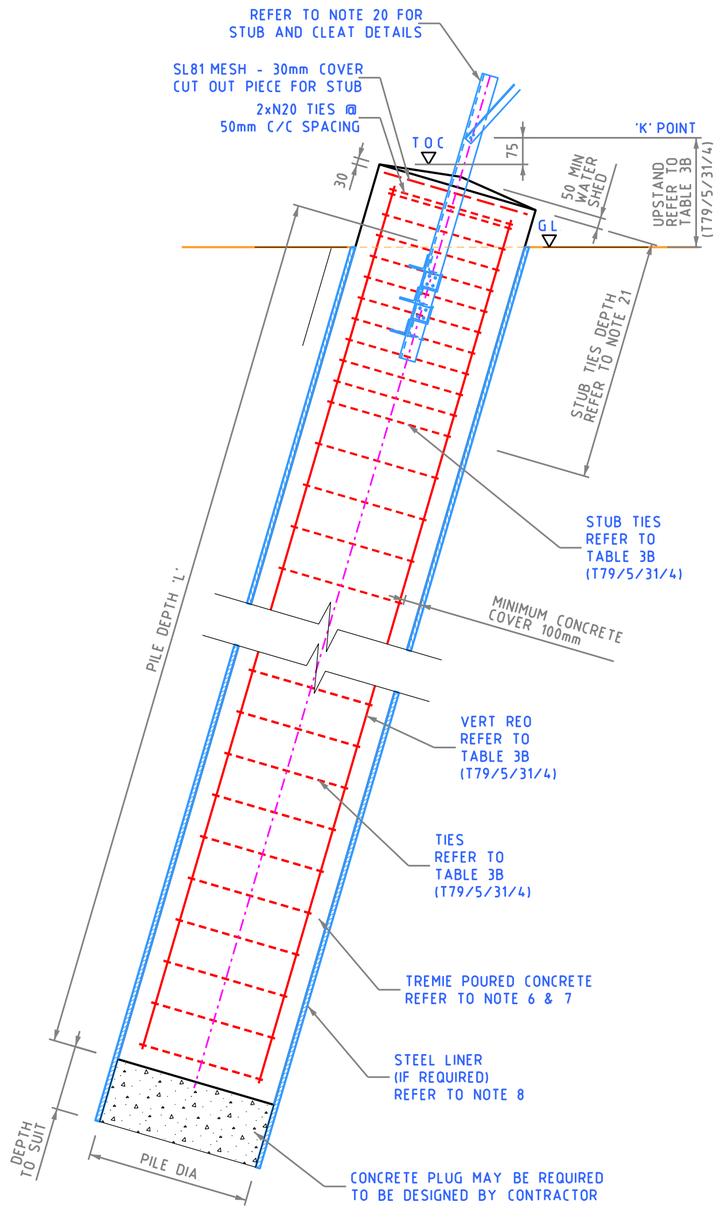
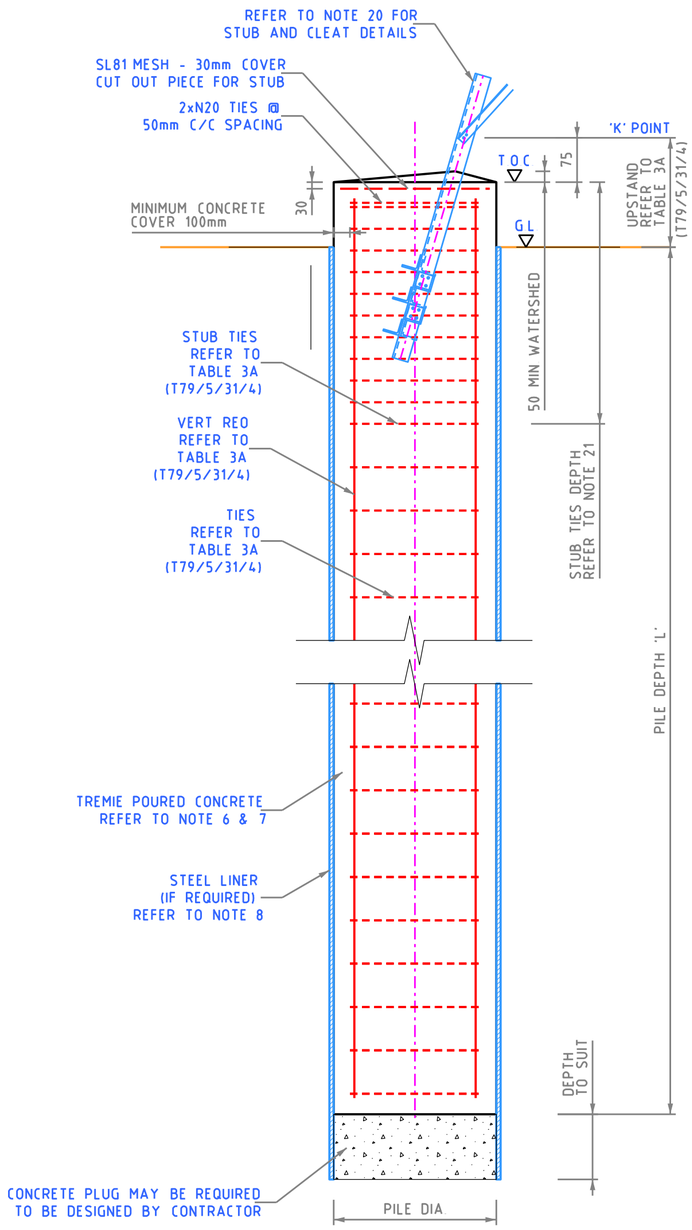
DRAWN: APD HC	DATE: 12/24	DRG No T79/5/22/4
CHECKED: APD KA	DESIGNED: APD KA	
EXAMINED: APD ABM		
EXAMINED		SCALE N/A / NEXT SHT 5
APPROVED: APD EC		REVISION: 1

A2



INCLINED PILE FOUNDATION
NOT TO SCALE



VERTICAL PILE FOUNDATION
NOT TO SCALE

GENERAL NOTES

1 THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL OTHER DRAWINGS, SPECIFICATIONS AND WITH SUCH OTHER WRITTEN INSTRUCTIONS AS MAY BE ISSUED DURING THE COURSE OF THE CONTRACT ANY DISCREPANCY SHALL BE REFERRED TO THE SUPERINTENDENT FOR DECISION BEFORE PROCEEDING WITH THE WORK
2 REFER TO CONSTRUCTION SCHEDULES T79/4/40/1 TO 4 AND T79/4/48/1 TO 3 FOR STRUCTURE LOCATIONS REFER TO DRAWING T5003/6/0/3/1 FOR ADDITIONAL NOTES
3 ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE SAA CODES AND THE BY-LAWS AND ORDINANCES OF THE RELEVANT AUTHORITIES

