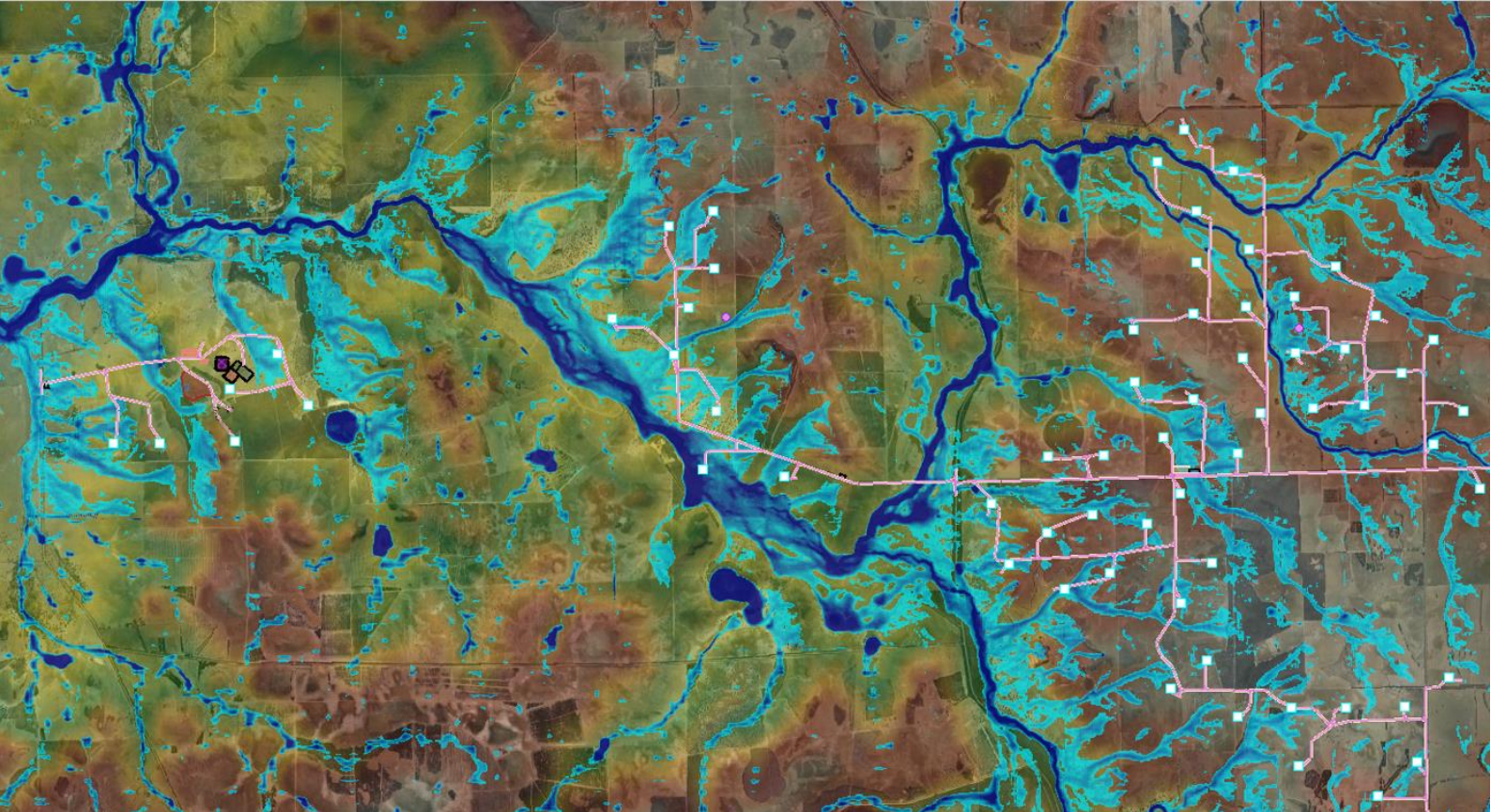




Dinner Hill Wind Farm Surface Water Hydrology Report

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Executive Summary

The proposed Dinner Hill Wind Farm Project (the Project) is a renewable energy facility comprising up to 131 wind turbine generators and associated ancillary infrastructure including (but not limited to) a BESS, hardstand areas, substation and switch yard, operational and maintenance facility, control room, site offices and car parking, construction compound and laydown areas, concrete batching plants, overhead and underground cabling, and upgraded access tracks. The Project has been conceptually designed to generate up to 943 MW of electricity for transmission into the South West Interconnected System (SWIS) which will be dependent on final turbine model and numbers.

A hydrological and hydraulic analysis was undertaken to ensure assets are constructed above flood levels, to identify scour risks, and to ensure the Project does not change flood behaviour in a way that impacts the surrounding environment or communities. The analysis shows that transmission towers and WTG foundations are generally located outside of concentrated flow channels. Maximum velocities for surface water runoff in the modelled area occur within the Hill River channel. Infrastructure within the Hill River 1% Annual Exceedance Probability (AEP) flood extents is recommended to be relocated or protected from scour. This can be considered in the detailed design stage of the Project. Outside of the river channel, the hydraulic results do not indicate a need for rip rap scour protection. Throughout the development footprint, excavated slopes or fill embankments should be lined with vegetation, matting, or coarse material appropriate for the design slope and pad size to protect against erosion from localised rainfall and runoff.

The results indicate potential inundation of access tracks as some tracks cross through depressions without outlets. As a result, additional fill or re-routing of the access tracks may be required to provide ongoing serviceability. Ponded water levels in internally draining areas are expected to drop relatively rapidly over time through infiltration and evapotranspiration based on the assumed site soil properties. Some additional silts from construction activities may settle in depressions over time, and ongoing maintenance or rehabilitation of exposed slopes may be required during operations. The desired level of flood protection and freeboard may be adjusted with further design updates in coordination with the design team.

The results show no discernible effect of the proposed infrastructure on adjacent flood levels, peak discharge rates, or downstream flow volumes; as such, the existing conditions hydraulic results presented in this report are considered applicable to the project conditions. Relocation or protection from scour of two WTGs (DIN.10201 and DIN.10121) located within the 1% AEP flood extents is recommended based on the hydraulic results. This can be further considered in the detailed design stage of the Project. Some ponding up to 20 cm in depth occurs at other WTG and transmission tower locations; the placement of minor fill may be warranted in these areas to facilitate local drainage and reduce required maintenance. Hydraulic modelling results indicate that the minor fill has a negligible effect on offsite flows.



The hydraulic results are limited to the accuracy of the available terrain data. All site features are covered by high-resolution terrain data with the exception of approximately 4 km of the transmission line alignment. Additionally, some contributing catchment areas are outside the available detailed terrain coverage. Assessments in the areas not covered by detailed terrain data rely on publicly available, satellite-based terrain data. There are notable vertical discrepancies in the satellite-based data; interface areas have been manually smoothed to limit hydrological impacts. Detailed LiDAR data covering all project features will be acquired and applied for updated modelling in the detailed design stage. Model outcomes are based on assumed soil properties, and the results are highly sensitive to the adopted values. Future gauging and calibration efforts may allow for increased confidence through further refinement of roughness coefficients, infiltration rates, and other parameters.



Abbreviations:

AEP	Annual Exceedance Probability
ARI	Average Recurrence Interval
ARR	Australian Rainfall and Runoff
BESS	Battery Energy Storage System
BOM	Bureau of Meteorology
DEM	Digital Elevation Model
DFD	Depth-Frequency-Duration
DWER	WA Department of Water and Environmental Regulation
EA	Engineers Australia
FFA	Flood Frequency Analysis
GDA	Geodetic Datum of Australia
GDE	Groundwater Dependent Ecosystem
GEV	Generalised Extreme Value
GSA	Geoscience Australia
HEC	Hydrologic Engineering Center
IFD	Intensity-Frequency-Duration
km	Kilometres
kv	Kilovolts (1,000 volts)
LGA	Local Government Area
LP3	Log-Pearson III
MGA	Map Grid of Australia
MGBT	Multiple Grubbs-Beck Test
MRWA	Main Roads Western Australia
m	Metres
MSL	Mean Sea Level
MW	Megawatts (1,000,000 watts)
PILF	Potentially Influential Low Flow
RCP	Representative Concentration Pathway
RFFE	Regional Flood Frequency Estimation
SILO	Scientific Information for Land Owners
SWIS	South West Interconnected System
USACE	United States Army Corps of Engineers
WA	Western Australia
WTG	Wind Turbine Generator



1. Introduction

1.1 Project Background

The Dinner Hill Wind Farm project (the Project) is located approximately 200 km North of Perth in Western Australia, within the Dandaragan Local Government Area (LGA) and within the Northern Wheatbelt zone. The land on which the Project is located spans approximately 30,024 ha within the localities of Hill River, Boothendarra, and Badgingarra and is herein referred to as the Project Area. For the purposes of this report, the Project Area refers to the boundaries of all involved land parcels where consent has been granted for development of the Project and wherein all Project infrastructure will be contained.

The Project has been designed, in consultation with the participating landholders, to ensure farming activities can co-exist within the Project Area and will provide supplementary income support for local farmers hosting the wind turbines. Dinner Hill Wind Farm Pty Ltd (the Proponent) is proposing to provide a community benefit framework, including a Community Benefit Fund, neighbour benefit initiatives and benefit-sharing arrangements with the Yued People, will be developed to ensure benefits are shared broadly across the region.

The Project consists of up to 131 wind turbine generators and associated ancillary infrastructure including (but not limited to) battery energy storage system (BESS), hardstand areas, substation and switch yard, operational and maintenance facility, control room, site offices and car parking, construction compound and laydown areas, concrete batching plants, overhead and underground cabling, and upgraded access tracks. The Project has been conceptually designed to generate up to 943 MW of electricity for transmission into the South West Interconnected System (SWIS) which will be dependent on final turbine model and numbers.

The Development Footprint refers to the maximum area of land that will be used for the development of the Project including the above infrastructure within the Project Area. It is based on a “worst case” largest possible layout and has been used to calculate the maximum area of impacts for technical assessments. Within this Development Footprint an Indicative Project Layout is provided for key infrastructure and it is expected that this layout will be confirmed during the detailed design stage and micro siting of infrastructure including WTGs may occur. The Development Footprint totals 933 ha within the Project Area (3% of the project area).

1.2 Project Location

The Project Area is located north of the Badgingarra township, east of Yerramullah Road and west of Coalara Road and includes 27 land parcels of freehold land tenure, the Brand Highway and local road corridors. The regional location is shown in **Figure 1-1**, and the project location is shown in **Figure 1-2**. The Project Area almost entirely comprises productive farmland that is largely cleared and utilised for mixed cropping and grazing. The Project development strategy is to maintain the majority of existing remnant vegetation located within the Project Area.

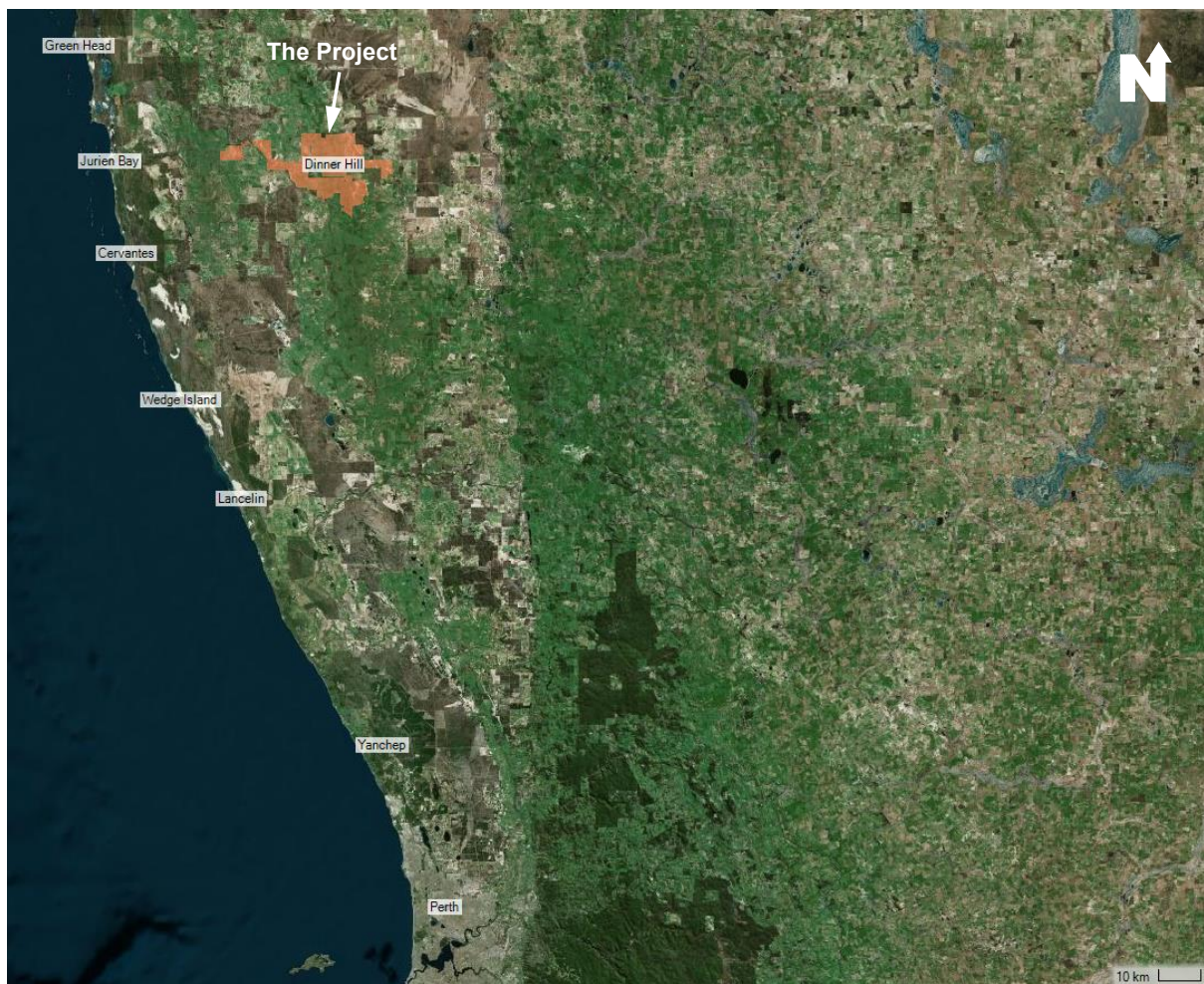


Figure 1-1: Regional location

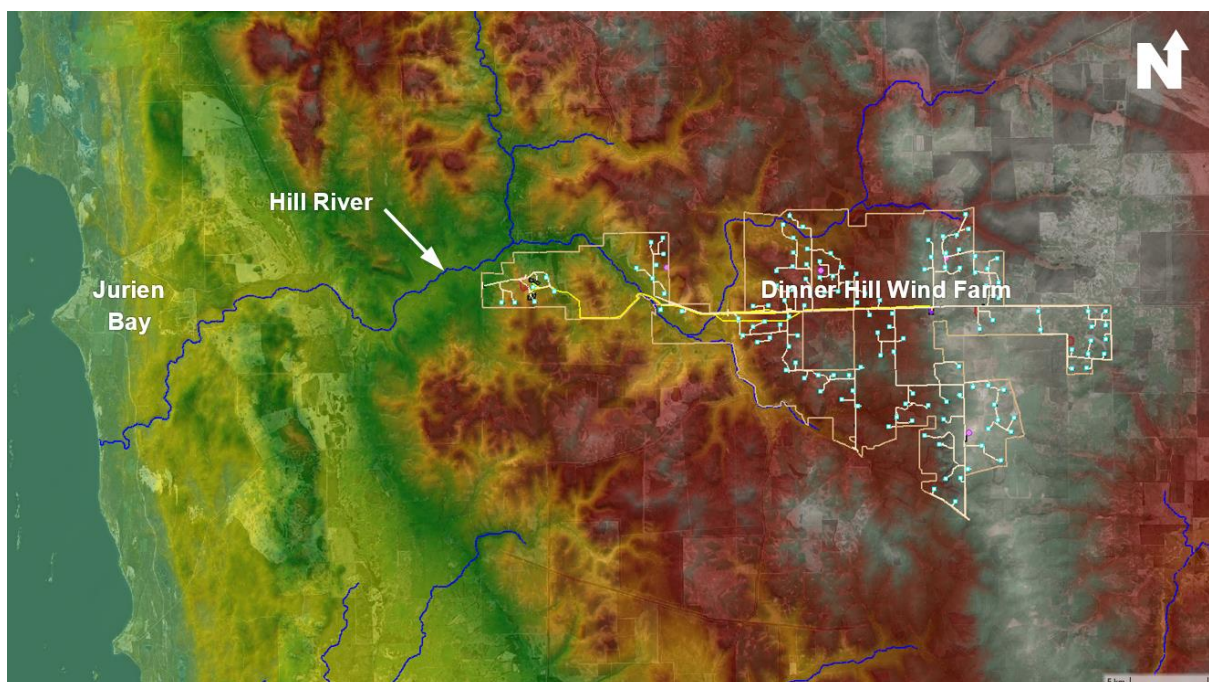


Figure 1-2: Project location

1.3 Scope of Work

This report documents the approach, input parameters, and results of hydrologic and hydraulic assessments of the Project Area. **Figure 1-3** shows the indicative project layout located on a tenement area of approximately 313 km². Access roads and WTG locations within the Development Footprint are shown relative to existing watercourses.

The inset map areas shown in **Figure 1-3** are presented in more detail in **Figure 1-4** and **Figure 1-5**. The substation, switching yard, BESS facilities, and transmission lines are shown in **Figure 1-4**. Three optional transmission line alignments are shown with pole locations in **Figure 1-5**. Eleven meteorological mast locations are shown in the project layout. The locations are indicative, and only up to four permanent meteorological masts will ultimately be constructed; final locations will be confirmed during the detailed design phase.

This study provides maximum water depths, flow velocities, and inundation extents associated with the 10% Annual Exceedance Probability (AEP), the 1% AEP, and the 1 in 1,000 AEP flood event under existing and proposed conditions. No previous hydrology reports have been provided to support this study. The purpose of the flood study is to provide guidance in accordance with Australian Rainfall and Runoff (ARR) guidelines (Ball, et al. 2019) to ensure assets are constructed above flood levels, to identify scour risks, and to ensure the Project does not change flood behaviour in a way that impacts the surrounding environment or communities.