FOUNDATION NOTES

4 FOUNDATIONS HAVE BEEN DESIGNED IN ACCORDANCE WITH AS/NZS 7000 AND WESTERN POWER ENGINEERING AND DESIGN STANDARD - TRANSMISSION LINE GEOTECHNICAL INVESTIGATIONS (EDM £28483277) WITH A GEOTECHNICAL REDUCTION FACTOR OF 0 65 THE SOIL PROPERTIES SHOWN IN TABLES 2 1 TO 2 4 (REFER TO SHEET 2 - T79/5/31/2) ARE AS PER "PS203357-WSP-PER-GEO-REP-00025 Rev0" (EDM£69907160) IF SOIL IS FOUND TO BE SIGNIFICANTLY DIFFERENT, IT SHALL BE REPORTED TO THE ENGINEER FOR GUIDANCE PRIOR TO CONSTRUCTION
5 ALL STRUCTURAL CONCRETE SHALL BE SPECIAL CLASS CONCRETE IT SHALL HAVE A CEMENTITIOUS CONTENT AND COMPOSITION SO THAT PEAK TEMPERATURE SHALL NOT EXCEED 70°C AND THE TEMPERATURE DIFFERENCE SHALL NOT EXCEED 20°C FORMWORK MAY NOT BE STRIPPED EARLIER THAN 3 DAYS FROM POURING
6 ALL STRUCTURAL CONCRETE SHALL BE GRADE S32 MINIMUM AND TREMIE POURED CONCRETE MIX AND CURING REQUIREMENTS TO BE IN ACCORDANCE WITH AS 3600 AND AS 1379
7 FOR FOUNDATION IN AGGRESSIVE SOIL AND/OR GROUNDWATER CONDITION, CONCRETE GRADE SHALL BE S40 WITH SULFATE-RESISTING CEMENT IN ACCORDANCE WITH AS 3972
8 A STEEL LINER MAY BE REQUIRED FOR FOUNDATION CONSTRUCTION IN COLLAPSIBLE SOIL LINER TO BE KEPT IN INTIMATE CONTACT WITH UNDISTURBED SOIL LINER AND CONCRETE PLUG SHALL BE DESIGNED BY THE CONTRACTOR AND TO BE CONFIRMED WITH WESTERN POWER PRIOR TO PROCUREMENT
9 THE PILE SHAFT AND BASE SHALL BE CLEANED OF LOOSE MATERIAL AND DEBRIS TO ENSURE THAT THE DESIGN STRENGTH CAN BE MOBILISED
10 ANY EXCAVATIONS IN CLOSE PROXIMITY TO EXISTING POLES CAN ONLY BE DONE AFTER SUPPORTING THE EXISTING POLE WITH ADDITIONAL TEMPORARY STAYS IN THE OPPOSITE SIDE OF THE EXCAVATION
11 CONCRETE TO BE USED UNDER THE GENERAL ACCEPTABLE TRANSPORT TIMES FOR DELIVERY
- 60 MINUTES FOR CONCRETE AT OR BELOW 32°C
- 45 MINUTES FOR CONCRETE ABOVE 32°C BUT NOT EXCEEDING 35°C
12 ALL BORED PILES SHALL BE CONSTRUCTED IN ACCORDANCE WITH AS 2159 FORMED EXPOSED SURFACE FINISHED TO AS 3610 CLASS 3 ALL UNFORMED EXPOSED SURFACES TO BE SMOOTH STEEL TROWELLED FINISHED BEFORE THE CONCRETE HARDENS EDGES TO HAVE A R10 BULLNOSE U N O
13 CONCRETE SHOULD CURE FOR AT LEAST 14 DAYS BEFORE ERECTING TOWERS STRINGING OF THE CONDUCTORS SHOULD ONLY COMMENCE 28 DAYS AFTER THE CONCRETE PLACEMENT
14 EARTHING SHALL BE INSTALLED IN ACCORDANCE TO T5000/7/8/15/1
15 CONTRACTOR SHALL ENSURE THE STABILITY OF THE EXCAVATION AT ALL TIMES DURING CONSTRUCTION SHORING OR BATTERED EXCAVATIONS MAY BE REQUIRED DURING INSTALLATION
16 CONTRACTOR TO SUBMIT THE PROPOSED ITP AND METHODOLOGY FOR REVIEW BY DESIGNER PRIOR TO MOBILISATION TO CONFIRM DESIGN INTENT IS ACHIEVED
17 REFER TO EDM £70576346 FOR CELN NBT-NT 92 93 FOUNDATIONS CONSTRUCTABILITY REPORT

STUB AND CLEAT NOTES

18 MAXIMUM TOLERANCE FOR CORRECT LOCATION OF STUB LEG TO CENTRE OF BORED SHAFT IS 50mm
19 THE CENTROID OF THE CLEAT GROUP SHALL INTERSECT WITH THE CENTRE OF THE PILE
20 FOR STUB AND CLEAT DETAILS, REFER TO T201/6/12/132 FOR 9DS0A STRUCTURES AND T201/6/13/70 FOR 9DA50A (9DT25A) STRUCTURES
21 STUB TIES SHALL START AT THE TOP OF THE PILE AND FINISH AT A MINIMUM DEPTH AS BELOW

TOWER TYPE	STUB TIES DEPTH (mm)
9DS0A	2900
9DA50A (9DT25A)	3500

Safety First Every Second

TL-T79
t79-05-031-003.dgn

REVISIONS	DRN	DATE	CHKD
0	HC	11/24	KA
	PROJ No	DESIGN	EXMD
	T0618140	KA	ABM
	APPROVED	EC	
ISSUED FOR REVIEW			
1	DRN	DATE	CHKD
	HC	12/24	KA
	PROJ No	DESIGN	EXMD
	T0618140	KA	ABM
	APPROVED	EC	
NOTE 17 ADDED			

T5000/7/8/15/1	STRUCTURE EARTHING ASSEMBLY
T5003/6/0/3/1	CIVIL AND STRUCTURAL NOTES
T79/4/40/1 TO 4	NBT-NT 93 LINE CONSTRUCTION SCHEDULE
T79/4/48/1 TO 3	NT-RGT 91 LINE CONSTRUCTION SCHEDULE
T79/5/31/4	NBT-NT 93 & NT-RGT 91 LINE - TOWER FOUNDATIONS - SHEET 4
T79/5/27/1 & 2	NBT-NT 93 & NT-RGT 91 LINE - FOUNDATIONS - POLE SUITE
T201/6/12/132	STUB DETAILS - SUSPENSION TOWER TYPE 9DS0A
T201/6/13/70	STUB DETAILS - STRAIN TOWER TYPE 9DA50A (9DT25A)

NBT-NT 93 & NT-RGT 91 LINE
FOUNDATIONS
D/C TOWER SUITE
TOWER 51/25 TO 71/5
SHEET 3

westernpower

DRAWN APD HC	DATE 12/24	DRG No	T79/5/31/3
CHECKED APD KA	DESIGNED APD KA		
EXAMINED APD ABM			
EXAMINED		SCALE N T S	NEXT SHT 4
APPROVED APD EC			REVISION 1

A2

TABLE 3A FOUNDATION SUMMARY TABLE - VERTICAL PILE

TOWER TYPE	TOWER NUMBER	ULTIMATE FOUNDATION REACTION			WITHOUT LINER		WITH LINER		REINFORCEMENTS			UPSTAND (mm) REFER NOTE 7	SOIL PROFILE
		UPLIFT (kN)	COMPRESSION FORCE (kN)	SHEAR FORCE (kN)	PILE DIA (mm)	PILE DEPTH 'L' (m)	PILE DIA (mm)	PILE DEPTH 'L' (m)	VERT REO	STUB TIES	TIES		
9DA50A (9DT25A)	NT-RGT 91 Tower 25 / NBT-NT 93 Tower 51	2355	2673	671	2100	17.4	2100	23.5	44-N32	N16-100	N16-200	400	WBH4
9DS0A	NT-RGT 91 Tower 24 / NBT-NT 93 Tower 52	1269	1073	169	1800	13.5	1800	18	44-N28	N16-100	N16-200	400	WBH4
9DA50A (9DT25A)	NT-RGT 91 Tower 23 / NBT-NT 93 Tower 53	619	992	281	2100	7.8	2100	9.3	44-N32	N16-100	N16-200	300	WBH13
9DS0A	NT-RGT 91 Tower 22 / NBT-NT 93 Tower 54	1269	1073	170	1800	13.9	1800	18.5	44-N28	N16-100	N16-200	400	WBH13
9DA50A (9DT25A)	NT-RGT 91 Tower 21 / NBT-NT 93 Tower 55	2097	2429	622	2100	16.5	2100	22.1	44-N32	N16-100	N16-200	400	WBH13
9DS0A	NT-RGT 91 Tower 20 / NBT-NT 93 Tower 56	1269	1073	177	1800	13.9	1800	18.5	44-N28	N16-100	N16-200	300	WBH13
9DS0A	NT-RGT 91 Tower 19 / NBT-NT 93 Tower 57	1269	1073	164	1800	13.9	1800	18.5	44-N28	N16-100	N16-200	300	WBH13
9DA50A (9DT25A)	NT-RGT 91 Tower 18 / NBT-NT 93 Tower 58	612	971	280	2100	7.7	2100	9.3	44-N32	N16-100	N16-200	300	WBH13
9DA50A (9DT25A)	NT-RGT 91 Tower 17 / NBT-NT 93 Tower 59	557	930	269	2100	7.3	2100	8.6	44-N32	N16-100	N16-200	300	WBH13
9DA50A (9DT25A)	NT-RGT 91 Tower 16 / NBT-NT 93 Tower 60	673	1033	286	2100	8.2	2100	9.9	44-N32	N16-100	N16-200	300	WBH13
9DA50A (9DT25A)	NT-RGT 91 Tower 15 / NBT-NT 93 Tower 61	578	948	272	2100	8.3	2100	9.8	44-N32	N16-100	N16-200	300	WBH15
9DA50A (9DT25A)	NT-RGT 91 Tower 14 / NBT-NT 93 Tower 62	1636	1953	506	2100	15.7	2100	20.2	44-N32	N16-100	N16-200	300	WBH15
9DS0A	NT-RGT 91 Tower 13 / NBT-NT 93 Tower 63	1269	1073	165	1800	15.3	1800	19.9	44-N28	N16-100	N16-200	300	WBH15
9DA50A (9DT25A)	NT-RGT 91 Tower 12 / NBT-NT 93 Tower 64	1641	1958	512	2100	15.7	2100	20.2	44-N32	N16-100	N16-200	300	WBH15
9DA50A (9DT25A)	NT-RGT 91 Tower 11 / NBT-NT 93 Tower 65	1644	1968	518	2100	15.7	2100	20.3	44-N32	N16-100	N16-200	300	WBH15
9DA50A (9DT25A)	NT-RGT 91 Tower 9 / NBT-NT 93 Tower 67	1577	1891	494	2100	15.3	2100	19.7	44-N32	N16-100	N16-200	300	WBH15
9DS0A	NT-RGT 91 Tower 8 / NBT-NT 93 Tower 68	1269	1073	160	1800	15.3	1800	19.9	44-N28	N16-100	N16-200	300	WBH15
9DS0A	NT-RGT 91 Tower 7 / NBT-NT 93 Tower 69	1269	1073	162	1800	15.3	1800	19.9	44-N28	N16-100	N16-200	300	WBH15
9DS0A	NT-RGT 91 Tower 6 / NBT-NT 93 Tower 70	1269	1073	164	1800	14.9	1800	19.5	44-N28	N16-100	N16-200	300	WBH7
9DA50A (9DT25A)	NT-RGT 91 Tower 5 / NBT-NT 93 Tower 71	1758	2068	523	2100	15.9	2100	20.7	44-N32	N16-100	N16-200	400	WBH7

TABLE 3B FOUNDATION SUMMARY TABLE - INCLINED PILE

TOWER TYPE	TOWER NUMBER	PILE RAKE ANGLE (°)	ULTIMATE FOUNDATION REACTION IN LEG DIRECTION			WITHOUT LINER		WITH LINER		REINFORCEMENTS			UPSTAND (mm) REFER NOTE 7	SOIL PROFILE
			UPLIFT (kN)	COMPRESSION FORCE (kN)	SHEAR FORCE (kN)	PILE DIA (mm)	PILE DEPTH 'L' (m)	PILE DIA (mm)	PILE DEPTH 'L' (m)	VERT REO	STUB TIES	TIES		
9DA50A (9DT25A)	NT-RGT 91 Tower 25 / NBT-NT 93 Tower 51	16.3	2452	2791	52	1800	20.2	1800	28	44-N32	N16-100	N16-200	400	WBH4
9DS0A	NT-RGT 91 Tower 24 / NBT-NT 93 Tower 52	9.3	1073	1269	30	1800	12.2	1800	16	44-N28	N16-100	N16-200	400	WBH4
9DA50A (9DT25A)	NT-RGT 91 Tower 23 / NBT-NT 93 Tower 53	16.3	651	1047	48	1800	9.3	1800	11.7	44-N32	N16-100	N16-200	300	WBH13
9DS0A	NT-RGT 91 Tower 22 / NBT-NT 93 Tower 54	9.3	1073	1269	30	1800	12.6	1800	16.5	44-N28	N16-100	N16-200	400	WBH13
9DA50A (9DT25A)	NT-RGT 91 Tower 21 / NBT-NT 93 Tower 55	16.3	2187	2541	52	1800	19.1	1800	26.2	44-N32	N16-100	N16-200	400	WBH13
9DS0A	NT-RGT 91 Tower 20 / NBT-NT 93 Tower 56	9.3	1073	1269	30	1800	12.6	1800	16.5	44-N28	N16-100	N16-200	300	WBH13
9DS0A	NT-RGT 91 Tower 19 / NBT-NT 93 Tower 57	9.3	1073	1269	30	1800	12.6	1800	16.5	44-N28	N16-100	N16-200	300	WBH13
9DA50A (9DT25A)	NT-RGT 91 Tower 18 / NBT-NT 93 Tower 58	16.3	645	1026	48	1800	9.3	1800	11.6	44-N32	N16-100	N16-200	300	WBH13
9DA50A (9DT25A)	NT-RGT 91 Tower 17 / NBT-NT 93 Tower 59	16.3	587	983	49	1800	8.7	1800	10.9	44-N32	N16-100	N16-200	300	WBH13
9DA50A (9DT25A)	NT-RGT 91 Tower 16 / NBT-NT 93 Tower 60	16.3	704	1087	48	1800	9.8	1800	12.4	44-N32	N16-100	N16-200	300	WBH13
9DA50A (9DT25A)	NT-RGT 91 Tower 15 / NBT-NT 93 Tower 61	16.3	608	1001	48	1800	10	1800	12.2	44-N32	N16-100	N16-200	300	WBH15
9DA50A (9DT25A)	NT-RGT 91 Tower 14 / NBT-NT 93 Tower 62	16.3	1707	2045	52	1800	18.1	1800	24.1	44-N32	N16-100	N16-200	300	WBH15
9DS0A	NT-RGT 91 Tower 13 / NBT-NT 93 Tower 63	9.3	1073	1269	30	1800	13.9	1800	17.9	44-N28	N16-100	N16-200	300	WBH15
9DA50A (9DT25A)	NT-RGT 91 Tower 12 / NBT-NT 93 Tower 64	16.3	1712	2049	52	1800	18.2	1800	24.1	44-N32	N16-100	N16-200	300	WBH15
9DA50A (9DT25A)	NT-RGT 91 Tower 11 / NBT-NT 93 Tower 65	16.3	1716	2060	53	1800	18.2	1800	24.1	44-N32	N16-100	N16-200	300	WBH15
9DA50A (9DT25A)	NT-RGT 91 Tower 9 / NBT-NT 93 Tower 67	16.3	1644	1979	52	1800	17.8	1800	23.5	44-N32	N16-100	N16-200	300	WBH15
9DS0A	NT-RGT 91 Tower 8 / NBT-NT 93 Tower 68	9.3	1073	1269	30	1800	13.9	1800	17.9	44-N28	N16-100	N16-200	300	WBH15
9DS0A	NT-RGT 91 Tower 7 / NBT-NT 93 Tower 69	9.3	1073	1269	30	1800	13.9	1800	17.9	44-N28	N16-100	N16-200	300	WBH15
9DS0A	NT-RGT 91 Tower 6 / NBT-NT 93 Tower 70	9.3	1073	1269	30	1800	13.5	1800	17.5	44-N28	N16-100	N16-200	300	WBH7
9DA50A (9DT25A)	NT-RGT 91 Tower 5 / NBT-NT 93 Tower 71	16.3	1830	2160	52	1800	18.4	1800	24.6	44-N32	N16-100	N16-200	400	WBH7

GENERAL NOTES

1 REFER TO SHEET 3 FOR GENERAL AND FOUNDATION DESIGN NOTES

STEEL REINFORCEMENT NOTES

2 ALL REINFORCING STEEL TO BE GRADE 500MPa ALL STEELWORK TO BE HOT DIP GALVANISED TO AS/NZS 4680 OR AS/NZS 4792 (WHICHEVER IS APPLICABLE)

3 BORED FOUNDATION FITMENTS TO BE EITHER CONTINUOUS SPIRAL OR TIES WITH 160mm LONG SINGLE SPLICE WELD IN ACCORDANCE WITH AS/NZS 1554.3

4 IN ADDITION TO FITMENT REINFORCEMENT SHOWN, TWO N20 WELDED TIES @ 50mm C/C REQUIRED AT THE TOP OF THE REINFORCEMENT CAGE FOR ALL FOUNDATION TYPES

5 TACK WELDING OF TIES TO THE MAIN REINFORCEMENT SHALL BE STRICTLY UNDERTAKEN IN ACCORDANCE WITH AS/NZS 1554.3 ANY OTHER REINFORCEMENT WELDING IS SUBJECT TO APPROVAL BY WESTERN POWER'S ON SITE FOUNDATION REPRESENTATIVE

6 PILE REINFORCEMENT TO BE FULL LENGTH UNLESS NOTED OTHERWISE WHERE THIS IS NOT POSSIBLE, REINFORCEMENT TO BE LAPPED 50x BAR DIAMETER IN MIDDLE OF PILE

7 UPSTAND TO BE AT LEAST 200mm AND NOT MORE THAN 600mm

8 ALL SUSPENSION STRUCTURE (9DS0A) ARE DESIGNED TO THEIR STRUCTURAL CAPACITY

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REVISIONS

	DRN	DATE	CHKD
0	HC	11/24	KA
PROJ No	DESIGN	EXMD	ABM
T0618140	KA		
APPROVED	EC		
ISSUED FOR REVIEW			

	DRN	DATE	CHKD
1	HC	12/24	KA
PROJ No	DESIGN	EXMD	ABM
T0618140	KA		
APPROVED	EC		
TABLE LAYOUT UPDATED			

T5000/7/8/15/1	STRUCTURE EARTHING ASSEMBLY
T5003/6/0/3/1	CIVIL AND STRUCTURAL NOTES
T79/4/40/1 TO 4	NBT-NT 93 LINE CONSTRUCTION SCHEDULE
T79/4/48/1 TO 3	NT-RGT 91 LINE CONSTRUCTION SCHEDULE
T79/5/31/3	NBT-NT 93 & NT-RGT 91 LINE - TOWER FOUNDATIONS - SHEET 3
T79/5/31/5	NBT-NT 93 & NT-RGT 91 LINE - TOWER FOUNDATIONS - SHEET 5
T79/5/27/1 & 2	NBT-NT 93 & NT-RGT 91 LINE - FOUNDATIONS - POLE SUITE