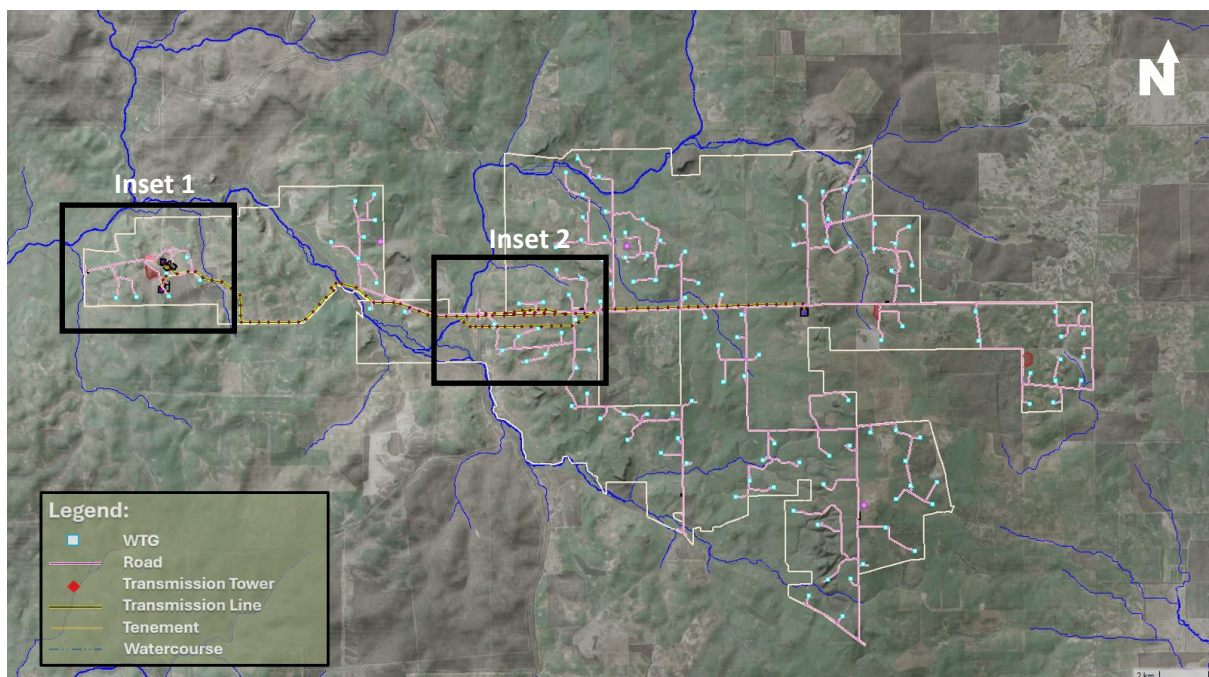


Figure 1-3: Indicative project layout and watercourses

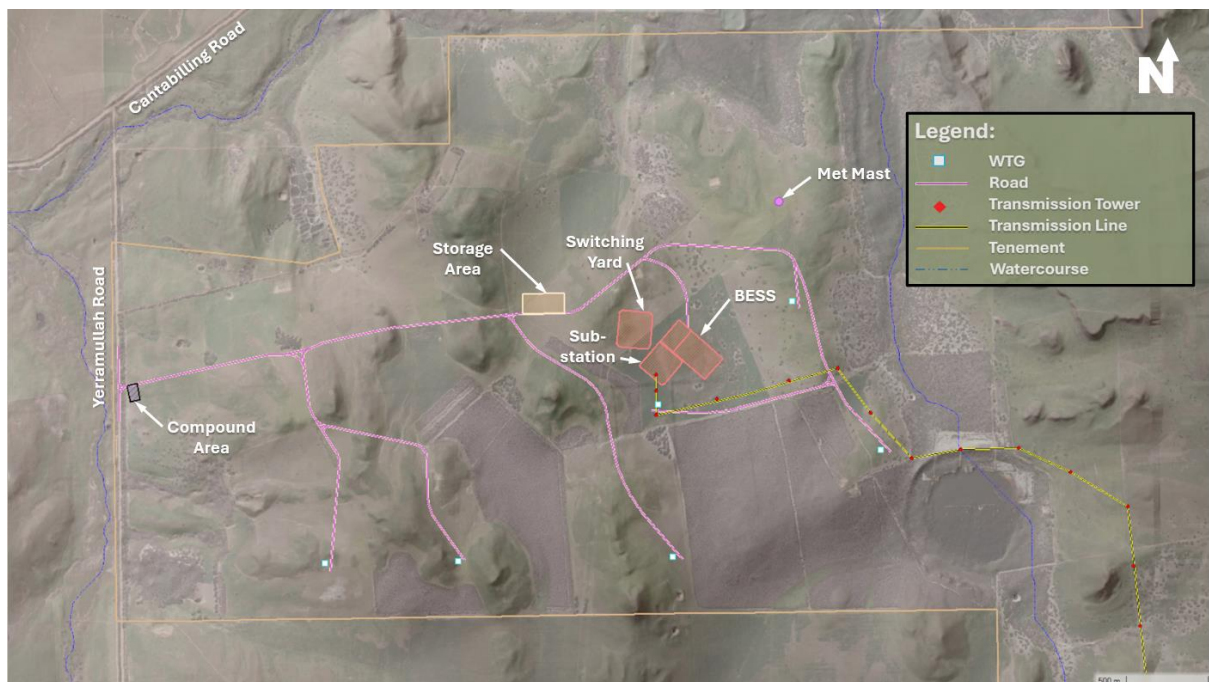


Figure 1-4: BESS location (Inset 1)

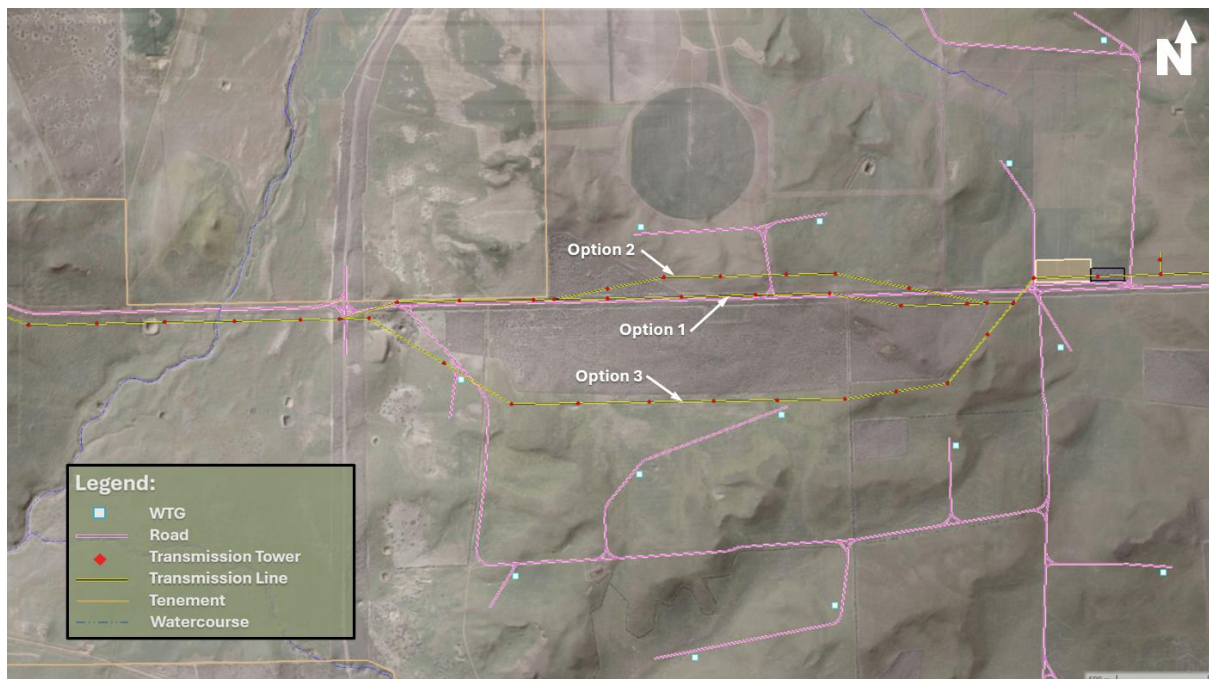


Figure 1-5: Optional transmission line alignments and pole locations (Inset 2)



2. Hydrology

2.1 Catchments

The Project is located within the Hill River catchment. The Hill River has a total catchment area of 3,589 km² and reaches the Indian Ocean just south of Jurien Bay. As shown in **Figure 2-1**, the 2,243 km² northern branch enters the river just downstream of the project features. The total catchment area at the Hill River Springs Gauge, located just upstream of the northern branch confluence, is approximately 915 km². The catchment area includes the 271 km² eastern branch, which drains to the upper Project site area. The effective catchment areas vary seasonally as internally draining areas in the upper catchments may contribute flows to the Hill River in less frequent events or wet periods while remaining isolated in more frequent events or dry periods. **Figure 2-2** shows the relative location of the site features to the local catchment boundaries. **Figure 2-3** shows streamflow gauge locations from the Department of Water and Environmental Regulation (DWER 2025).

2.2 Geology and Soils

The Geological Survey of Western Australia's regolith mapping (2020) shows the presence of alluvium (fluvial sediments) and colluvium localised along Hill River and its tributaries. Eolian sands (wind derived) are present across the eastern side of the Project Area. Review of the Western Australia Acid Sulfate Soil Risk Mapping (Department of Water and Environmental Regulation, 2017) indicates that the Project Area generally has an extremely low probability of the occurrence of Acid Sulfate Soils. An exception to this is associated with the alluvium along Hill River, with a small area (approximately 0.3 km²) located within the development footprint to the south of Hill River mapped as having a high probability of the occurrence of Acid Sulfate Soils. The Project will include an Acid Sulfate Soils Management Plan which will support referral to the Environment Protection Authority under Section 38 of the Environmental Protection Act 1986. Review of imagery and mapping indicates this area is also associated with a mapped high potential aquatic Groundwater Dependent Ecosystem (GDE). A hydrogeological assessment has also been prepared for the Project and considers potential impacts of the Project on GDE (Umwelt, 2026).

The basement geology mapping shows that the Project Area is dominated by the Yarragadee Formation to the west and Parmelia Group to the east. The geological formations trend in a north-south direction and dip towards the east. A syncline is mapped trending in a north-south direction on the eastern edge of the Project Area, where the Coolyena Group is mapped. Fault structures also trend in a general north-south direction within the region. This includes the Eneabba Fault and Coomallo Fault present in the Yarragadee Formation within the Project Area. **Table 2-1** summarises the geology in the Project Area surrounds.

**Table 2-1: Summary of Geology (Geological Survey of Western Australia (2020))**

Era	Stratigraphic Unit	Description
Recent	Alluvium	Clay, silt, sand, and gravel in channels and on floodplains
	Colluvium	Colluvium derived from different rock types; includes gravel, sand, silt and clay
	Eolian sediments	Eolian sand, silt and clay in sheet deposits and dunes
	Lacustrine sediments	Clay and silt in swamps, commonly surrounding clay ponds and lagoons
Cretaceous	Coolyena Group	Chalk, greensand, glauconitic sandstone, siltstone, marl; characteristically glauconitic
Jurassic	Parmelia Group	Predominantly sandstone; most formations recognized only in subsurface
	Otorowiri Formation	Micaceous siltstone, shale, minor glauconitic sandstone
	Yarragadee Formation	Fine- to coarse-grained sandstone, thin shale interbeds
	Cadda Formation	Grey shale, siltstone and sandstone; scattered carbonate lenses
	Cattamarra Coal Measures	Carbonaceous siltstone, shale, claystone, coal, sandstone

2.3 Precipitation

Figure 2-4 shows the locations of Bureau of Meteorology (BoM) precipitation gauges in the vicinity of the project along with the period of record for the three closest gauges:

- The Pindarita Gauge is located approximately 10 km southeast of the Project Area and has a period of record from 1968 to present. The highest recorded daily precipitation depth is 80 mm, and the mean annual precipitation is 505 mm.
- The Badgingarra Gauge is located approximately 20 km east of the Project Area and has a period of record from 1952 to present. The highest recorded daily precipitation depth is 98 mm, and the mean annual precipitation is 519 mm.
- The Warradarge Gauge is located approximately 20 km north of the Project Area and has a period of record from 1967 to present. The highest recorded daily precipitation depth is 92 mm, and the mean annual precipitation is 535 mm.

Intensity-Frequency-Duration (IFD) information was sourced for the Project Area from the 2016 BoM (BOM 2016) data set. Appendix A includes additional precipitation details for the site sourced from the ARR data hub.

Table 2-2 shows the rainfall depths corresponding to a range of events from the 50% AEP to the 1 in 1,000 AEP for durations of up to 3 days. **Figure 2-5** shows the associated depth-frequency-duration (DFD) curves, and **Figure 2-6** shows the intensity-frequency-duration (IFD) curves for the area.