NBT-NT 93 & NT-RGT 91 LINE
FOUNDATIONS
D/C TOWER SUITE
TOWER 51/25 TO 71/5
SHEET 4

westernpower

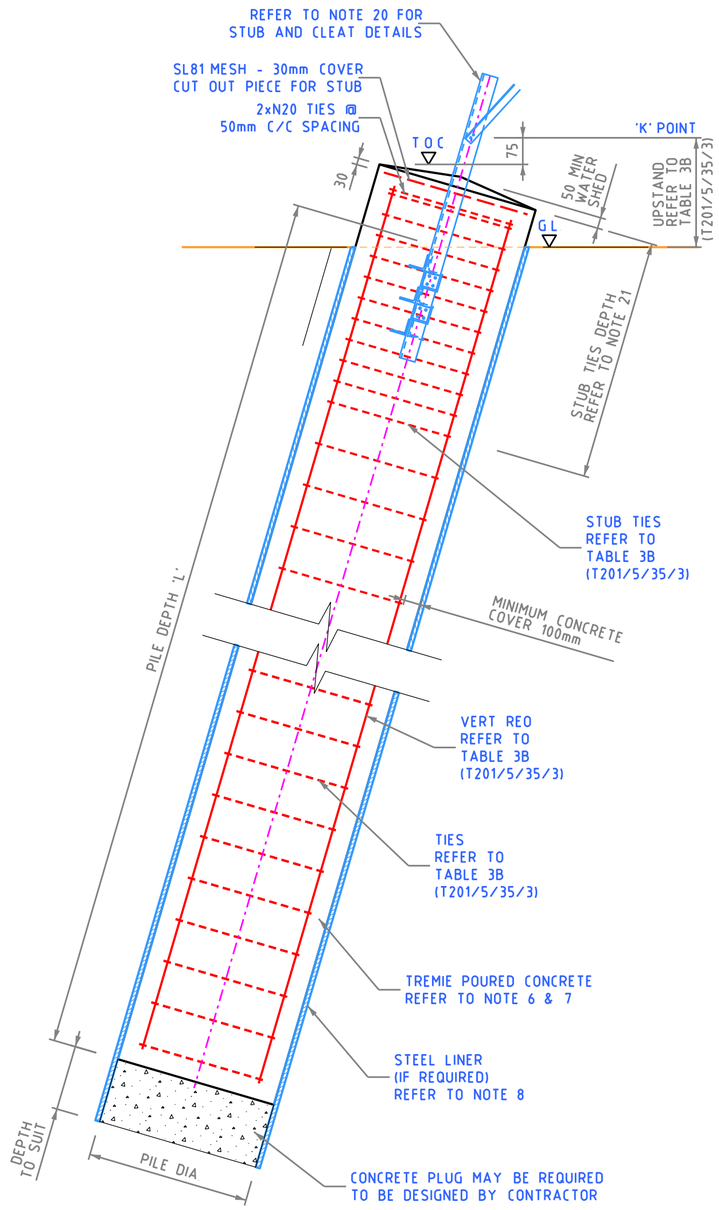
DRAWN: APD HC	DATE: 12/24
CHECKED: APD KA	DESIGNED: APD KA
EXAMINED: APD ABM	
EXAMINED	
APPROVED: APD EC	

DRG No T79/5/31/4

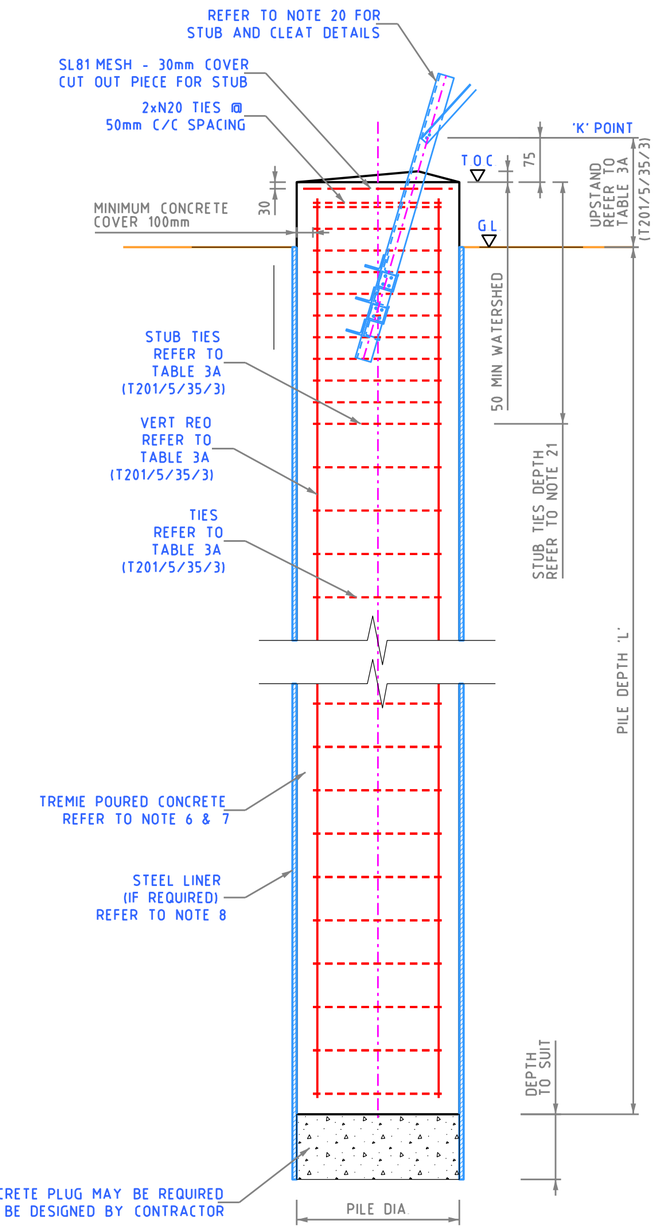
SCALE N/A | NEXT SHT 5

REVISION: 1

A2



INCLINED PILE FOUNDATION
NOT TO SCALE



VERTICAL PILE FOUNDATION
NOT TO SCALE

GENERAL NOTES

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL OTHER DRAWINGS, SPECIFICATIONS AND WITH SUCH OTHER WRITTEN INSTRUCTIONS AS MAY BE ISSUED DURING THE COURSE OF THE CONTRACT ANY DISCREPANCY SHALL BE REFERRED TO THE SUPERINTENDENT FOR DECISION BEFORE PROCEEDING WITH THE WORK
2. REFER TO CONSTRUCTION SCHEDULES T79/4/40/1 TO 4 AND T201/4/32/1 FOR STRUCTURE LOCATIONS REFER TO DRAWING T5003/6/0/3/1 FOR ADDITIONAL NOTES
3. ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE SAA CODES AND THE BY-LAWS AND ORDINANCES OF THE RELEVANT AUTHORITIES

FOUNDATION NOTES

4. FOUNDATIONS HAVE BEEN DESIGNED IN ACCORDANCE WITH AS/NZS 7000 AND WESTERN POWER ENGINEERING AND DESIGN STANDARD - TRANSMISSION LINE GEOTECHNICAL INVESTIGATIONS (EDM £28483277) WITH A GEOTECHNICAL REDUCTION FACTOR OF 0.65 THE SOIL PROPERTIES SHOWN IN TABLES 2.1 TO 2.5 (REFER TO SHEET 1 - T201/5/35/1) ARE AS PER "PS203357-WSP-PER-GEO-REP-00025 Rev0" (EDM£69907160) IF SOIL IS FOUND TO BE SIGNIFICANTLY DIFFERENT, IT SHALL BE REPORTED TO THE ENGINEER FOR GUIDANCE PRIOR TO CONSTRUCTION
5. ALL STRUCTURAL CONCRETE SHALL BE SPECIAL CLASS CONCRETE IT SHALL HAVE A CEMENTITIOUS CONTENT AND COMPOSITION SO THAT PEAK TEMPERATURE SHALL NOT EXCEED 70°C AND THE TEMPERATURE DIFFERENCE SHALL NOT EXCEED 20°C FORMWORK MAY NOT BE STRIPPED EARLIER THAN 3 DAYS FROM POURING
6. ALL STRUCTURAL CONCRETE SHALL BE GRADE S32 MINIMUM AND TREMIE POURED CONCRETE MIX AND CURING REQUIREMENTS TO BE IN ACCORDANCE WITH AS 3600 AND AS 1379
7. FOR FOUNDATION IN AGGRESSIVE SOIL AND/OR GROUNDWATER CONDITION, CONCRETE GRADE SHALL BE S40 WITH SULFATE-RESISTING CEMENT IN ACCORDANCE WITH AS 3972
8. A STEEL LINER MAY BE REQUIRED FOR FOUNDATION CONSTRUCTION IN COLLAPSIBLE SOIL LINER TO BE KEPT IN INTIMATE CONTACT WITH UNDISTURBED SOIL LINER AND CONCRETE PLUG SHALL BE DESIGNED BY THE CONTRACTOR AND TO BE CONFIRMED WITH WESTERN POWER PRIOR TO PROCUREMENT
9. THE PILE SHAFT AND BASE SHALL BE CLEANED OF LOOSE MATERIAL AND DEBRIS TO ENSURE THAT THE DESIGN STRENGTH CAN BE MOBILISED
10. ANY EXCAVATIONS IN CLOSE PROXIMITY TO EXISTING POLES CAN ONLY BE DONE AFTER SUPPORTING THE EXISTING POLE WITH ADDITIONAL TEMPORARY STAYS IN THE OPPOSITE SIDE OF THE EXCAVATION
11. CONCRETE TO BE USED UNDER THE GENERAL ACCEPTABLE TRANSPORT TIMES FOR DELIVERY
    - 60 MINUTES FOR CONCRETE AT OR BELOW 32°C
    - 45 MINUTES FOR CONCRETE ABOVE 32°C BUT NOT EXCEEDING 35°C
12. ALL BORED PILES SHALL BE CONSTRUCTED IN ACCORDANCE WITH AS 2159 FORMED EXPOSED SURFACE FINISHED TO AS 3610 CLASS 3 ALL UNFORMED EXPOSED SURFACES TO BE SMOOTH STEEL TROWELLED FINISHED BEFORE THE CONCRETE HARDENS EDGES TO HAVE A R10 BULLNOSE U N O
13. CONCRETE SHOULD CURE FOR AT LEAST 14 DAYS BEFORE ERECTING TOWERS STRINGING OF THE CONDUCTORS SHOULD ONLY COMMENCE 28 DAYS AFTER THE CONCRETE PLACEMENT
14. EARTHING SHALL BE INSTALLED IN ACCORDANCE TO T5000/7/8/15/1
15. CONTRACTOR SHALL ENSURE THE STABILITY OF THE EXCAVATION AT ALL TIMES DURING CONSTRUCTION SHORING OR BATTERED EXCAVATIONS MAY BE REQUIRED DURING INSTALLATION
16. CONTRACTOR TO SUBMIT THE PROPOSED ITP AND METHODOLOGY FOR REVIEW BY DESIGNER PRIOR TO MOBILISATION TO CONFIRM DESIGN INTENT IS ACHIEVED
17. REFER TO EDM £70576346 FOR CELN NBT-NT 92 93 FOUNDATIONS CONSTRUCTABILITY REPORT

STUB AND CLEAT NOTES

18. MAXIMUM TOLERANCE FOR CORRECT LOCATION OF STUB LEG TO CENTRE OF BORED SHAFT IS 50mm
19. THE CENTROID OF THE CLEAT GROUP SHALL INTERSECT WITH THE CENTRE OF THE PILE
20. FOR STUB AND CLEAT DETAILS, REFER TO T201/6/12/132 FOR 9DS0A STRUCTURES AND T201/6/13/70 FOR 9DA50A (9DT25A) STRUCTURES
21. STUB TIES SHALL START AT THE TOP OF THE PILE AND FINISH AT A MINIMUM DEPTH AS BELOW:

TOWER TYPE	STUB TIES DEPTH (mm)
9DS0A	2900
9DA50A (9DT25A)	3500

REVISIONS					
0	DRN	HC	DATE	11/24	CHKD KA
	PROJ No	T0618140	DESIGN	KA	EXMD ABM
	APPROVED	EC	ISSUED FOR REVIEW		
1	DRN	HC	DATE	12/24	CHKD KA
	PROJ No	T0618140	DESIGN	KA	EXMD ABM
	APPROVED	EC	TABLES 3A & 3B MOVED TO SHEET 3. NOTE 17 ADDED		

T5000/7/8/15/1	STRUCTURE EARTHING ASSEMBLY
T5003/6/0/3/1	CIVIL AND STRUCTURAL NOTES
T79/4/40/1 TO 4	NBT-NT 93 LINE CONSTRUCTION SCHEDULE
T201/4/32/1	ENT-NBT 91 LINE CONSTRUCTION SCHEDULE
T201/5/35/3	NBT-NT 93 & ENT-NBT 91 LINE - TOWER FOUNDATIONS - SHT 3
T79/5/26/1 & 2	NBT-NT 93 & ENT-NBT 91 LINE - FOUNDATIONS - POLE SUITE
T201/6/12/132	STUB DETAILS - SUSPENSION TOWER TYPE 9DS0A
T201/6/13/70	STUB DETAILS - STRAIN TOWER TYPE 9DA50A (9DT25A)

NBT-NT 93 & ENT-NBT 91 LINE
FOUNDATIONS
D/C TOWER SUITE
TOWER 1/454 TO 9/452A
SHEET 2

westernpower

DRAWN APD HC	DATE 12/24	DRG No	T201/5/35/2
CHECKED APD KA	DESIGNED APD KA		
EXAMINED APD ABM			
EXAMINED		SCALE N.T.S	NEXT SHT 3
APPROVED APD EC			REVISION 1

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t201-05-035-002.dgn

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TABLE 3A FOUNDATION SUMMARY TABLE - VERTICAL PILE													
TOWER TYPE	TOWER NUMBER	ULTIMATE FOUNDATION REACTION			WITHOUT LINER		WITH LINER		REINFORCEMENTS			UPSTAND (mm) REFER NOTE 7	SOIL PROFILE
		UPLIFT (kN)	COMPRESSION FORCE (kN)	SHEAR FORCE (kN)	PILE DIA (mm)	PILE DEPTH 'L' (m)	PILE DIA (mm)	PILE DEPTH 'L' (m)	VERT REO	STUB TIES	TIES		
9DA50A (9DT25A)	ENT-NBT 91 Tower 454/ NBT-NT 93 Tower 1	2233	2551	651	2100	14 5	2100	20	44-N32	N16-100	N16-200	400	FloodWBH8
9DS0A	ENT-NBT 91 Tower 453A/ NBT-NT 93 Tower 2	1269	1073	189	1800	10 4	1800	13 2	44-N28	N16-100	N16-200	300	WBH8
9DA50A (9DT25A)	ENT-NBT 91 Tower 453/ NBT-NT 93 Tower 3	1282	1691	446	2100	9 9	2100	12 9	44-N32	N16-100	N16-200	400	BH2
9DS0A	ENT-NBT 91 Tower 452F/ NBT-NT 93 Tower 4	1269	1073	205	1800	11 4	1800	15 5	44-N28	N16-100	N16-200	300	BH2
9DS0A	ENT-NBT 91 Tower 452E/ NBT-NT 93 Tower 5	1269	1073	192	1800	11 4	1800	15 5	44-N28	N16-100	N16-200	300	BH2
9DS0A	ENT-NBT 91 Tower 452D/ NBT-NT 93 Tower 6	1269	1073	194	1800	10 3	1800	13 1	44-N28	N16-100	N16-200	300	BH3
9DS0A	ENT-NBT 91 Tower 452C/ NBT-NT 93 Tower 7	1269	1073	197	1800	10 3	1800	13 1	44-N28	N16-100	N16-200	300	BH3
9DS0A	ENT-NBT 91 Tower 452B/ NBT-NT 93 Tower 8	1269	1073	196	1800	10 3	1800	13 1	44-N28	N16-100	N16-200	300	BH3
9DA50A (9DT25A)	ENT-NBT 91 Tower 452A/ NBT-NT 93 Tower 9	2106	2458	629	2100	14 8	2100	20 3	44-N32	N16-100	N16-200	300	WBH10

TABLE 3B FOUNDATION SUMMARY TABLE - INCLINED PILE														
TOWER TYPE	TOWER NUMBER	PILE RAKE ANGLE (°)	ULTIMATE FOUNDATION REACTION IN LEG DIRECTION			WITHOUT LINER		WITH LINER		REINFORCEMENTS			UPSTAND (mm) REFER NOTE 7	SOIL PROFILE
			UPLIFT (kN)	COMPRESSION FORCE (kN)	SHEAR FORCE (kN)	PILE DIA (mm)	PILE DEPTH 'L' (m)	PILE DIA (mm)	PILE DEPTH 'L' (m)	VERT REO	STUB TIES	TIES		
9DA50A (9DT25A)	ENT-NBT 91 Tower 454/ NBT-NT 93 Tower 1	16 3	2329	2667	52	1800	17	1800	24 1	44-N32	N16-100	N16-200	400	FloodWBH8
9DS0A	ENT-NBT 91 Tower 453A/ NBT-NT 93 Tower 2	9 3	1073	1269	30	1800	9 4	1800	11 8	44-N28	N16-100	N16-200	300	WBH8
9DA50A (9DT25A)	ENT-NBT 91 Tower 453/ NBT-NT 93 Tower 3	16 3	1339	1773	48	1800	11 8	1800	16 2	44-N32	N16-100	N16-200	400	BH2
9DS0A	ENT-NBT 91 Tower 452F/ NBT-NT 93 Tower 4	9 3	1073	1269	30	1800	10 2	1800	13 6	44-N28	N16-100	N16-200	300	BH2
9DS0A	ENT-NBT 91 Tower 452E/ NBT-NT 93 Tower 5	9 3	1073	1269	30	1800	10 2	1800	13 6	44-N28	N16-100	N16-200	300	BH2
9DS0A	ENT-NBT 91 Tower 452D/ NBT-NT 93 Tower 6	9 3	1073	1269	30	1800	9 4	1800	11 8	44-N28	N16-100	N16-200	300	BH3
9DS0A	ENT-NBT 91 Tower 452C/ NBT-NT 93 Tower 7	9 3	1073	1269	30	1800	9 4	1800	11 8	44-N28	N16-100	N16-200	300	BH3
9DS0A	ENT-NBT 91 Tower 452B/ NBT-NT 93 Tower 8	9 3	1073	1269	30	1800	9 4	1800	11 8	44-N28	N16-100	N16-200	300	BH3
9DA50A (9DT25A)	ENT-NBT 91 Tower 452A/ NBT-NT 93 Tower 9	16 3	2196	2571	52	1800	17 3	1800	24 4	44-N32	N16-100	N16-200	300	WBH10