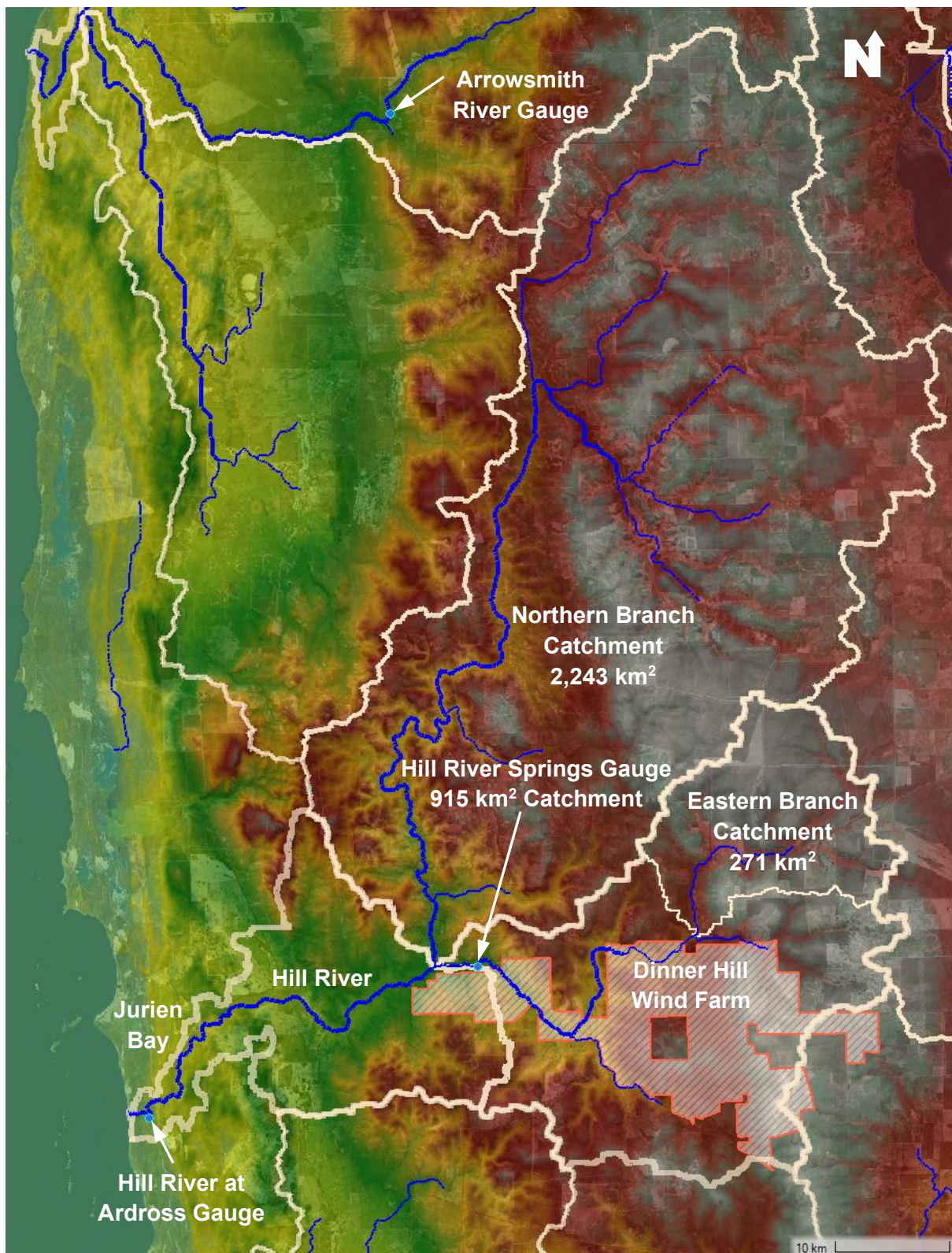


Figure 2-1: Irwin River and Arrowsmith River catchment areas

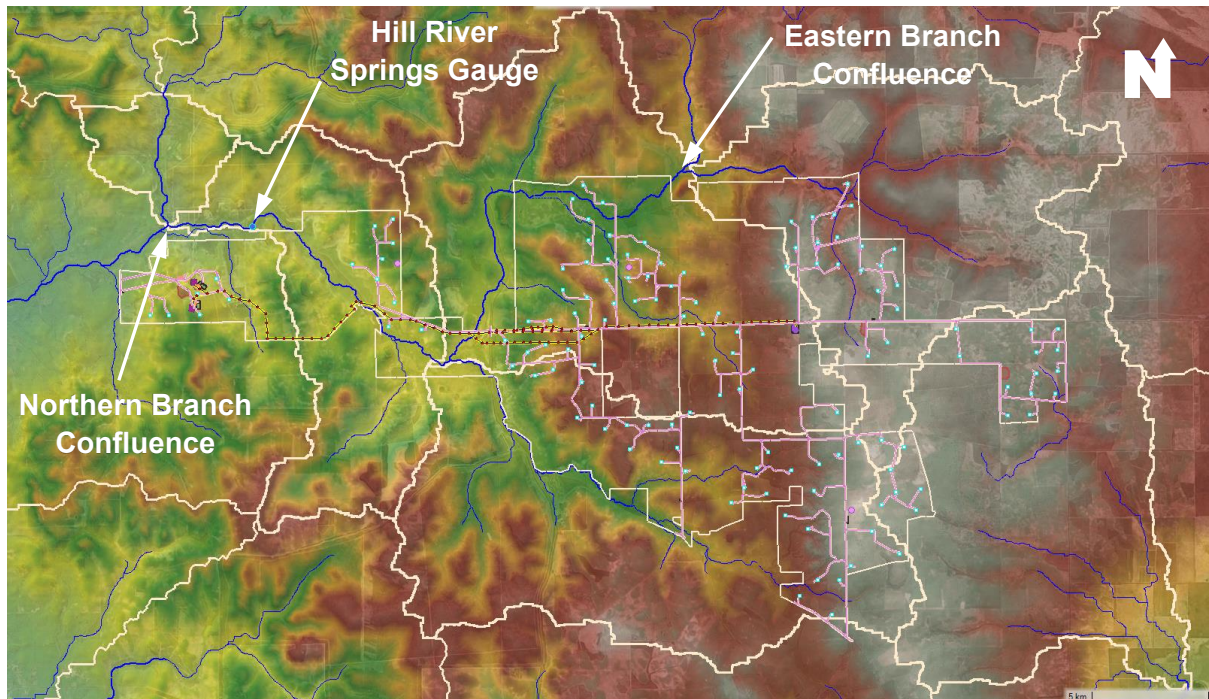


Figure 2-2: Project Area catchments and flow paths

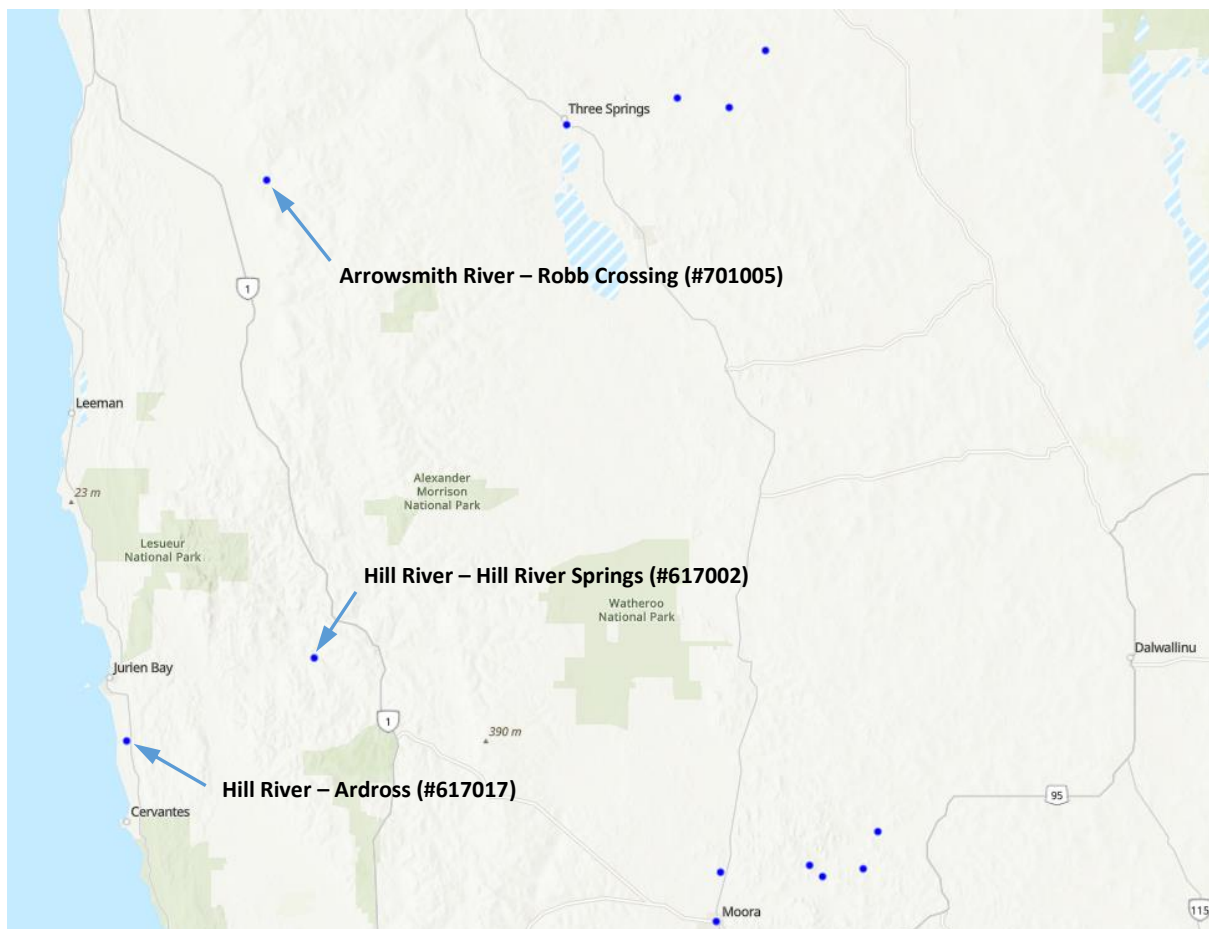


Figure 2-3: Stream flow gauge locations (DWER 2025)

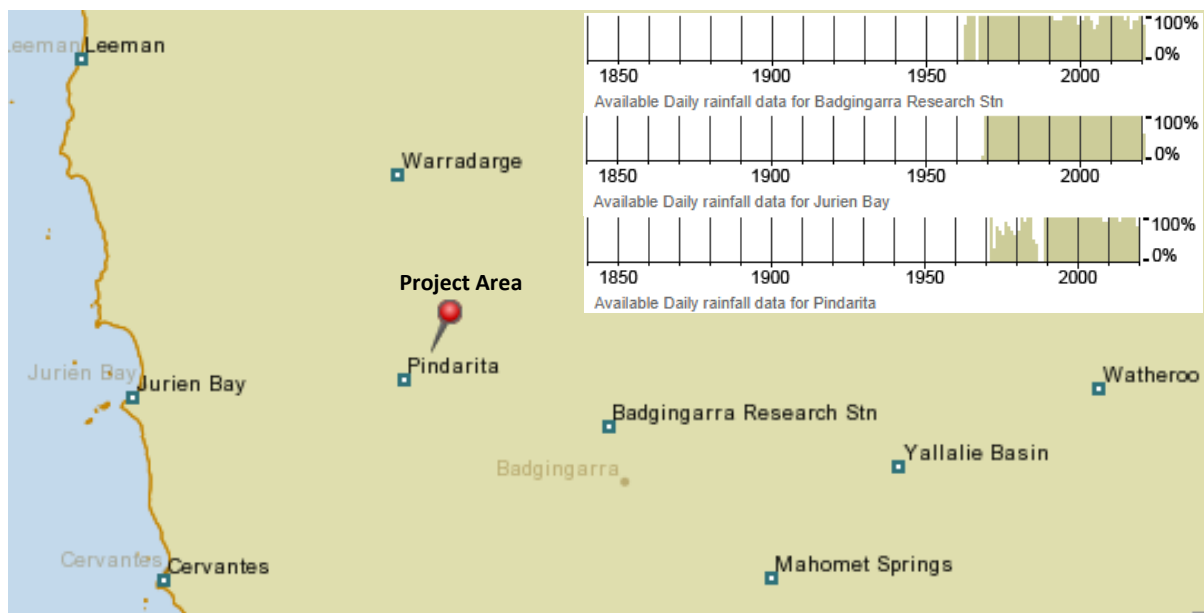


Figure 2-4: BoM Precipitation Gauge Records

Table 2-2: BoM IFD data for the Project Area

Duration	Rainfall depth in mm						
	50% AEP	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP	1 in 1000
1 min	1	2	2	3	3	4	6
5 min	5	7	8	9	11	13	20
10 min	7	10	12	14	17	20	30
15 min	9	13	15	18	21	24	37
30 min	12	17	20	23	28	32	49
1 hour	15	21	25	29	35	40	62
2 hour	20	26	31	36	44	50	78
3 hour	22	30	36	42	51	58	90
6 hour	29	39	46	54	66	76	117
12 hour	37	50	60	70	86	100	153
24 hour	46	62	75	88	109	127	197
48 hour	55	74	89	104	129	151	247
72 hour	60	81	96	111	138	160	258

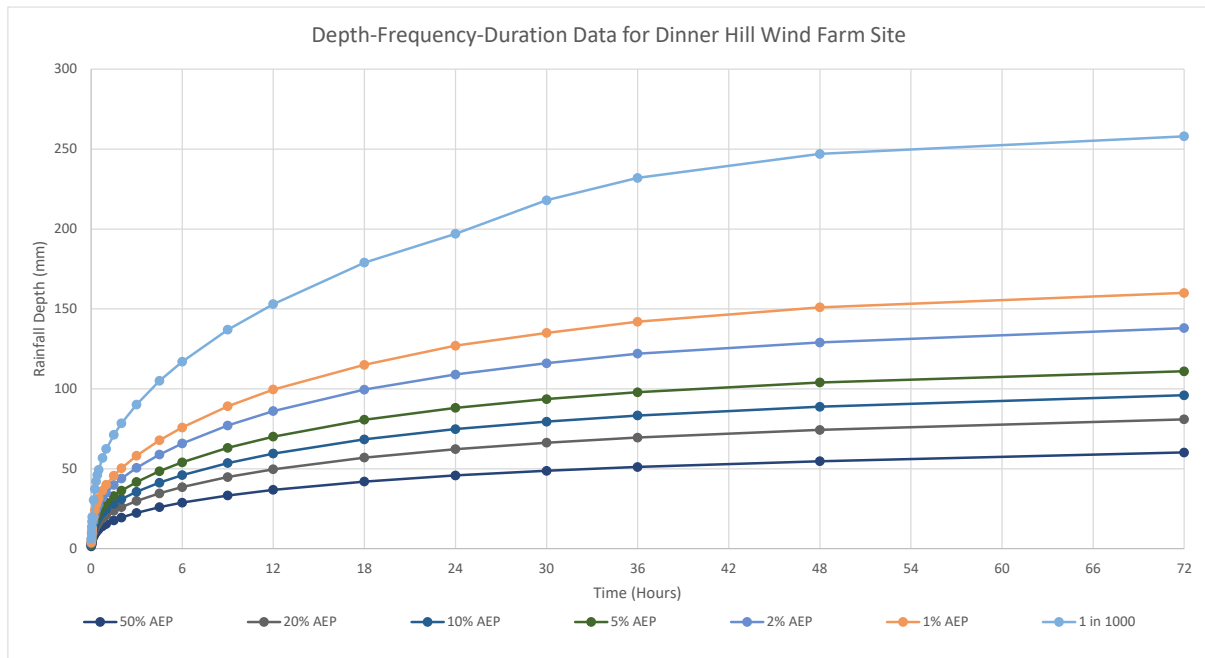


Figure 2-5: Depth-Frequency-Duration Curves for the Project Area

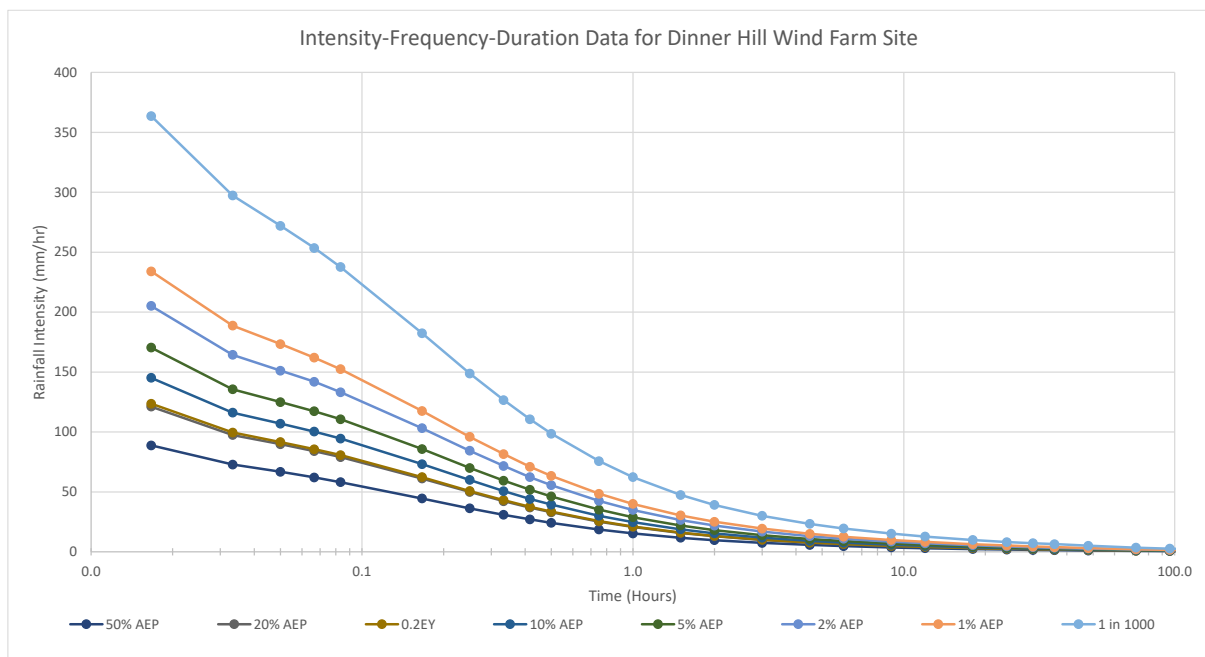


Figure 2-6: Intensity-Frequency-Duration Curves for the Project Area

2.4 Climate Change

ARR guidelines were updated in August 2024 to incorporate revised climate change guidance. The ARR data hub details for the Project Area (Appendix A) include recommended climate change uplifts for rainfall intensity. Uplifts vary by the adopted Shared Socioeconomic Pathways (SSP) model and the design project life. The guidance also includes recommended uplifts for soil infiltration losses.



There is some flexibility in the selection of an SSP model, and the design life and relative risk of individual project elements may vary. In light of the inherent uncertainties, an interim uniform uplift factor of 20% has been applied to all model runs, with a 10% increase in initial loss rates for natural catchments. The selected input parameters are considered reasonably conservative for design purposes.

2.5 Flow records

Figure 2-3 shows surface water gauge locations relative to the Project Area, with the locations of the three nearest stream flow gauges highlighted.

- Gauge 617002 Hill River at Hill River Springs is located on the Hill River near the downstream extent of the Project Area. The reported catchment area is 915 km², and flow records available from 1971-2025.
- Gauge 617017 Hill River at Ardross is located on the Hill River near Jurien Bay. The reported catchment area is 3,589 km², and flow records are available from 2003-2025.
- Gauge 701015 Arrowsmith River at Robb Crossing is located along the internally draining Arrowsmith River approximately 75 km north of the site. The reported catchment area is 814 km², and flow records are available from 1972-2001.

The historical discharge rates for the period of record are presented in Appendix C. The records show that the highest mean daily flows at Ardross are approximately twice the flow rates at Hill River Springs.

2.6 Flood Study

The current DWER flood mapping portal (DWER 2025) does not show any delineated floodplains within the Project Area or in the vicinity of the Hill River. The nearest mapped floodplain is at Moora, approximately 50 km southeast of the Project Area.

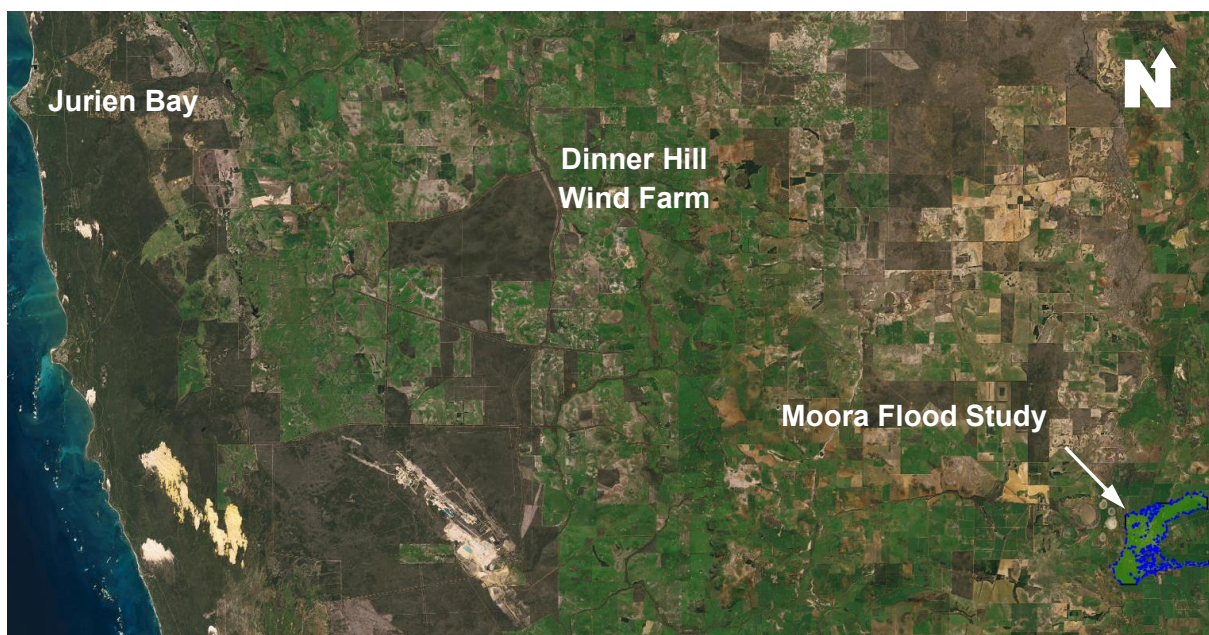


Figure 2-7: Available flood studies from the Floodplain Mapping Tool (DWER 2025)



2.7 Flood Frequency Analysis

Appendix D includes flood frequency analysis (FFA) results from BoM's Water Information Online database for the Arrowhead River and Hill River gauges. The results are based on the annual maximum series for the available period of record. The results show peak 1% AEP discharge rates of approximately 80 m³/s for both data sets. There are some potential discrepancies in the predicted 1% AEP peak discharge rates due to improper filtering of low outliers. The Arrowsmith River records also show a high outlier that could potentially skew the extrapolated results. Due to these factors, the FFA results are presented for reference only.

2.8 Regional Flood Frequency Estimation

For comparison to the FFA estimates, Regional Flood Frequency Estimation (RFFE) procedures were applied to the Dinner Hill catchment, the Northern Branch catchment, and the Eastern Branch catchment (Engineers Australia, 2015). The resulting peak discharge rates are shown in Appendix C. Results from a 2021 update (currently in beta format) are included for comparison (WMA Water, 2021).

RFFE procedures are considered to be applicable to catchments with a maximum drainage area of 1,000 km². The Northern Branch exceeds this threshold, so the results are indicative only. The input parameters for the other catchments fall within the limitations of the procedure. The predicted peak discharge rates are generally higher than the FFA results. The RFFE results align reasonably well with the direct precipitation hydraulic modelling results as presented below.

3. Hydraulic model setup

Hydraulic modelling of the Project Area was conducted using the U.S. Army Corps of Engineers' HEC-RAS software Version 6.7 (USACE, 2025). HEC-RAS models were developed using two-dimensional (2D) direct precipitation analyses for storm events with durations ranging up to 72 hours. Flood levels were assessed for the 10% AEP, 1% AEP, and 1 in 1,000 AEP events. Flood and scour risks are presented based on digital elevation models (DEMs) for the existing conditions; no earthworks for roadways, pads, or drainage features are included in the proposed conditions model. These features will be added to future model iterations as design surfaces are developed.

3.1 Modelled area

Figure 3-1 shows the 1,400 km² modelled area for application of precipitation. The modelled area covers all catchment areas contributing directly to the Project Area features. The Northern Branch catchment area is excluded from the model, with inflows applied separately as described below.