TABLE 4 AS BUILT INFORMATION (TO BE COMPLETED BY CONTRACTOR)								
TOWER NUMBER	CONCRETE COMPRESSIVE STRENGTH AT 28 DAYS (MPa)	PILE DEPTH 'L' ACTUAL (m)	RAKE ANGLE ACTUAL (°)	SOIL DESCRIPTION * (G/S/SI/R - L/M/H/R) OR (C - SO/F/ST)			WATER TABLE	
				1-3m	3-6m	¢6m	DEPTH (m)	DATE

*SOIL DESCRIPTION (TYPE - DENSITY)
(L = LOOSE / M = MEDIUM / H = DENSE/CEMENTED)
G = GRAVEL S = SAND
SI = SILT R = ROCK
OR
(SO = SOFT / F FIRM / ST = STIFF)
C = CLAY

GENERAL NOTES

1 REFER TO SHEET 2 FOR GENERAL AND FOUNDATION DESIGN NOTES

2 AS BUILT INFORMATION TO BE COMPLETED BY CONTRACTOR AFTER CONSTRUCTION

STEEL REINFORCEMENT NOTES

2 ALL REINFORCING STEEL TO BE GRADE 500MPa ALL STEELWORK TO BE HOT DIP GALVANISED TO AS/NZS 4680 OR AS/NZS 4792 (WHICHEVER IS APPLICABLE)

3 BORED FOUNDATION FITMENTS TO BE EITHER CONTINUOUS SPIRAL OR TIES WIH 160mm LONG SINGLE SPLICE WELD IN ACCORDANCE WITH AS/NZS 1554 3

4 IN ADDITION TO FITMENT REINFORCEMENT SHOWN, TWO N20 WELDED TIES @ 50mm C/C REQUIRED AT THE TOP OF THE REINFORCEMENT CAGE FOR ALL FOUNDATION TYPES

5 TACK WELDING OF TIES TO THE MAIN REINFORCEMENT SHALL BE STRICTLY UNDERTAKEN IN ACCORDANCE WITH AS/NZS 1554 3 ANY OTHER REINFORCEMENT WELDING IS SUBJECT TO APPROVAL BY WESTERN POWER'S ON SITE FOUNDATION REPRESENTATIVE

6 PILE REINFORCEMENT TO BE FULL LENGTH UNLESS NOTED OTHERWISE WHERE THIS IS NOT POSSIBLE, REINFORCEMENT TO BE LAPPED 50x BAR DIAMETER IN MIDDLE OF PILE

7 UPSTAND TO BE AT LEAST 200mm AND NOT MORE THAN 600mm

8 ALL SUSPENSION STRUCTURE (9DS0A) ARE DESIGNED TO THEIR STRUCTURAL CAPACITY

Safety First Every Second

TL-T201
t201-05-035-003.dgn

REVISIONS

	DRN	DATE	CHKD
0	HC	11/24	KA
PROJ No	DESIGN	EXMD	
T0618140	KA	ABM	
APPROVED	EC		
ISSUED FOR REVIEW			

	DRN	DATE	CHKD
1	HC	12/24	KA
PROJ No	DESIGN	EXMD	
T0618140	KA	ABM	
APPROVED	EC		
TABLES 3A & 3B MOVED IN FROM SHEET 2, TABLE 4 LAYOUT UPDATED			

T5000/7/8/15/1	STRUCTURE EARTHING ASSEMBLY
T5003/6/0/3/1	CIVIL AND STRUCTURAL NOTES
T79/4/40/1 TO 4	NBT-NT 93 LINE CONSTRUCTION SCHEDULE
T201/4/32/1	ENT-NBT 91 LINE CONSTRUCTION SCHEDULE
T201/5/35/2	NBT-NT 93 & ENT-NBT 91 LINE - TOWER FOUNDATIONS - SHT 2
T79/5/26/1 & 2	NBT-NT 93 & ENT-NBT 91 LINE - FOUNDATIONS - POLE SUITE

NBT-NT 93 & ENT-NBT 91 LINE
FOUNDATIONS
D/C TOWER SUITE
TOWER 1/454 TO 9/452A
SHEET 3

westernpower

DRAWN: APD HC	DATE: 12/24
CHECKED: APD KA	DESIGNED: APD KA
EXAMINED: APD ABM	
EXAMINED:	
APPROVED: APD EC	

DRG No T201/5/35/3
SCALE N T S
NEXT SHT -
REVISION 1

A2

APPENDIX D: REGIONAL GROUNDWATER QUALITY DATA AVAILABLE FROM DWER'S WATER INFORMATION REPORTING PORTAL

			TDSolids (evap @180øC) (mg/L)	TDSolids (mg/L)	Cond @ 25 deg C (uS/cm)	Suspended Solids (Total) {TSS} (mg/L)	Turbidity (NTU) (NTU)	pH (no units)	ORP uncomp (in situ) (mV)	O2-{DO %sat} (%)	O2-{DO conc} (mg/L)
Site Ref	**Collect Date**	**Sample Comment**	**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**
61610322	15-04-2021	Production bore. Light yellow no sheen, slight sulphur odour.	480	507	733	<5	12.2	6.14	74.6	41.8	3.83
61610322	08-12-2022	Pale yellow, low turbidity, strong sulfidic odour, low sediment load. Production bore.	444	516	711	<5	1.8	6.79	177.6	23.1	1.89
61610475	03-03-2021		230	212.55	323.9	<5	4.8	6.18	-36	9.7	0.85
61610475	28-11-2022		162	171	258	<5	9.4	6.99	-192.7	1.4	0.13
61610493	25-03-2021		518	446.3	686.2	<5	1.7	4.31	-56.3		1.93
61610493	07-12-2022		444	507	739.5	<5	1.3	4.5	-60.3	3.7	0.34
61610918	04-03-2021		189	218.4	309.2	<5	4.2	5.12	12.8	4	0.34
61610918	09-12-2022		182	206.7	302	<5	2.9	5.23	-44.5	4.81	0.42
61610933	30-03-2021		305	326.95	482.7	68	99.8	7.51	-132.4	1.9	0.17
61610954	04-03-2021		193	202.8	292.8	6	9.2	4.57	49.6	4.24	5.17
61610954	24-11-2022		160	172	257.8	22	18	4.33	-45.3	3.5	0.31
61610967	14-04-2021		234	186.55	269.2	<5	2.4	3.88	4.8	2.3	0.18
61610967	23-11-2022		200	190.1	286.2	<5	1.4	3.89	-65.9	4.1	0.37
61611871	16-11-2023		166		163.2	12	17	5.96	145.2		4.01
61618554	12-04-2021										

			Temperature (deg C)		Ion balance (%)	Na (sol) (ug/L)	K (sol) (ug/L)	Ca (sol) (ug/L)	Mg (sol) (ug/L)	Fe (sol) (ug/L)	Fe II (ug/L)	Al (sol) (ug/L)
Site Ref	**Collect Date**	**Sample Comment**	**Reading Value**		**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**
61610322	15-04-2021	Production bore. Light yellow no sheen, slight sulphur odour.	19.9		1.82	74000	4000	28000	23000		10200	860
61610322	08-12-2022	Pale yellow, low turbidity, strong sulfidic odour, low sediment load. Production bore.	24.5		3.63	76500	4500	36500	21000	9650	8465	255
61610475	03-03-2021		21.1		3.18	38000	4000	16000	6000		60	130
61610475	28-11-2022		22.3		2.62	29000	4000	12000	4000	90	90	110
61610493	25-03-2021		22.4		9.34	71000	3000	12000	24000		12400	5120
61610493	07-12-2022		19.5		1.44	75000	3000	10000	22000	13100	12500	6590
61610918	04-03-2021		21.4		4.62	26000	2000	12000	6000		6520	540
61610918	09-12-2022		21		1.79	25000	3000	12000	8000	6270	5870	520
61610933	30-03-2021		20.1		2.69	32000	4000	61000	4000		3410	80
61610954	04-03-2021		21.6		3.91	30000	2000	5000	6000		5620	750
61610954	24-11-2022		21		0.49	32000	1000	5000	7000	4080	3940	1600
61610967	14-04-2021		22.7			24000	<1000	4000	9000		220	1660
61610967	23-11-2022		20		2.08	23000	<1000	3000	10000	300	290	1470
61611871	16-11-2023		23.6		2.74	34000	3000	5000	7000	830	860	110
61618554	12-04-2021											

			Cations (sum sol) (meq/L)		Cl (sol) (ug/L)	SO4 (sol) (ug/L)	Alkalinity (HCO3-CaCO3) (mg/L)	F (sol) (ug/L)	Anions (sum sol) (meq/L)		N (tot) {TN, pTN} (ug/L)	NO2-N (sol) (ug/L)	NO3-N (sol) (ug/L)
Site Ref	**Collect Date**	**Sample Comment**	**Reading Value**		**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**		**Reading Value**	**Reading Value**	**Reading Value**
61610322	15-04-2021	Production bore. Light yellow no sheen, slight sulphur odour.	6.61		97000	146000	30	<100	6.38		800	<10	<10
61610322	08-12-2022	Pale yellow, low turbidity, strong sulfidic odour, low sediment load. Production bore.	7		104000	132500	40.5	<100	6.5		1450	<10	<10
61610475	03-03-2021		3.05		47000	42000	33	<100	2.86		500	<10	<10
61610475	28-11-2022		2.29		43000	28000	31	<100	2.42		600	<10	<10
61610493	25-03-2021		5.74		114000	178000	<1	<200	6.92		700	<10	<10
61610493	07-12-2022		6.35		124000	146000	<1	<200	6.54		700	<10	40
61610918	04-03-2021		2.27		45000	56000	3	<100	2.5		400	<10	<10
61610918	09-12-2022		2.42		44000	59000	2	<100	2.51		400	<10	<10
61610933	30-03-2021		4.87		53000	<1000	156	<100	4.61		300	<10	<10
61610954	04-03-2021		2.1		48000	44000	<1	<100	2.27		500	<10	70
61610954	24-11-2022		2.24		53000	37000	<1	<200	2.26		1300	<10	740
61610967	14-04-2021		1.98		37000	40000	<1	100	1.88		1100	<10	<10
61610967	23-11-2022		2.14		45000	46000	<1	<200	2.23		1000	<10	<10
61611871	16-11-2023		2.38		33000	53000	11	<100	2.25		500	<10	<10
61618554	12-04-2021												

			P (tot) {TP, pTP} (ug/L)	PO4 (tot) (ug/L)	PO4-P (tot react) (ug/L)		Acidity to pH 8.3 (CaCO3) (ug/L)	Alkalinity (tot) (CaCO3) (ug/L)	Alkalinity (CO3-CaCO3) (mg/L)	Alkalinity (OH-CaCO3) (mg/L)		As (sol) (ug/L)	Br (sol) (ug/L)
Site Ref	**Collect Date**	**Sample Comment**	**Reading Value**	**Reading Value**	**Reading Value**		**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**		**Reading Value**	**Reading Value**
61610322	15-04-2021	Production bore. Light yellow no sheen, slight sulphur odour.	20	<100	<100		26000	30000	<1	<1		<1	
61610322	08-12-2022	Pale yellow, low turbidity, strong sulfidic odour, low sediment load. Production bore.	35	105	<100		17000	40500	<1	<1		<1	297
61610475	03-03-2021		140	410	400		14000	33000	<1	<1		<1	
61610475	28-11-2022		20	<100	<100		8000	31000	<1	<1		<1	81
61610493	25-03-2021		20	<100	<100		76000	<1000	<1	<1		<1	
61610493	07-12-2022		20	<100	<100		72000	<1000	<1	<1		<1	362
61610918	04-03-2021		20	<100	<100		29000	3000	<1	<1		2	
61610918	09-12-2022		30	<100	<100		22000	2000	<1	<1		1	124
61610933	30-03-2021		120	360	<100		10000	156000	<1	<1		<1	
61610954	04-03-2021		20	<100	<100		31000	<1000	<1	<1		<1	
61610954	24-11-2022		<10	<100	<100		33000	<1000	<1	<1		<1	73
61610967	14-04-2021		70	230	150		36000	<1000	<1	<1		<1	
61610967	23-11-2022		50	160	120		66000	<1000	<1	<1		<1	116
61611871	16-11-2023		40	130	<100		24000	11000	<1	<1		<1	109
61618554	12-04-2021												

			Cd (sol) (ug/L)	Cu (sol) (ug/L)	Mn (sol) (ug/L)	Ni (sol) (ug/L)	Sr (sol) (ug/L)	Zn (sol) (ug/L)
Site Ref	**Collect Date**	**Sample Comment**	**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**
61610322	15-04-2021	Production bore. Light yellow no sheen, slight sulphur odour.	<0.1	<1	15	2	116	<5
61610322	08-12-2022	Pale yellow, low turbidity, strong sulfidic odour, low sediment load. Production bore.	<0.1	<1	38	2		49
61610475	03-03-2021		<0.1	<1	4	<1	48	<5
61610475	28-11-2022		<0.1	6	4	<1		6
61610493	25-03-2021		<0.1	<1	5	8	78	8
61610493	07-12-2022		<0.1	<1	5	7		<5
61610918	04-03-2021		<0.1	<1	3	3	82	22
61610918	09-12-2022		<0.1	<1	4	1		<5
61610933	30-03-2021		0.2	<1	28	<1	107	921
61610954	04-03-2021		<0.1	<1	2	<1	42	<5
61610954	24-11-2022		<0.1	<1	2	<1		<5
61610967	14-04-2021		<0.1	<1	1	<1	43	8
61610967	23-11-2022		<0.1	<1	<1	<1		<5
61611871	16-11-2023		<0.1	<1	21	1		10
61618554	12-04-2021							

Table D2 - Available Surfacewater Quality data

			Flow status (no units)	TDSolids (mg/L)	Cond @ 25 deg C (uS/cm)	Suspended Solids (Total) {TSS} (mg/L)	Turbidity (FNU) (FNU)	pH (no units)	O2-{DO %sat} (%)	O2-{DO conc} (mg/L)
Site Ref	**Date**	**Sample Comment**	**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**
6163360	23-07-2020	Drain not flowing. Water in culvert sampled	stationary or static		498	1		6.78	87.3	8.68
6163360	27-08-2020	Medium flow. Slight odour. Grass growing in flow. Algae present	flowing		689	3	4.28	6.83	128.2	11.72
6163360	24-09-2020	Moderate flow. Emergent macrophytes. Low level waterline	flowing		639	1		6.94	150.1	13.13
6163360	29-07-2021	Moderate flow. Very clear	flowing		290	<2		6.07	94.4	9.25
6163360	26-08-2021	Moderate flow. Clear. Odourous	flowing		653	2.3		6.28	82.4	7.86
6163360	23-09-2021	Very clear	flowing		640	<1		6.22	96.2	9.09
6163360	13-07-2023	Algae	flowing		692.9	<1		6.21	69.2	6.53
6163360	10-08-2023	Smelly	flowing		669.1	2		6.34	70.6	6.92
6163360	08-09-2023	Strong flow. Clear water. Rubbish. Lots of weeds present	flowing		611.9	1		6.5	89.9	8.99
6163360	12-07-2024	Drain clogged. Flow still present	flowing	380	583.9	4		6.52	88.7	9.15
6163360	09-08-2024	Minor turbidity. Large decaying vegetation mass blocking drain	flowing		594.5	2		5.6	98.8	9.34
6163360	13-09-2024	Clear. Little or no turbidity. Large mass of plastic/vegetation blocking 95% of drain	flowing		639.3	3		5.69	110.9	10.48
6160957	26-08-2021	Stagnant shallow pool. Light tannins. Clear. Lots of organic debris/leaf litter	stationary or static		1612	24		5.94	38.6	3.94
6160957	25-08-2022	Iron colour. Off odour. Surface foam. Milky sheen. Organic debris	stationary or static	1154	1775.2	12		6.18	25.6	2.71
6160957	06-10-2022	Dark tannin. Surface film	stationary or static	861	1324	72		5.93	21.9	2.18
6163363	23-07-2020	Tannin stained. No flow through culvert	stationary or static		2101	24		4.49	12.9	1.39
6163363	27-08-2020	Cloudy brown water. Fringing vegetation. Foaming when disturbed. Floating organic matter	stationary or static		2171	38	67.81	3.73	36.5	3.98
6163363	24-09-2020	Tannin stained. Organic debris. Fringing vegetation. Little or no flow	stationary or static		3673	3		4.09	7.6	0.76
6163363	29-07-2021	Low flow. Very heavy tannins. Clear. Sandy substrate	flowing		2828	8		3.58	37.7	3.88
6163363	26-08-2021	Low flow. Light tannins. Lots of organic debris	flowing		2022	19		3.53	28.7	2.97
6163363	23-09-2021	Heavy tannins. Lots of organic debris	flowing		1727	9		3.48	38.3	4.19
6163363	04-08-2022	No flow. Cloudy. Heavy tannins. Lots of organic debris	stationary or static	1350	2077.6	69		4.3	12.7	1.34
6163363	25-08-2022	Shaded. Heavy tannins. Sandy bottom	flowing	1371	2108.8	26		3.61	38.2	4.23
6163363		Tannins. Overcast	stationary or static	910	1400.6	14		3.52	37.1	3.94
6163363	13-07-2023		stationary or static		2156.9	18		5.2	5.9	0.62
6163363	10-08-2023	Very brown red dark brown. Organic debris. Frogs, Birds	stationary or static		2424.8	5		3.59	52	5.8
6163363	08-09-2023	Clear water. High tannins. Lots of organic debris. Sandy substrate	stationary or static		2081.2	13		3.74	40.3	4.54
6163363	13-09-2024	No observable flow. Signs of recent flow. Lots of floating debris	stationary or static		2099.8	3		3.64	40.3	4.18