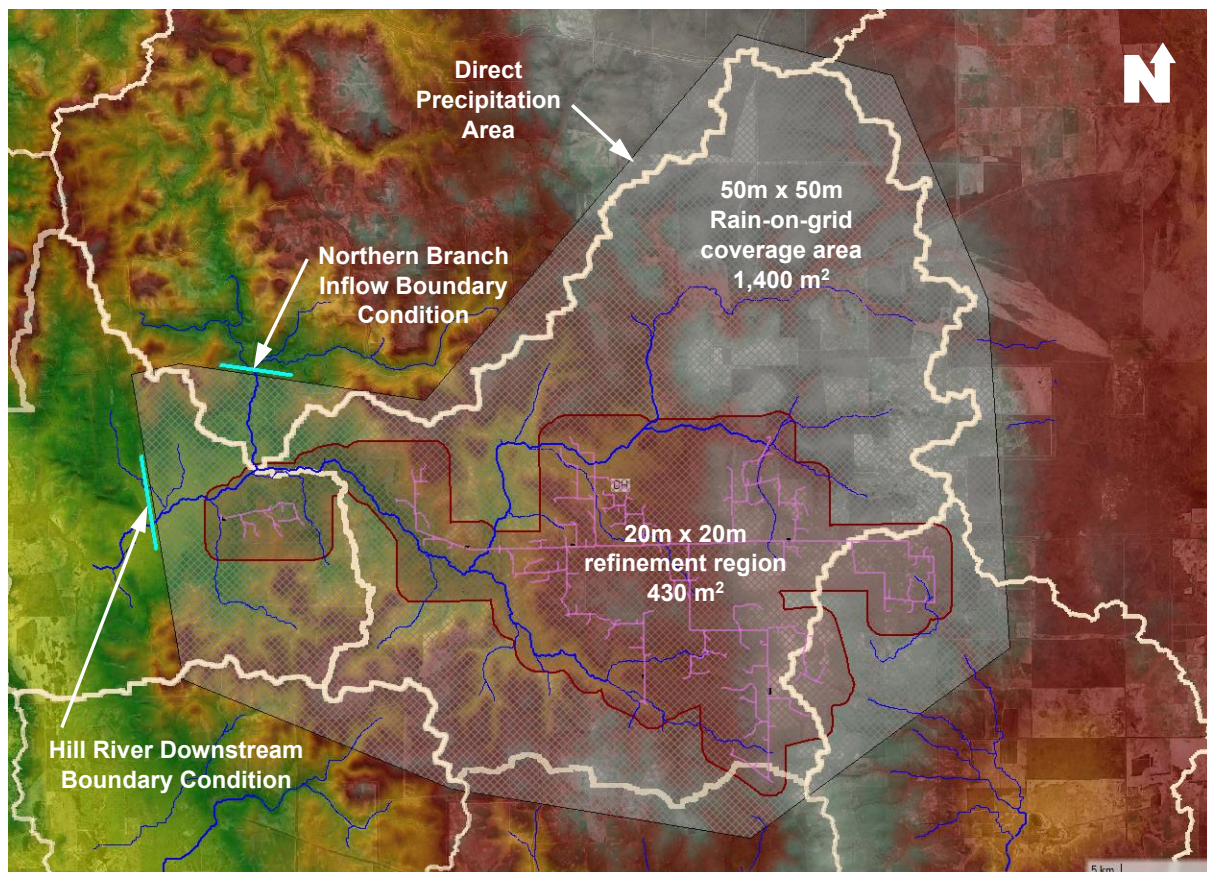


Figure 3-1: Modelled area

3.2 Terrain

Terrain data for the direct precipitation model were derived from several sources. **Figure 3-2** shows the relative coverage areas of each data set. A 1m x 1m LiDAR-based terrain data set was provided for a 430 km² area covering all of the Project Area features with the exception of a 4-km portion of the transmission line alignment (Poles DHI TL NP 50 to DHI TL NP 60). Remaining areas within the rain-on-grid (ROG) model area are covered with satellite-based terrain data from the Shuttle Radar Topography Mission (SRTM), which has an effective resolution of approximately 30m x 30m. All geospatial data are projected to the GDA2020 MGA Zone 50 horizontal datum; elevations are shown relative to the ADH71 vertical datum.

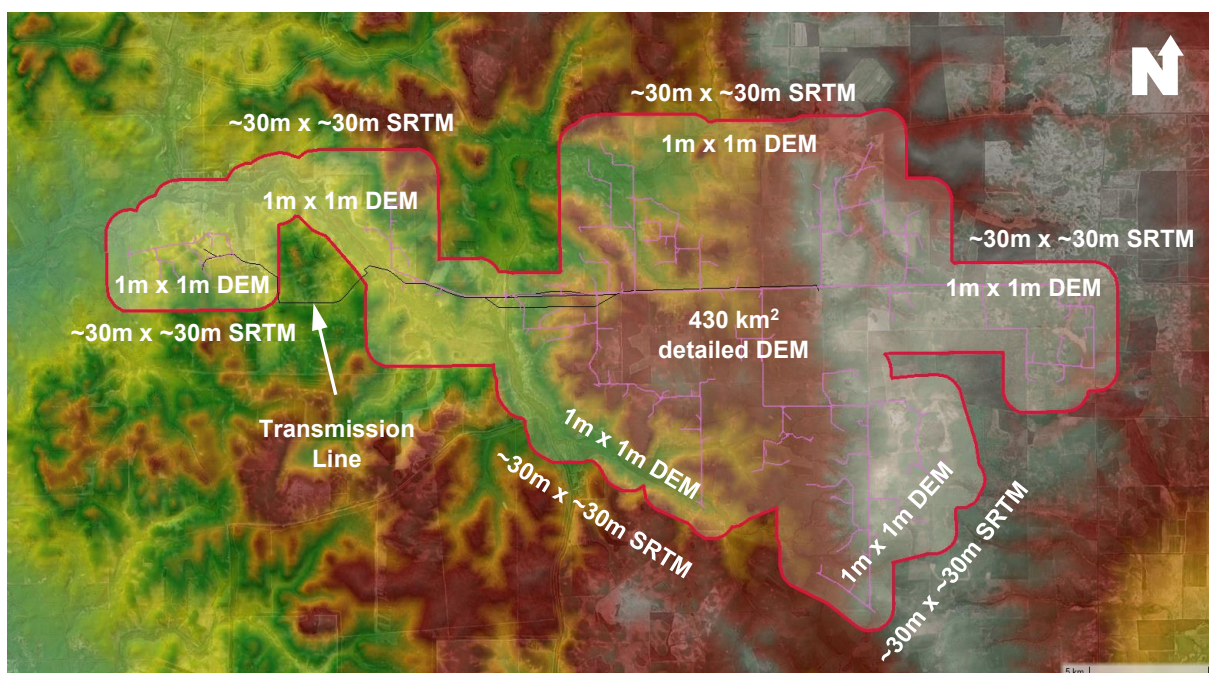


Figure 3-2: Terrain coverage

The detailed terrain was merged with the surrounding SRTM data for use in the ROG model. Comparisons of elevations in interface areas show vertical discrepancies of approximately +/-5 m for the SRTM, which is indicative of the accuracy in the remaining model area. SRTM data are provided by GSA (2025) with elevations relative to the EGM96 datum. According to GSA, corrections between EGM96 and AHD71 should not be uniformly applied but should be site-specific. Topographic differences in the interface area were assessed, and a uniform adjustment of -3.5m was applied to the SRTM data set to best reflect AHD71 vertical datum values. The composite DEM surface was smoothed in channelised interface areas to minimise hydraulic impacts from the discrepancies in elevation. In areas outside the detailed terrain coverage, hydraulic results are indicative only due to the coarseness of the underlying SRTM data.



3.3 Computational Mesh

A computational mesh of 50 m by 50 m was applied to the modelled area covered by the SRTM surface. A mesh spacing of 20 m by 20 m was applied to the detailed terrain coverage area as shown in **Figure 3-1**. Break lines were delineated along the Hill River, proposed pad perimeters, drainage lines, and roadways to align cell faces along crests and flow paths

The sub-grid terrain resolution within individual computational cells is applied in the model, and the flow transfer calculations between individual grid cells account for the geometry of the underlying surface at the terrain resolution of up to 1m by 1m across the detailed terrain coverage area. Should more detailed terrain data be acquired in the future, the mesh resolution should be refined to improve model accuracy.

3.4 Hydraulic Structures

No hydraulic structures were included in the flood model; the model results effectively assume that any existing culverts are completely blocked during the simulated flood events. If survey data for existing culverts, bridges, or other structures are identified in the future, these should be added to further model revisions, and the results should be revisited.

3.5 Inflow

An external inflow hydrograph boundary condition was applied for the Northern Branch based on the RFFE results shown in Appendix C. The inflow rates considered to be conservative relative to the FFA results. The conservatism is assumed to account for any climate change uplifts for inflows, as the climate change uplift factors decrease for catchments with longer response times and are offset by increased soil infiltration losses.

Based on the available IFD data, a centrally loaded, nested frequency storm was developed for use in the hydraulic model as an unsteady time series inflow boundary condition. The frequency storm pattern is developed by placing the highest 1-minute-duration rainfall (highest intensity) in the centre of the storm and adding each increasing duration (with successively lower intensities) to the precipitation hyetograph. The frequency storm represents a worst-case application of the ARR ensemble patterns for each sub-catchment area within the model.

Figure 3-3 shows the applied rainfall patterns; the rainfall excess hyetographs account for the impacts of climate change as presented above. No areal reduction factors were applied to the rainfall values; this approach conservatively assumes that the highest point rainfall intensities occur across the entire contributing catchment, allowing maximum discharge rates to be estimated for small catchment areas contributing runoff to proposed infrastructure outside of the major floodplains.

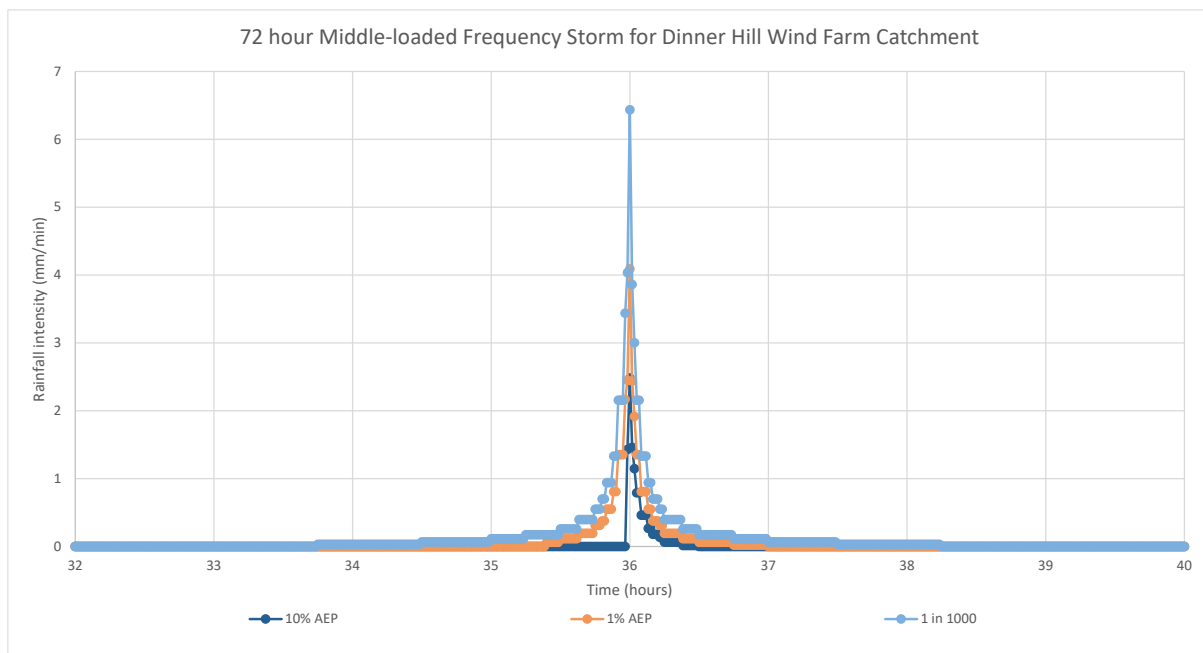


Figure 3-3: Applied rainfall hyetographs for Dinner Hill Wind Farm

3.6 Adopted Loss Rates

Regional soil characteristics are described above. No localised permeability or infiltration testing results have been provided for review. The underlying soils are assumed to be sandy, with a permeable, porous, and free-draining nature; should future investigations indicate otherwise, the hydrological results should be revisited.

The ARR data hub includes recommended, regionalised soil losses based on the site coordinates (GSA 2025). As tabulated in Appendix A, the recommended initial loss is 58 mm and the continuing loss rate is 7.9 mm/hr. With climate change uplift factors (20% for precipitation intensity and 10% for initial and continuing losses), these loss rates result in a total excess rainfall depth of 36 mm for the 1% AEP event and 75 mm for the 1 in 1,000 AEP, 72-hour events.

The recommended loss rates result in no excess precipitation for events more frequent than the 10% AEP. Stream gauge records indicate that runoff occurs more frequently than this, however, so the loss rates may be overestimated for the broader catchment in more frequent events. As a conservative approach, the initial loss rate was reduced to 45 mm for the 10% AEP event, resulting in 11.5 mm of excess rainfall for the 72-hour duration. The adopted infiltration losses were removed from the rainfall data to generate excess rainfall depths for application to the hydraulic model. The hyetographs are shown graphically as a time series plot in **Figure 3-3**, reflecting the excess rainfall with the assumed soil losses removed and climate change uplift factors applied.

Based on Scientific Information for Land Owners (SILO) estimates from 1899 to present, annual evaporation exceeds annual precipitation by a factor of five in the Project Area, significantly limiting the possibility for long-term ponding. A relatively high level of evapotranspiration further decreases the potential for surface water ponding.



Additional sensitivity analyses were conducted with varying pre-burst depths and saturated antecedent conditions (no initial loss). The results show that predicted inundation extents are highly sensitive to the adopted loss rates, which assume pervious soils. Site-based flood records or anecdotal information related to areas and depths of ponding may provide indicative calibration opportunities when combined with available historical rainfall data. Should future localised site data or observations become available in the future, additional calibration efforts may be warranted.

3.7 Outflow Boundary Condition

The downstream boundary condition was assigned a normal depth energy gradient of 0.5% around the external perimeter of the ROG model. The Hill River channel was assigned a normal depth energy gradient of 0.2%, matching the bed gradient and friction slope of the channel at the external perimeter.

3.8 Roughness

Most of the Project Area does not include concentrated, incised flow channels, and most of flow conveyance occurs as sheet flow with shallow depths. A uniform Manning's roughness coefficient of 0.12 was applied to sheet flow areas for the baseline condition model. This applied roughness coefficient is higher than typical channelised values and is adopted to reflect the relatively low flow depths relative to the size of the roughness elements. River corridors were assigned a Manning's roughness coefficient of 0.045.

To account for potential differences arising from the variable flow depths and other uncertainties, a range of Manning's roughness coefficients were applied to the model as a sensitivity analysis, with the high roughness model run applying a channel value of 0.18 and a floodplain value of 0.06. Channel roughness values ranged from 0.030 for the low roughness sensitivity to 0.060 for the high roughness sensitivity. For rain-on-grid models, increased roughness decreases the contributing flow rates, offsetting the hydraulic effects and minimising the sensitivity. The results show maximum depth differences of approximately +/-10% across the range of modelled roughness coefficients.

3.9 Simulation Window

A 72-hour simulation window was applied to allow the flood peak to occur after initial losses have been removed (wet antecedent conditions). The 72-hour duration captures peak discharges and allows the flood peaks to propagate through the model.

3.10 Computational Settings

An adaptive computational time step was applied based on a maximum Courant Number of 2.0 to comply with recommended thresholds in the HEC-RAS user manual, resulting in an average adopted time step of approximately 10-20 seconds. The Full Momentum shallow water equation set was adopted in order to account for the varying flow directions. Mass balance errors and water surface elevation convergence errors were checked to confirm that imbalances remained below reasonable thresholds for model stability (in this case within 0.1% for mass balance and within 1 cm for water surface elevation convergence).



3.11 HEC-RAS Model Summary

Table 3-1 summarises the model parameters used for the selected HEC-RAS model runs. There is a relatively high degree of conservatism in the adopted rainfall pattern, loss rates, peak river flows, and roughness coefficients. This conservatism is considered appropriate due to uncertainties in the underlying data and the lack of localised gauge data relevant for calibration of smaller sheet flow catchments. Except where otherwise noted, other program defaults have been applied to all remaining coefficients, options, tolerances and model settings.

Table 3-1: Summary of model parameters

Model Parameter	Value
Inflow	Northern Branch inflow from RFFE for 10%, 1%, and 1 in 1,000 AEP
Precipitation	72-hr frequency storm precip from BoM IFD data for + 20% climate change for 10%, 1%, and 1 in 1,000 AEP
Outflow	Normal depth energy gradient of 0.005 m/m along perimeter and 0.002 m/m in Hill River
Loss Rate	58 mm Initial Loss, 7.9 mm/hr Continuing Loss + 10% Climate Change Uplift
Simulation window	72 hours
Computational time step	10-20 seconds
Computational mesh grid	20 metres - 50 metres
Roughness	0.045 to 0.12 (baseline), 0.030 to 0.18 (sensitivity)
Equation set	Full momentum shallow water equation
DEM grid resolution	1 metre to 30 metres



4. Existing Condition Hydraulic Results

4.1 Maximum Depths and Inundation Extents

Maximum depths and inundation extents are shown below with a 10-cm threshold for display. **Figure 4-1** shows the tile layout for presentation of depth, velocity, and flood hazard results.

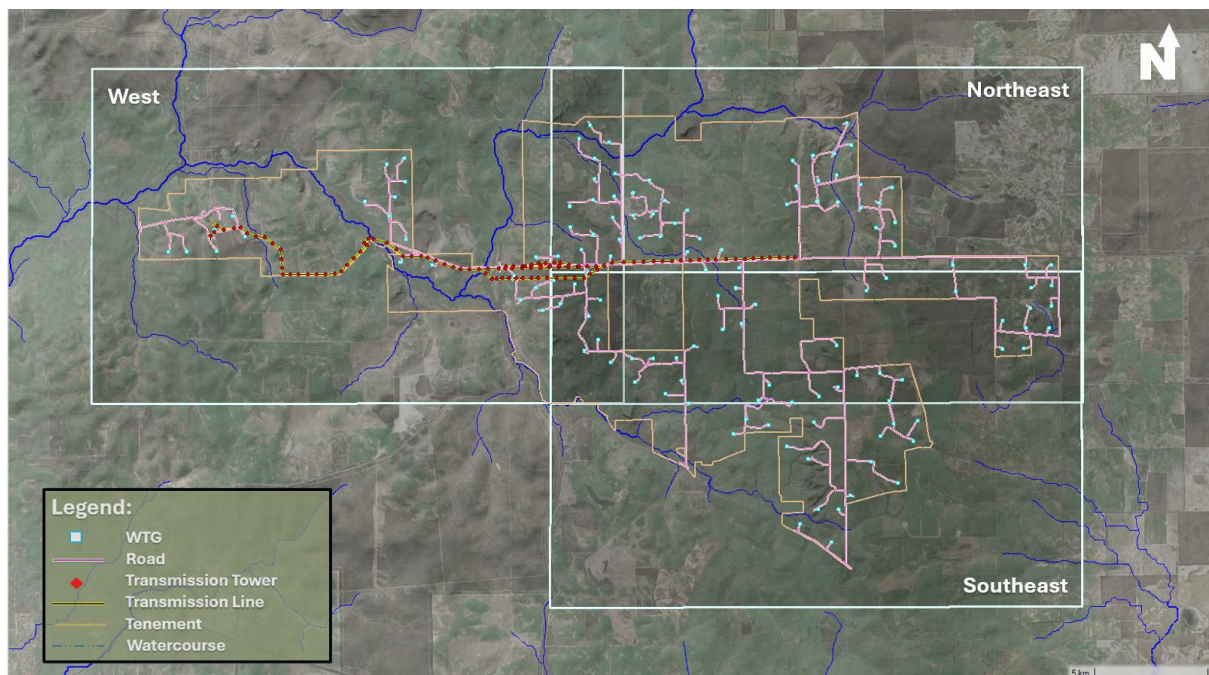


Figure 4-1: Tiles for presentation of depth and velocity results

Figure 4-2, Figure 4-3, and Figure 4-4 show the 10% AEP maximum depths and inundation extents. **Figure 4-5, Figure 4-6, and Figure 4-7** show the 1% AEP depths and extents. **Figure 4-8, Figure 4-9, and Figure 4-10** show the 1 in 1,000 AEP.

As indicated by the maximum depth figures, the proposed WTGs are generally located outside high depth zones. **Figure 4-11** shows that WTG DIN.10121 is located within the Hill River 1% AEP floodplain. **Figure 4-12** shows that WTG DIN.10201 is located within the 1% AEP floodplain of a minor tributary to the Hill River. Maximum 1% AEP inundation depths are less than 1 m. Where relocation of these WTGs to higher ground is not possible the pads in these areas should be raised or armoured.

As shown in the figures, transmission towers are generally located outside high depth areas. **Figure 4-11** highlights several transmission towers that are located within the 1% AEP floodplain. Maximum 1% AEP inundation depths are less than 1 m. One meteorological mast (PCV02) is located within the 1% AEP floodplain, as shown in **Figure 4-13**. The maximum 1% AEP inundation depth is less than 20 cm; relocation of the mast is not required due to the relatively shallow inundation depth. Some ponding up to 20 cm in depth occurs at other WTG and transmission tower locations. The placement of minor fill may be warranted in these areas to facilitate local drainage and reduce required maintenance.

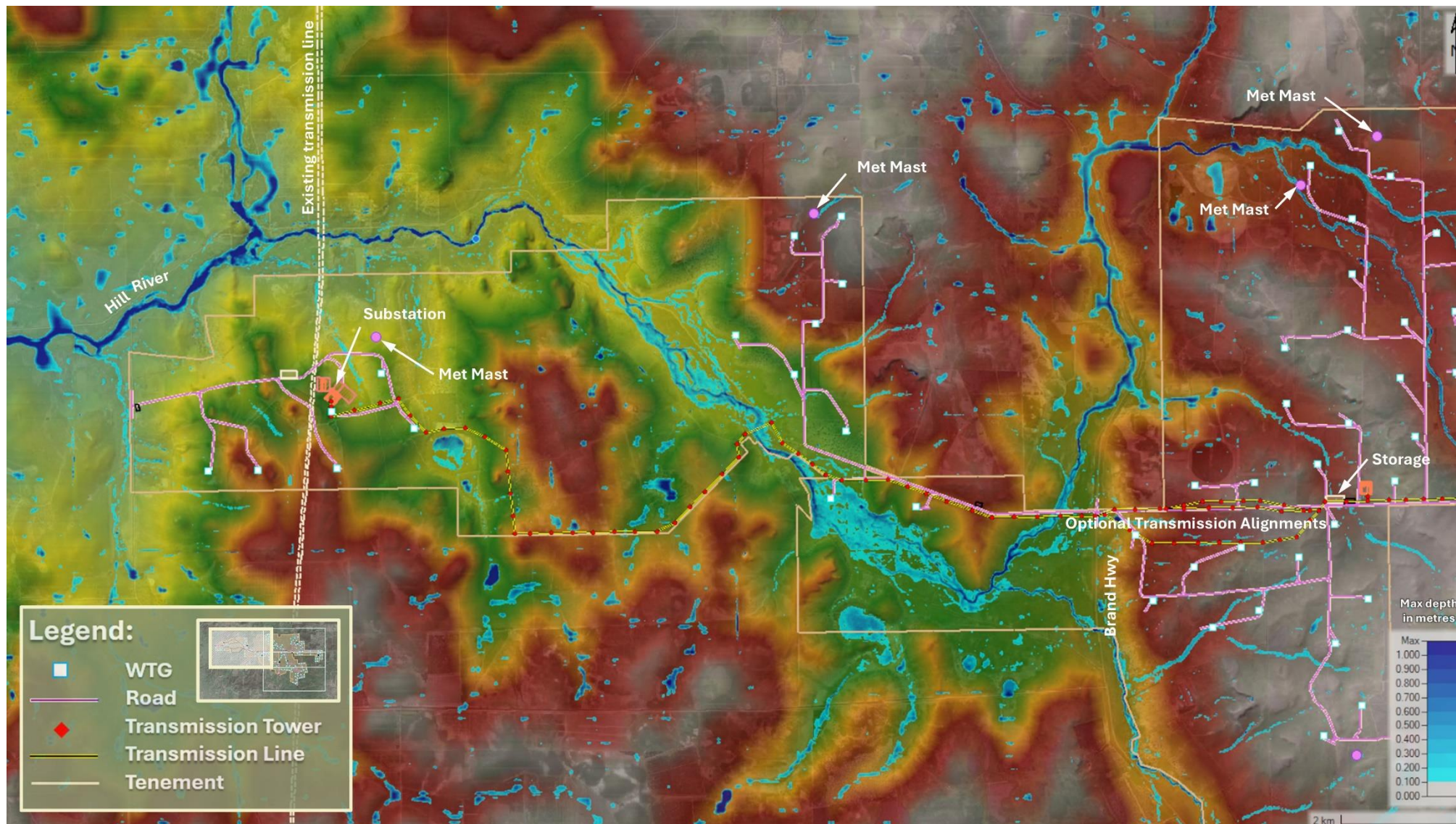


Figure 4-2: Maximum 10% AEP depths and inundation extents (West)

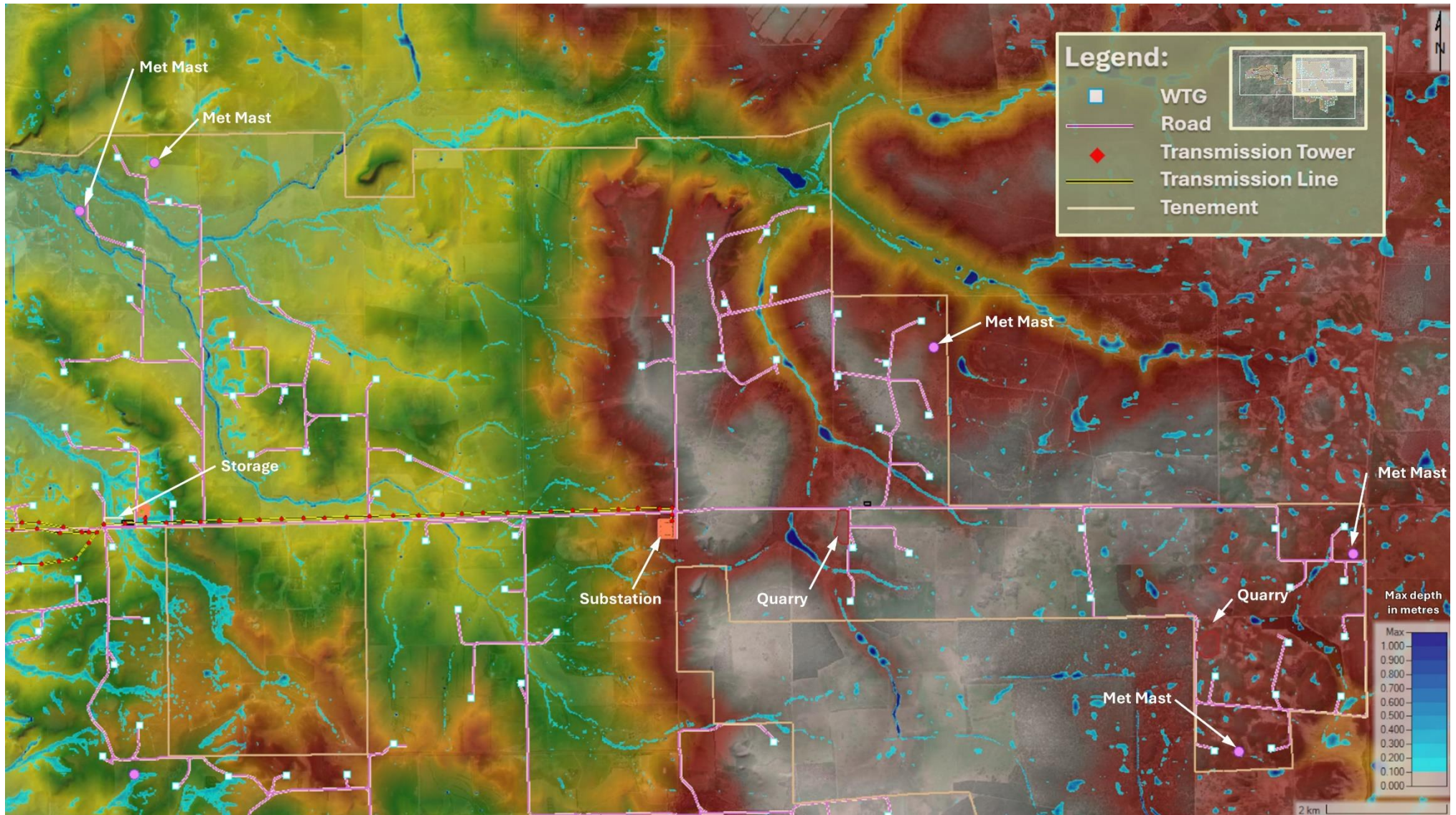


Figure 4-3: Maximum 10% AEP depths and inundation extents (Northeast)

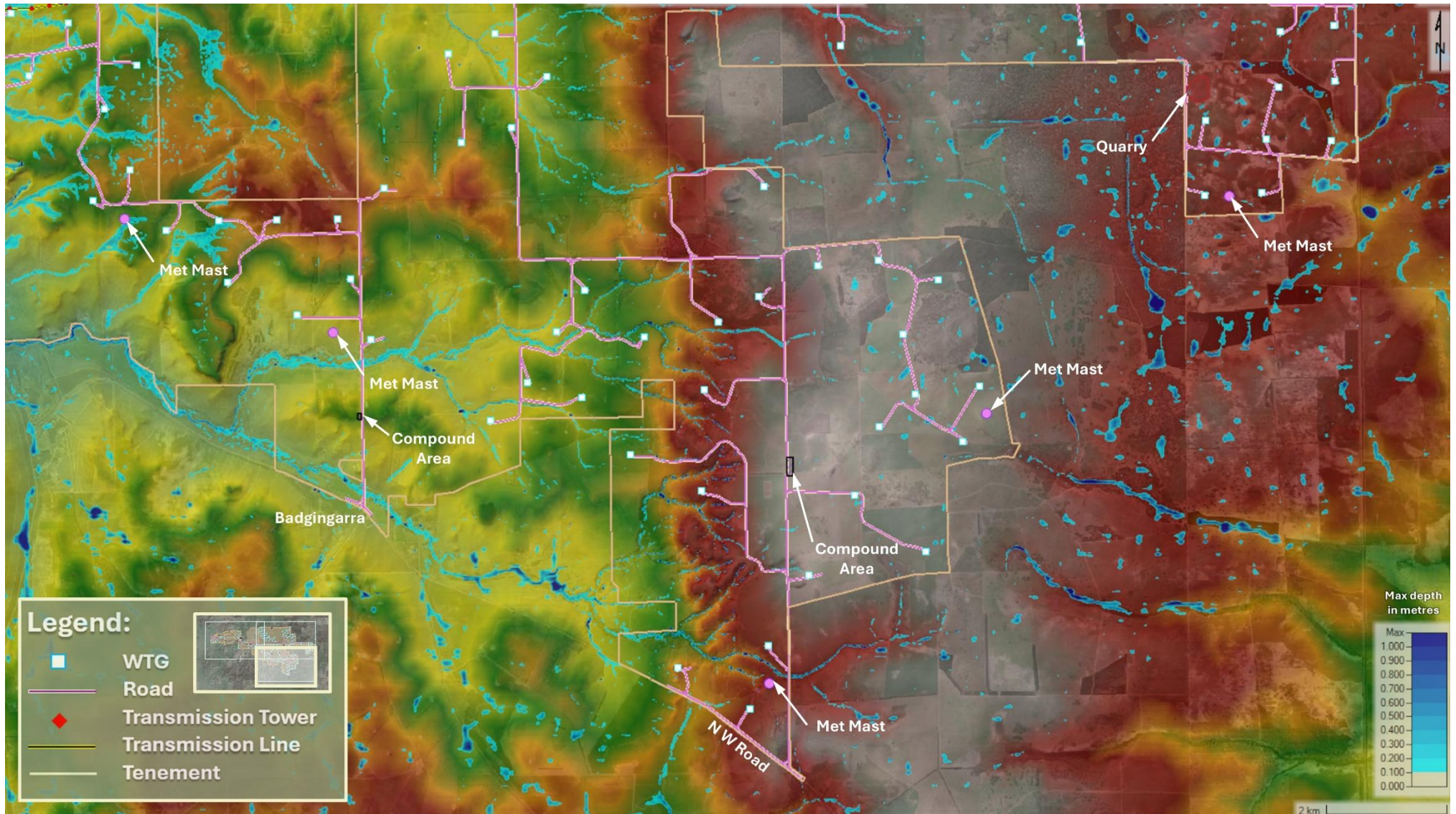


Figure 4-4: Maximum 10% AEP depths and inundation extents (Southeast)

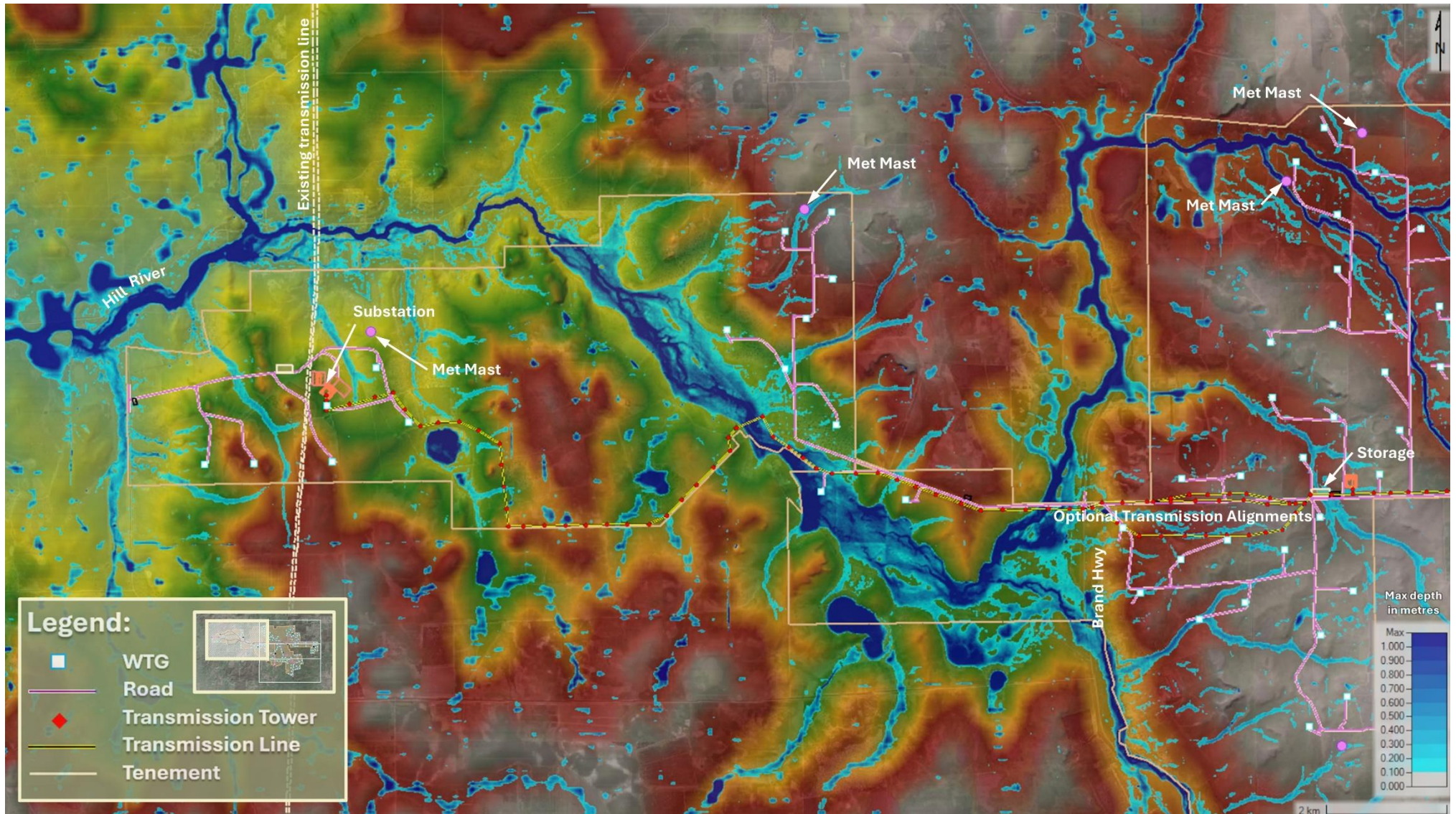


Figure 4-5: Maximum 1% AEP depths and inundation extents (West)

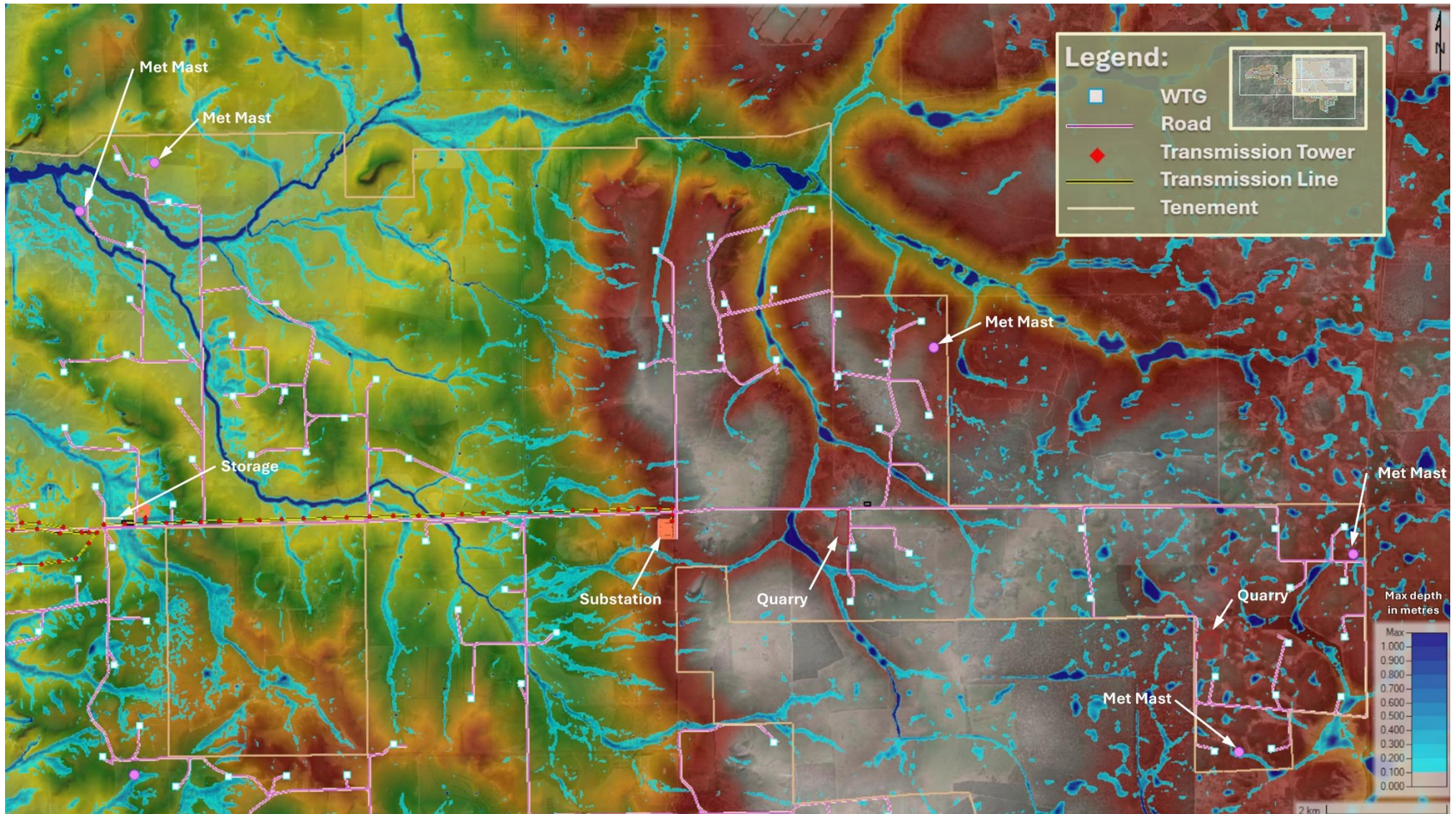


Figure 4-6: Maximum 1% AEP depths and inundation extents (Northeast)