			Temperature (deg C)		Ca (sol) (ug/L)	Mg (sol) (ug/L)	Fe (sol) (ug/L)	Al (sol) (ug/L)	Cu (sol) (ug/L)	Zn (sol) (ug/L)	Hardness (tot) (CaCO3) {Ca+Mg} (ug/L)
Site Ref	**Date**	**Sample Comment**	**Reading Value**		**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**
6163360	23-07-2020	Drain not flowing. Water in culvert sampled	15.6				230	82	1	29	89000
6163360	27-08-2020	Medium flow. Slight odour. Grass growing in flow. Algae present	19.6				120	56	1.3	32	120000
6163360	24-09-2020	Moderate flow. Emergent macrophytes. Low level waterline	21.9				140	73	1.2	17	110000
6163360	29-07-2021	Moderate flow. Very clear	16.3				150	86	3.8	30	58000
6163360	26-08-2021	Moderate flow. Clear. Odourous	17.5				155	92	1.9	26	120000
6163360	23-09-2021	Very clear	18				130	81	1.2	16	100000
6163360	13-07-2023	Algae	18.1		24000	11300	130	80	1.7	21	110000
6163360	10-08-2023	Smelly	16.2				97	82	2.7	18	84000
6163360	08-09-2023	Strong flow. Clear water. Rubbish. Lots of weeds present	15.3				130	130	1.8	120	100000
6163360	12-07-2024	Drain clogged. Flow still present	13.9				360	99	2.1	35	96000
6163360	09-08-2024	Minor turbidity. Large decaying vegetation mass blocking drain	18				510	150	3	21	110000
6163360	13-09-2024	Clear. Little or no turbidity. Large mass of plastic/vegetation blocking 95% of drain	18				260	130	3.2	9	100000
6160957	26-08-2021	Stagnant shallow pool. Light tannins. Clear. Lots of organic debris/leaf litter	14.1				7500	200	1.4	17	590000
6160957	25-08-2022	Iron colour. Off odour. Surface foam. Milky sheen. Organic debris	12.5				7600	8900	2.3	28	560000
6160957	06-10-2022	Dark tannin. Surface film	15.4				26000	250	2.1	33	440000
6163363	23-07-2020	Tannin stained. No flow through culvert	11.7				23000	2200	3.6	19	420000
6163363	27-08-2020	Cloudy brown water. Fringing vegetation. Foaming when disturbed. Floating organic matter	11.2				11000	2100	25	27	460000
6163363	24-09-2020	Tannin stained. Organic debris. Fringing vegetation. Little or no flow	14.6				1700	10000	5.1	11	750000
6163363	29-07-2021	Low flow. Very heavy tannins. Clear. Sandy substrate	13.6				4700	11000	2.3	16	740000
6163363	26-08-2021	Low flow. Light tannins. Lots of organic debris	13.4				7200	7300	2.5	12	480000
6163363	23-09-2021	Heavy tannins. Lots of organic debris	11.1				5400	4600	9.3	14	360000
6163363	04-08-2022	No flow. Cloudy. Heavy tannins. Lots of organic debris	12.7				7200	2200	2.9	36	450000
6163363	25-08-2022	Shaded. Heavy tannins. Sandy bottom	10.6				11000	660	2.9	49	700000
6163363		Tannins. Overcast	12.4				6200	4100	8.7	17	350000
6163363	13-07-2023		13.3		56100	74300	33000	1800	2.7	6	450000
6163363	10-08-2023	Very brown red dark brown. Organic debris. Frogs, Birds	10.1				1300	7500	9.7	5	490000
6163363	08-09-2023	Clear water. High tannins. Lots of organic debris. Sandy substrate	9.8				2600	6400	2	1	470000
6163363	13-09-2024	No observable flow. Signs of recent flow. Lots of floating debris	13.4				5400	6900	13	7	480000

Table D2 - Available Surfacewater Quality data

			N (tot) {TN, pTN} (ug/L)	N (tot kjel) {TKN} (ug/L)	N (tot org) {TON} (ug/L)	N (sum sol org) {DON} (ug/L)	N (sum sol ox) {NOx-N, TON} (ug/L)	NH3-N/NH4-N (sol) (ug/L)	P (tot) {TP, pTP} (ug/L)	PO4-P (sol react) {SRP, FRP} (ug/L)	
Site Ref	**Date**	**Sample Comment**	**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**	**Reading Value**	
6163360	23-07-2020	Drain not flowing. Water in culvert sampled	380	360	330	330	23	31	16	7	
6163360	27-08-2020	Medium flow. Slight odour. Grass growing in flow. Algae present	540	540	520	430	<10	15	12	<5	
6163360	24-09-2020	Moderate flow. Emergent macrophytes. Low level waterline	440	420	410	390	14	17	<5	<5	
6163360	29-07-2021	Moderate flow. Very clear	630	260	260	230	370	<10	9	<5	
6163360	26-08-2021	Moderate flow. Clear. Odourous	660	435	430	420	230	<10	5	<5	
6163360	23-09-2021	Very clear							<5	<5	
6163360	13-07-2023	Algae	540	390	390	330	150	<10	<5	<5	
6163360	10-08-2023	Smelly	550	400	380	370	150	22	11	<5	
6163360	08-09-2023	Strong flow. Clear water. Rubbish. Lots of weeds present	470	400	370	370	73	22	10	<5	
6163360	12-07-2024	Drain clogged. Flow still present	560	450	410	370	110	36	20	<5	
6163360	09-08-2024	Minor turbidity. Large decaying vegetation mass blocking drain	910	570	500	460	340	71	12	<5	
6163360	13-09-2024	Clear. Little or no turbidity. Large mass of plastic/vegetation blocking 95% of drain	790	530	520	370	260	12	15	<5	
6160957	26-08-2021	Stagnant shallow pool. Light tannins. Clear. Lots of organic debris/leaf litter	1100	1100	1100	1000	<10	35	11	<5	
6160957	25-08-2022	Iron colour. Off odour. Surface foam. Milky sheen. Organic debris	850	850	820	810	<10	38	<5	<5	
6160957	06-10-2022	Dark tannin. Surface film	860	860	820	760	<10	43	<5	<5	
6163363	23-07-2020	Tannin stained. No flow through culvert	1600	1600	1500	970	35	19	21	<5	
6163363	27-08-2020	Cloudy brown water. Fringing vegetation. Foaming when disturbed. Floating organic matter	1100	1100		670	<10	23	15	<5	
6163363	24-09-2020	Tannin stained. Organic debris. Fringing vegetation. Little or no flow	810	810	790	780	<10	20	<5	<5	
6163363	29-07-2021	Low flow. Very heavy tannins. Clear. Sandy substrate	1000	1000	970	950	<10	27	<5	<5	
6163363	26-08-2021	Low flow. Light tannins. Lots of organic debris	840	840	770	730	<10	72	<5	<5	
6163363	23-09-2021	Heavy tannins. Lots of organic debris	760	760	720	650	<10	40	<5	<5	
6163363	04-08-2022	No flow. Cloudy. Heavy tannins. Lots of organic debris	1300	1300	1300	700	16	24	25	<5	
6163363	25-08-2022	Shaded. Heavy tannins. Sandy bottom	1300	1300	1300	1300	<10	34	19	<5	
6163363		Tannins. Overcast	640	640	620	610	<10	29	<5	<5	
6163363	13-07-2023		1800	1800	1800	1500	22	39	26	<5	
6163363	10-08-2023	Very brown red dark brown. Organic debris. Frogs, Birds	720	720	700	660	<10	27	<5	<5	
6163363	08-09-2023	Clear water. High tannins. Lots of organic debris. Sandy substrate	680	680	660	650	<10	22	<5	<5	
6163363	13-09-2024	No observable flow. Signs of recent flow. Lots of floating debris	860	860	830	690	<10	29	<5	<5	