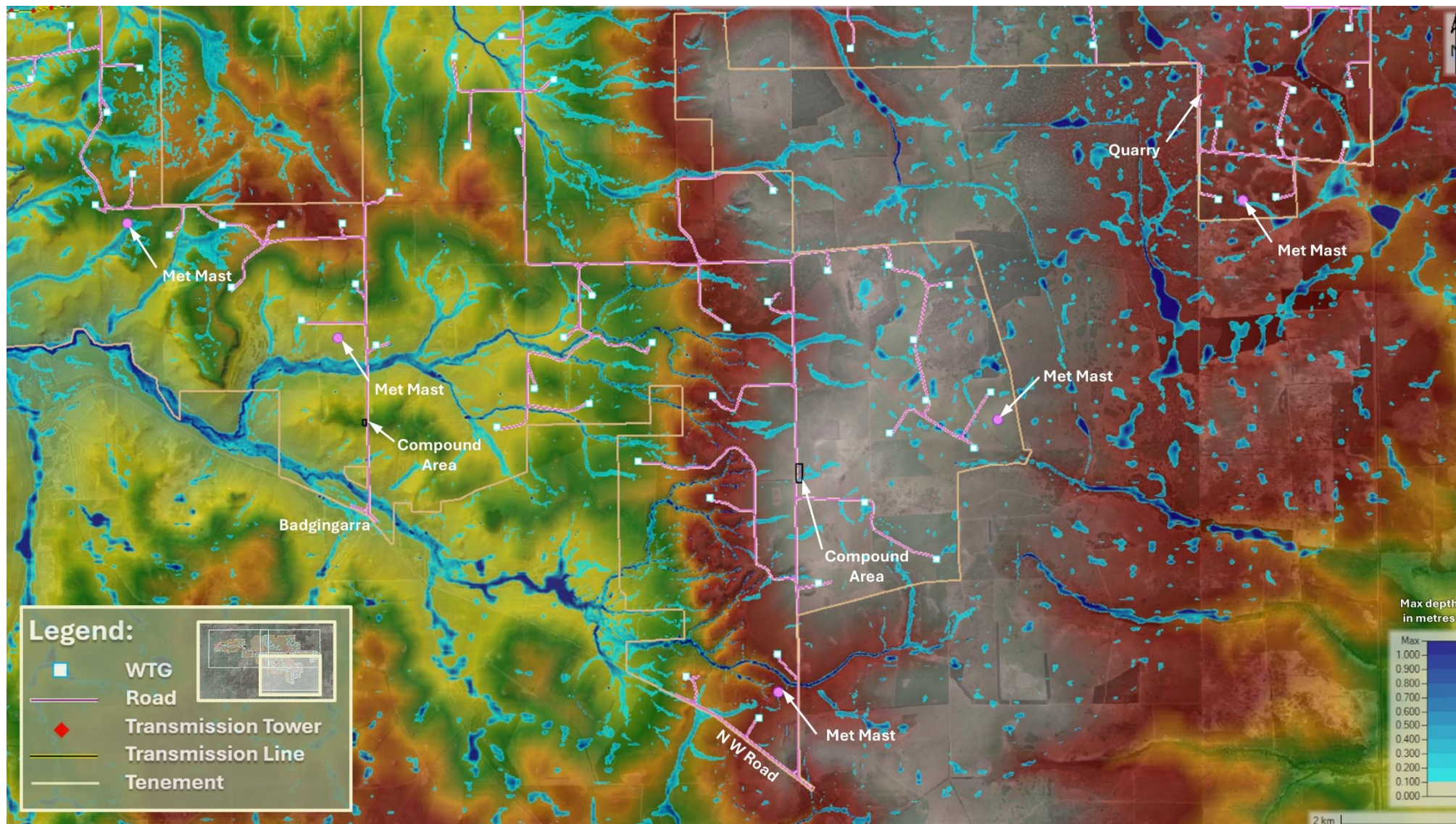


Figure 4-7: Maximum 1% AEP depths and inundation extents (Southeast)

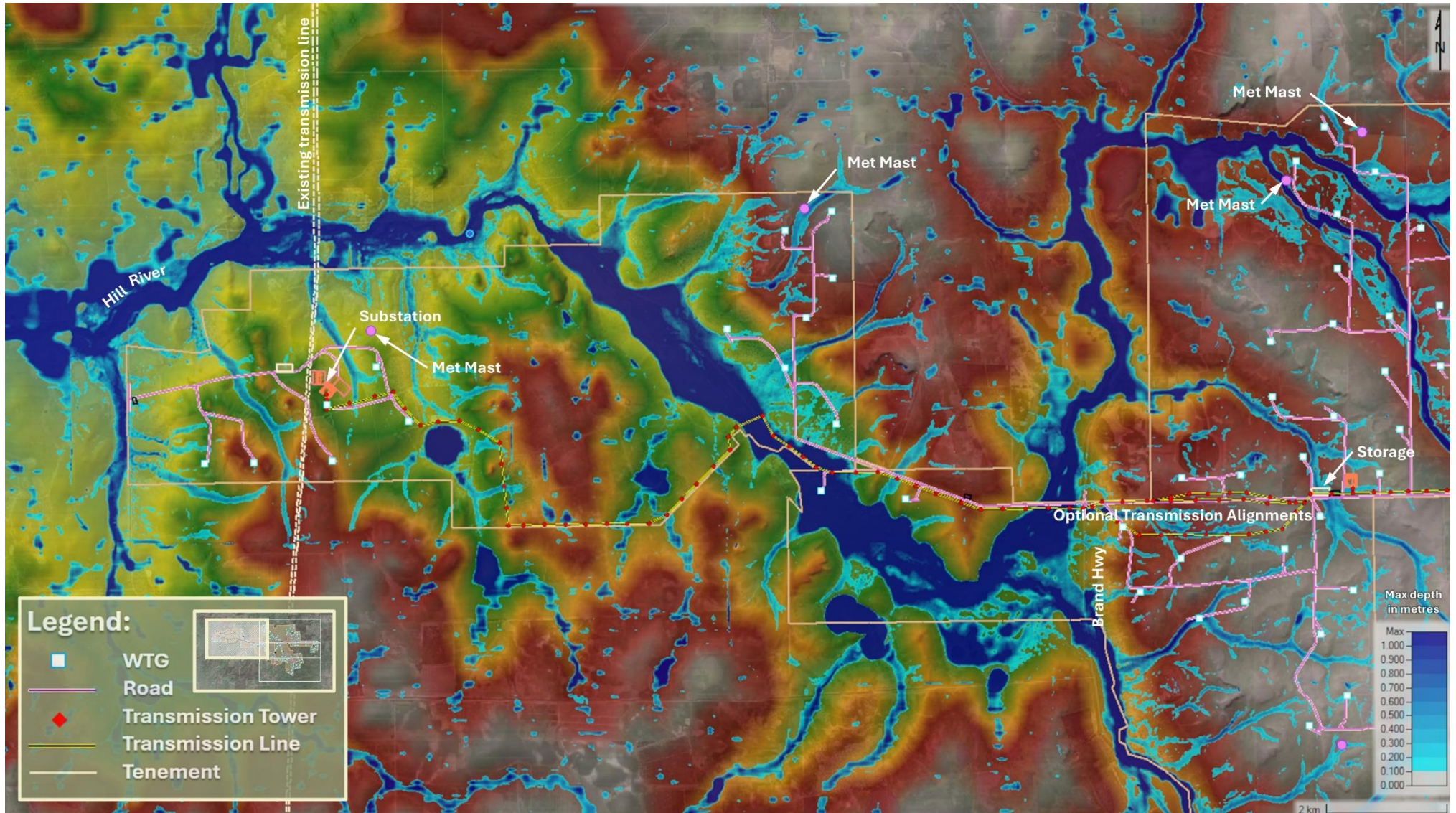


Figure 4-8: Maximum 1 in 1,000 AEP depths and inundation extents (West)

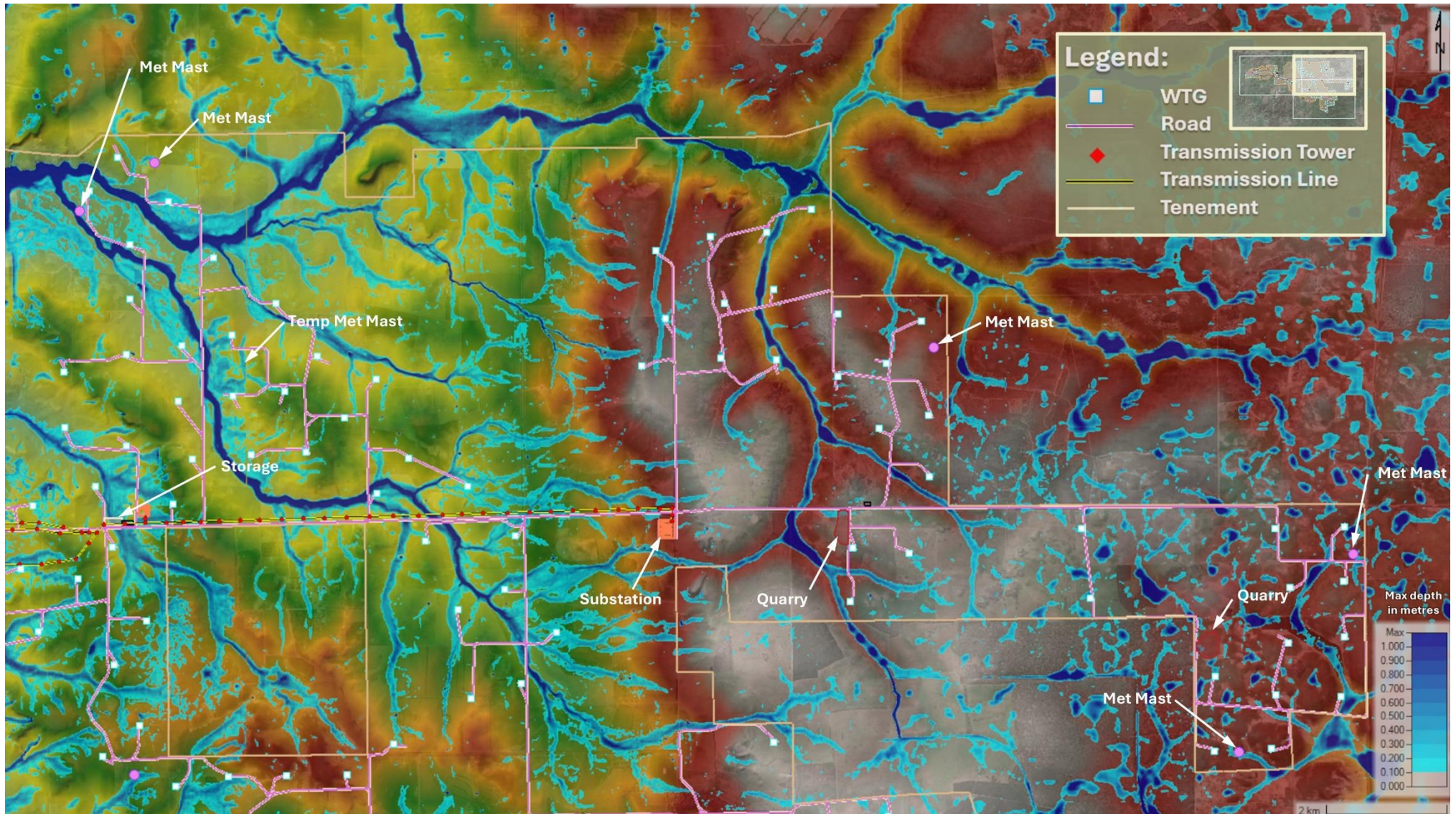


Figure 4-9: Maximum 1 in 1,000 AEP depths and inundation extents (Northeast)

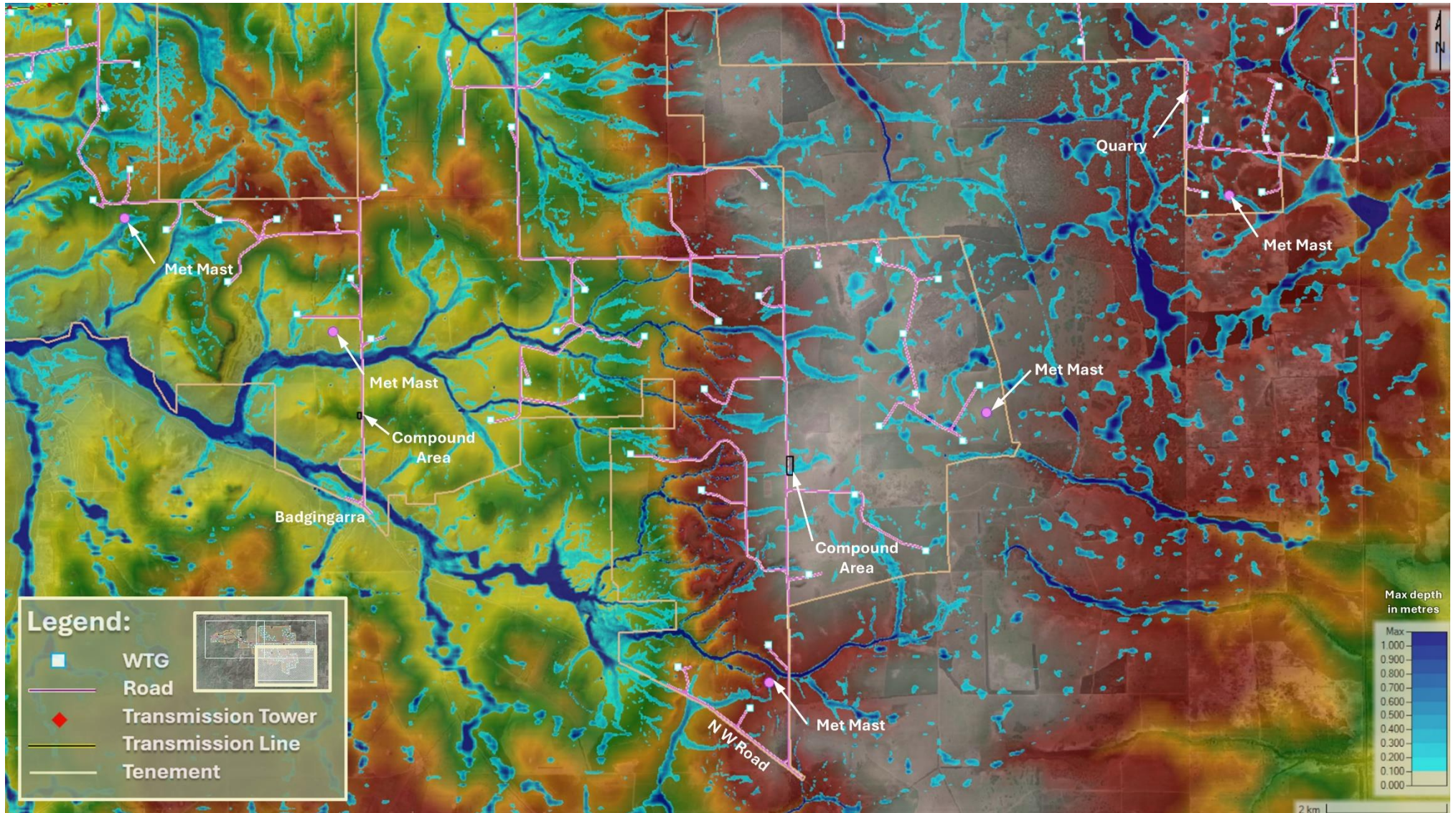


Figure 4-10: Maximum 1 in 1,000 AEP depths and inundation extents (Southeast)

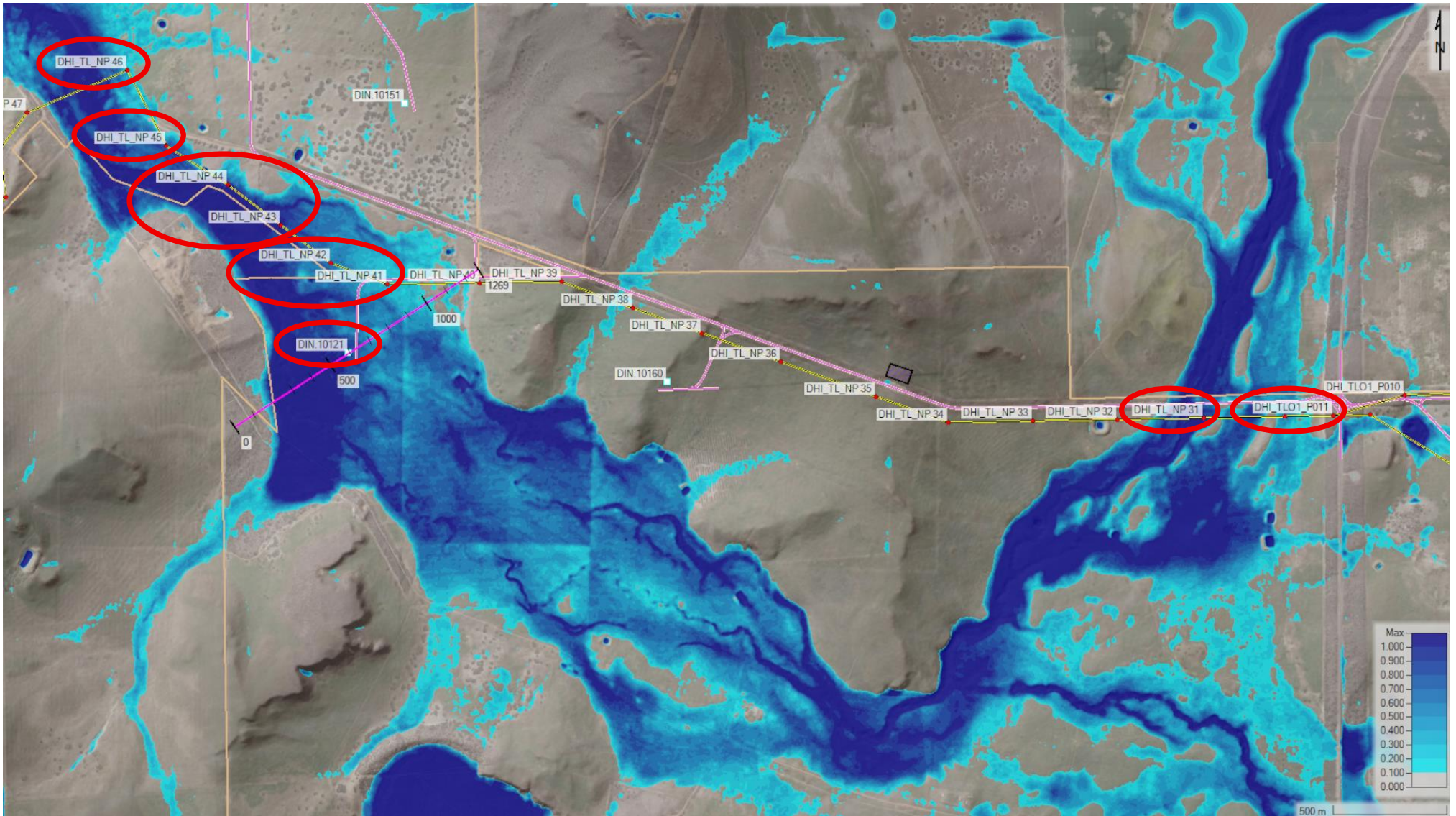


Figure 4-11: Transmission towers and WTG within 1% AEP floodplain

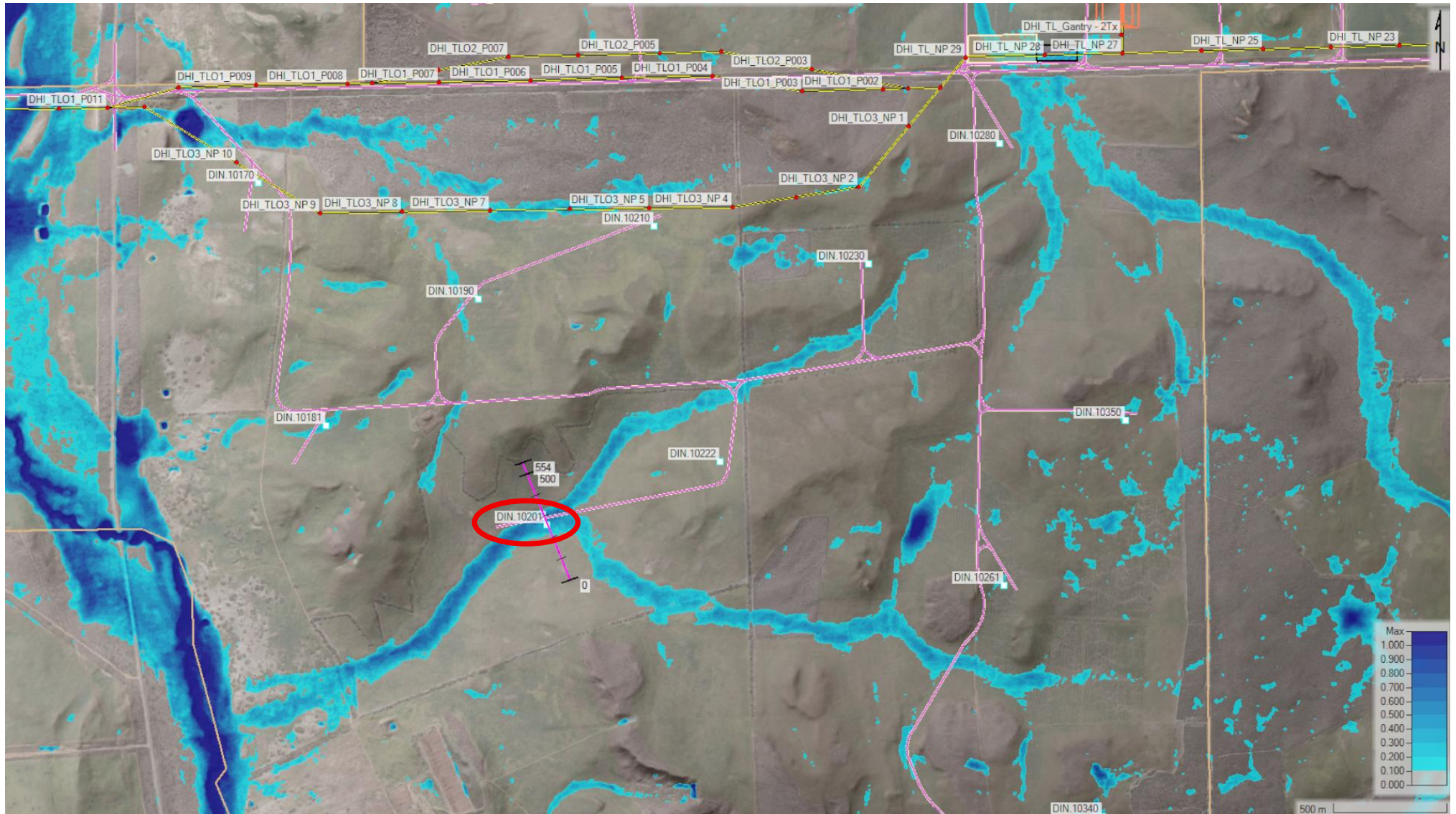


Figure 4-12: WTG within 1% AEP floodplain

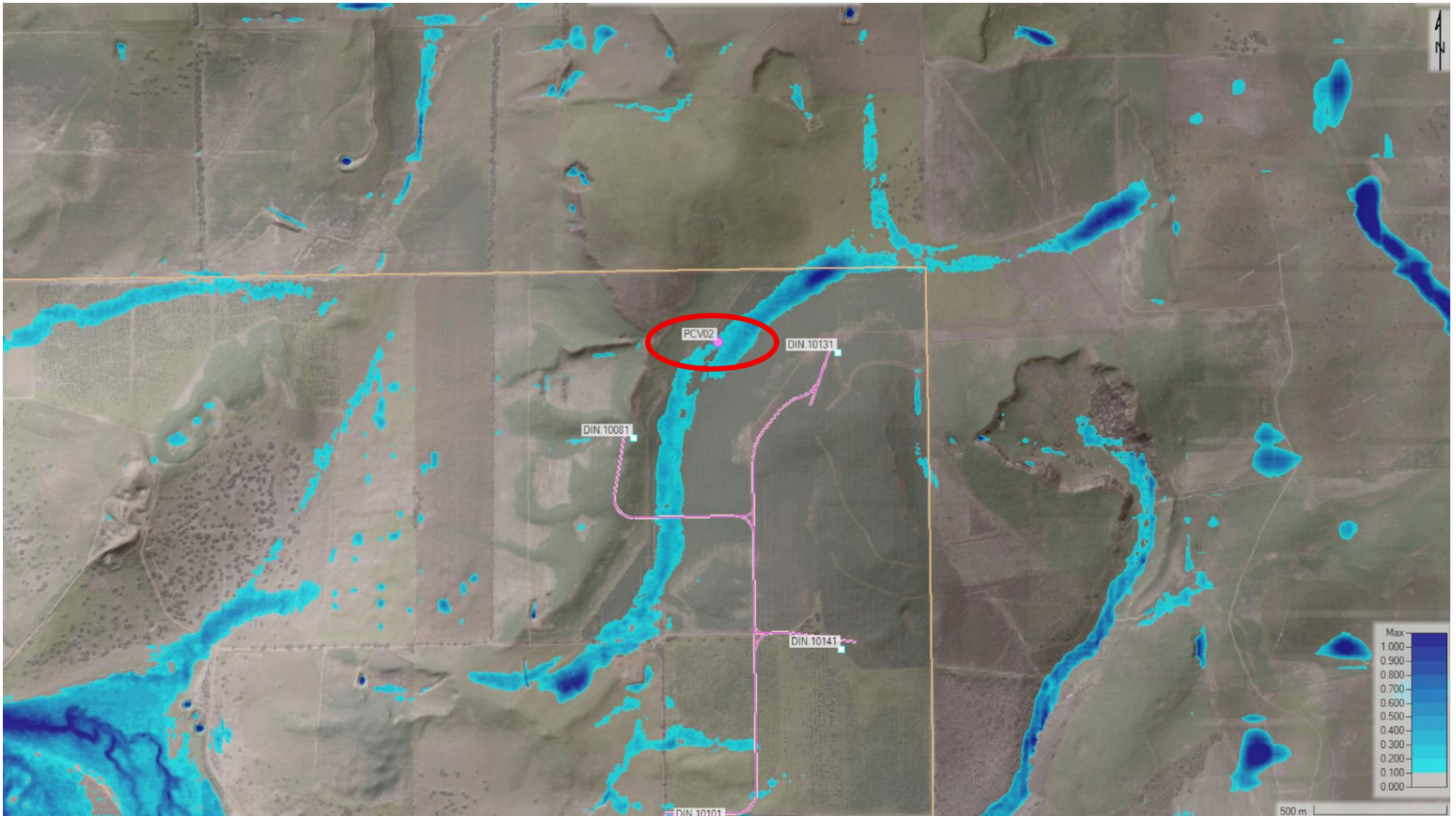


Figure 4-13: Met mast within 1% AEP floodplain



4.2 Maximum Velocity

Figure 4-14, Figure 4-15, and Figure 4-16 show the maximum velocity results for the 10% AEP flood event. **Figure 4-17, Figure 4-18, and Figure 4-19** show the 1% AEP event, and **Figure 4-20, Figure 4-21, and Figure 4-22** show the 1 in 1,000 AEP event.

As indicated by the maximum velocity figures, the proposed WTGs are generally located outside high velocity areas. **Figure 4-23** shows that the maximum 1% AEP velocity at the WTG DIN.10121 location is approximately 0.5 m/s. Any pads in this area should be armoured to prevent erosion; alternatively, the WTG should be relocated to higher ground. **Figure 4-24** shows that WTG DIN.10201 is located within a minor tributary to the Hill River. Maximum 1% AEP inundation velocities are less than 0.5 m/s.

As shown in the figures, transmission towers are generally located outside high velocity areas. As shown in **Figure 4-23**, the maximum 1% AEP velocity at Transmission Tower P048 is approximately 1.5 m/s. Maximum velocities for all other towers are less than 0.5 m/s.

One meteorological mast (PCV02) is located within the 1% AEP floodplain, as shown in **Figure 4-25**. The maximum 1% AEP velocity is less than 0.5 m/s; relocation of the mast is not required due to the relatively low velocity.

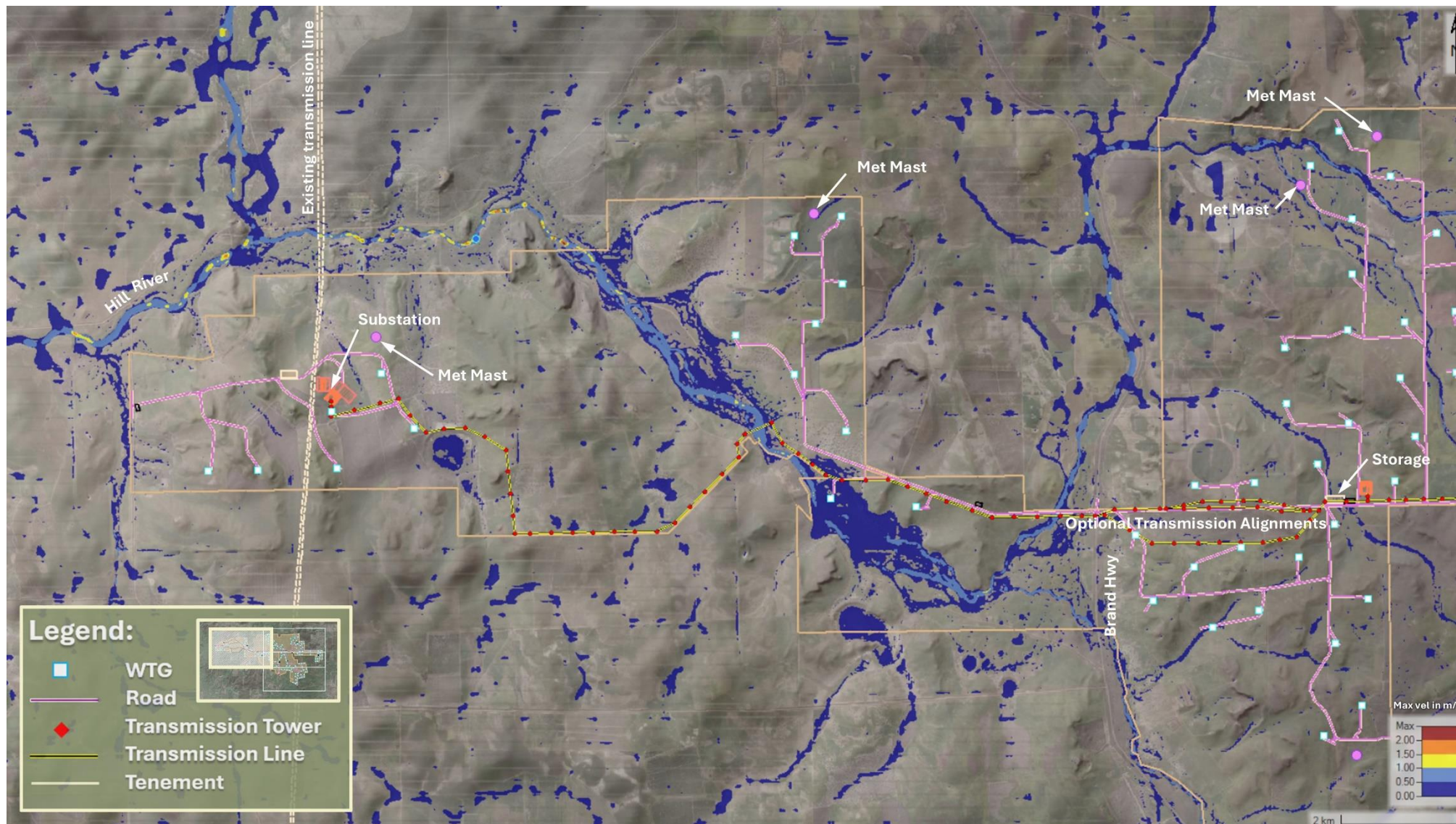


Figure 4-14: Maximum 10% AEP velocity (West)

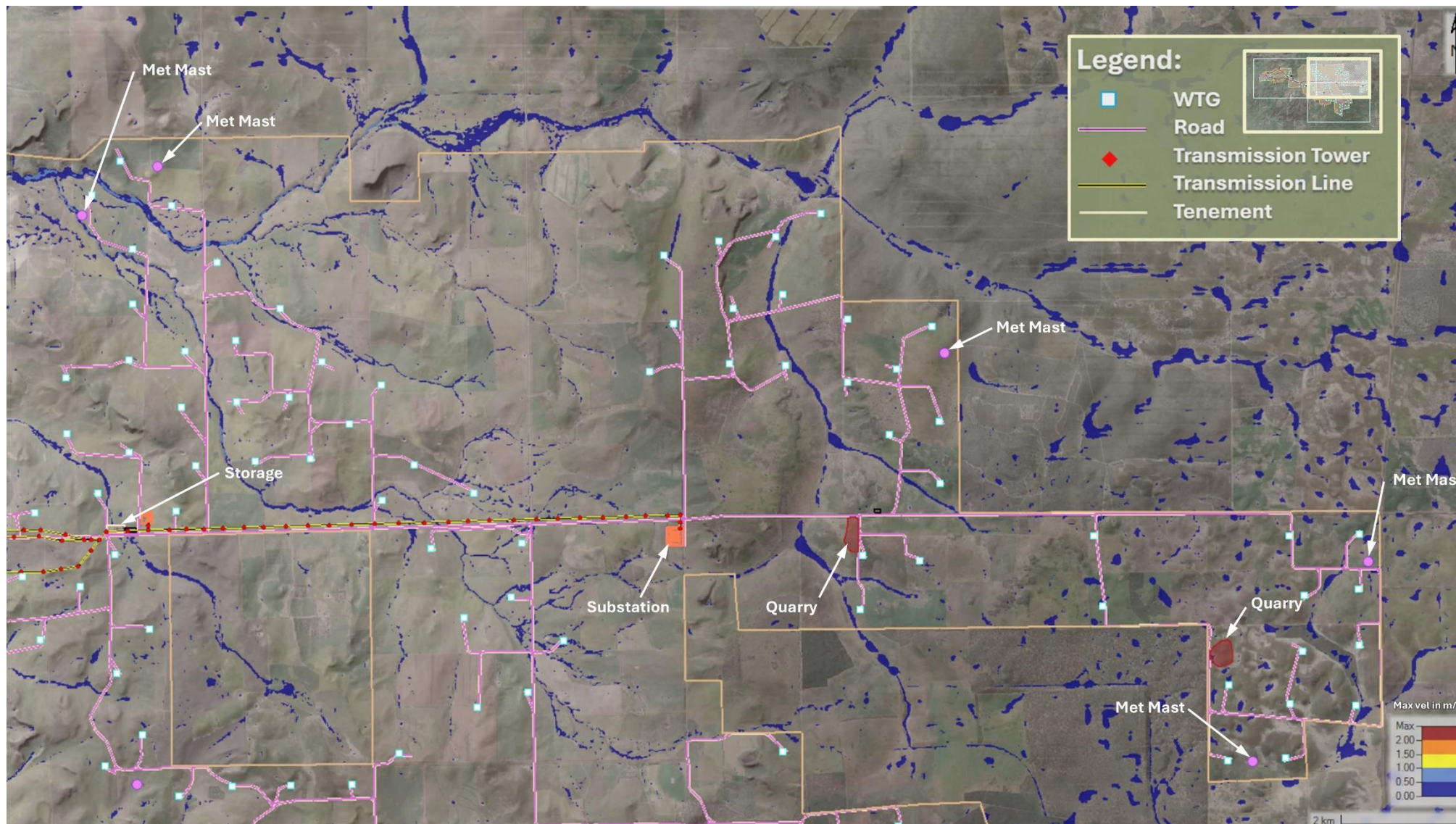


Figure 4-15: Maximum 10% AEP velocity (Northeast)

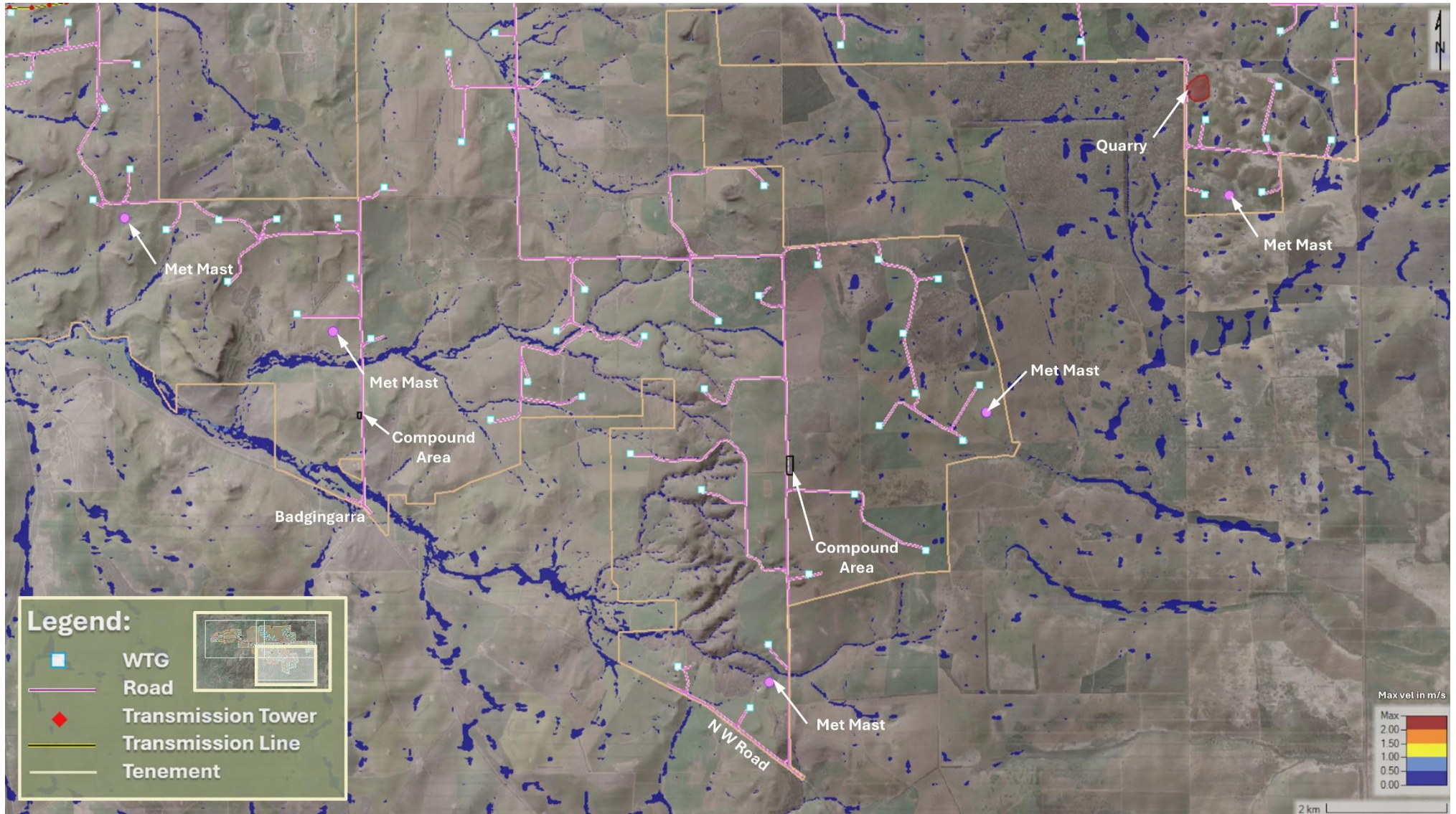


Figure 4-16: Maximum 10% AEP velocity (Southeast)

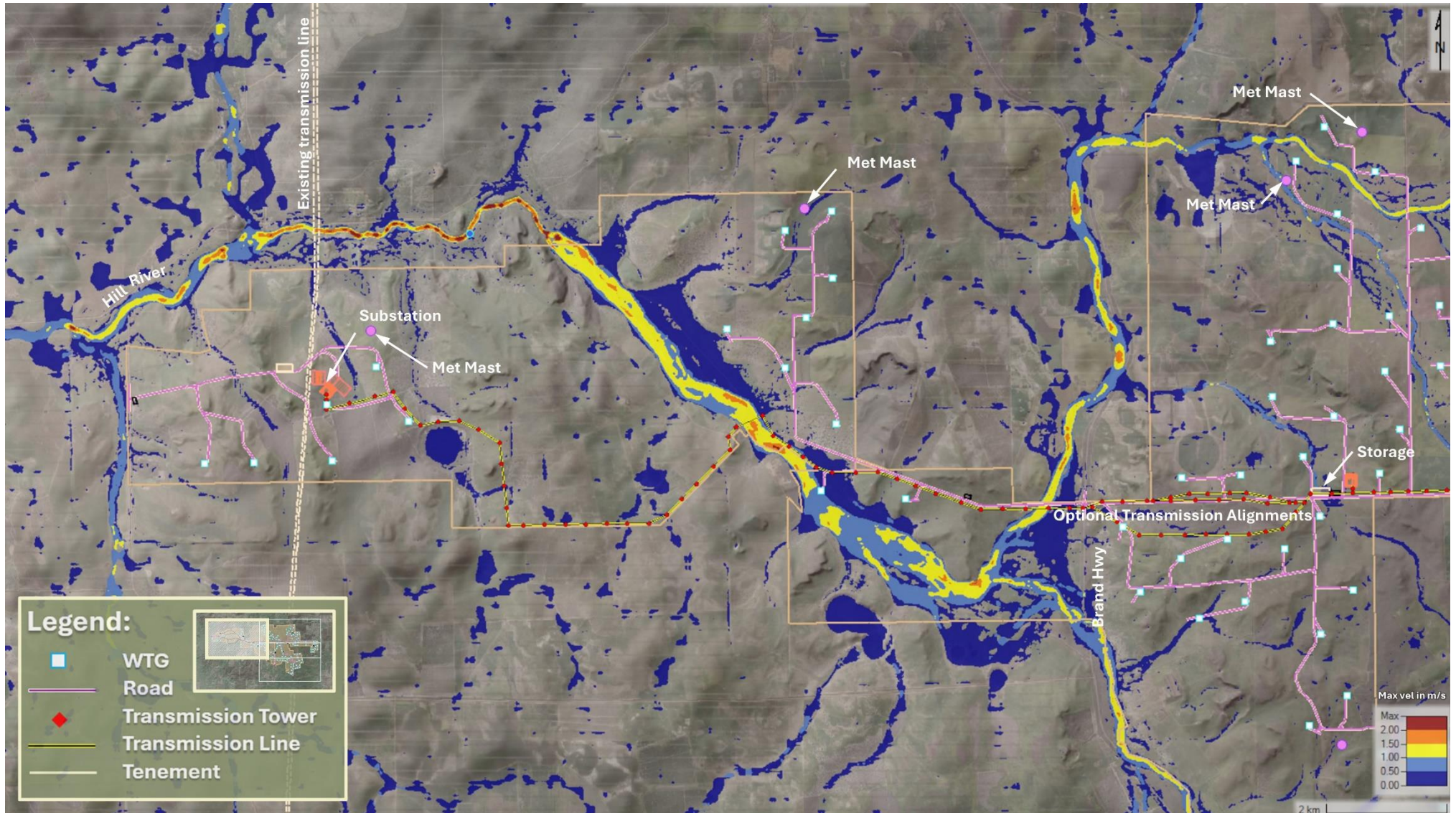


Figure 4-17: Maximum 1% AEP velocity (West)

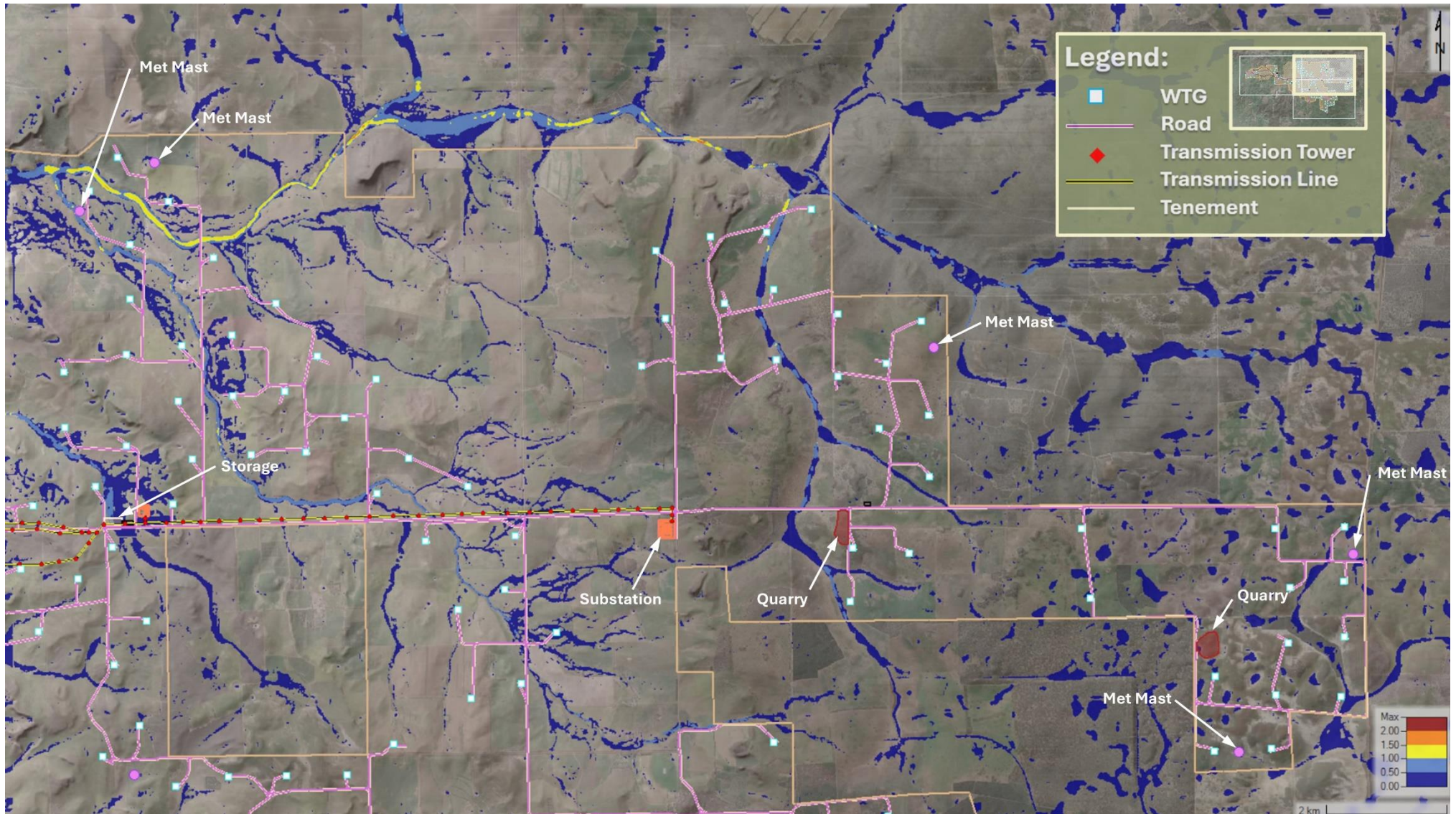


Figure 4-18: Maximum 1% AEP velocity (Northeast)

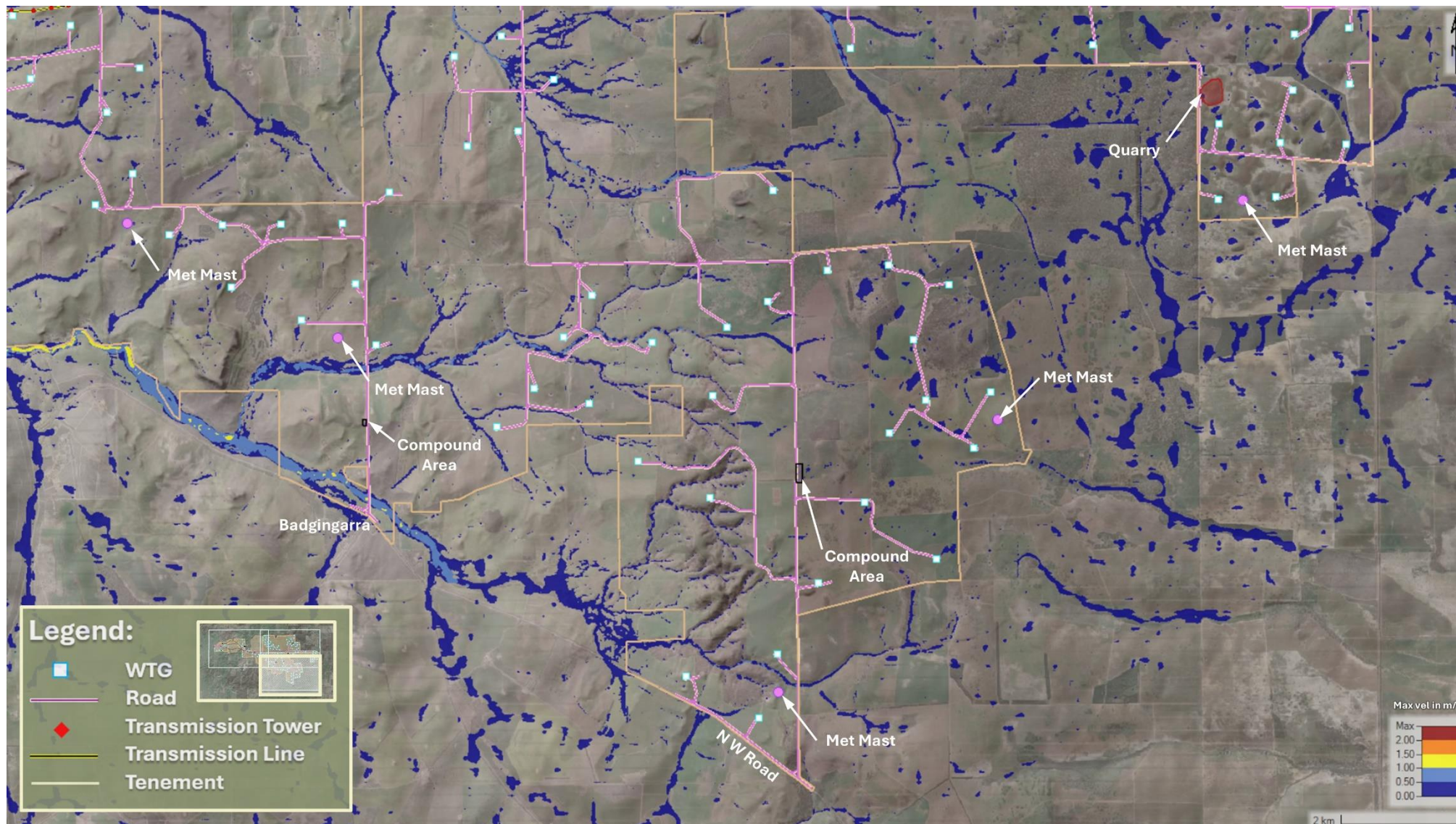


Figure 4-19: Maximum 1% AEP velocity (Southeast)

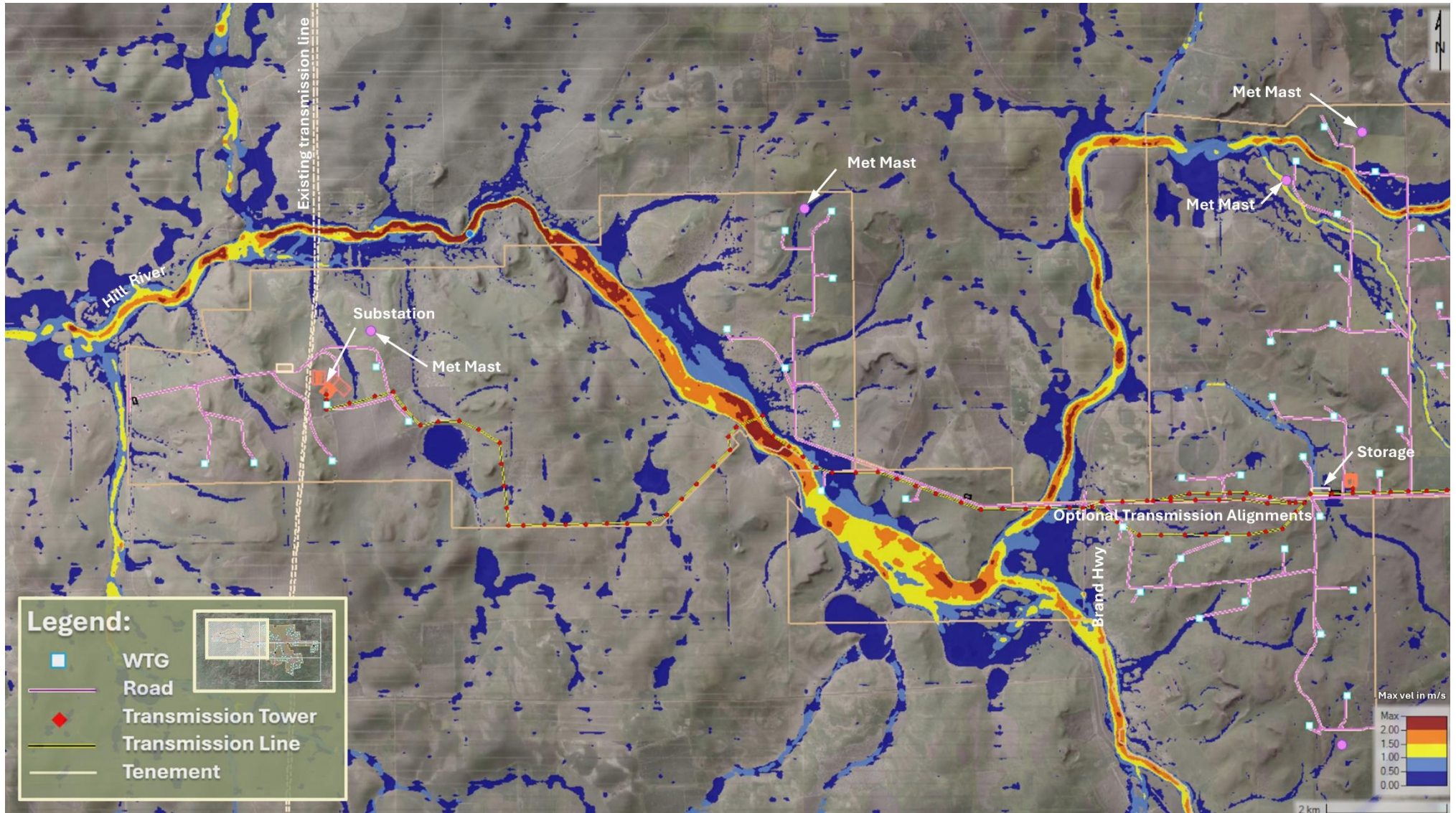


Figure 4-20: Maximum 1 in 1,000 AEP velocity (West)

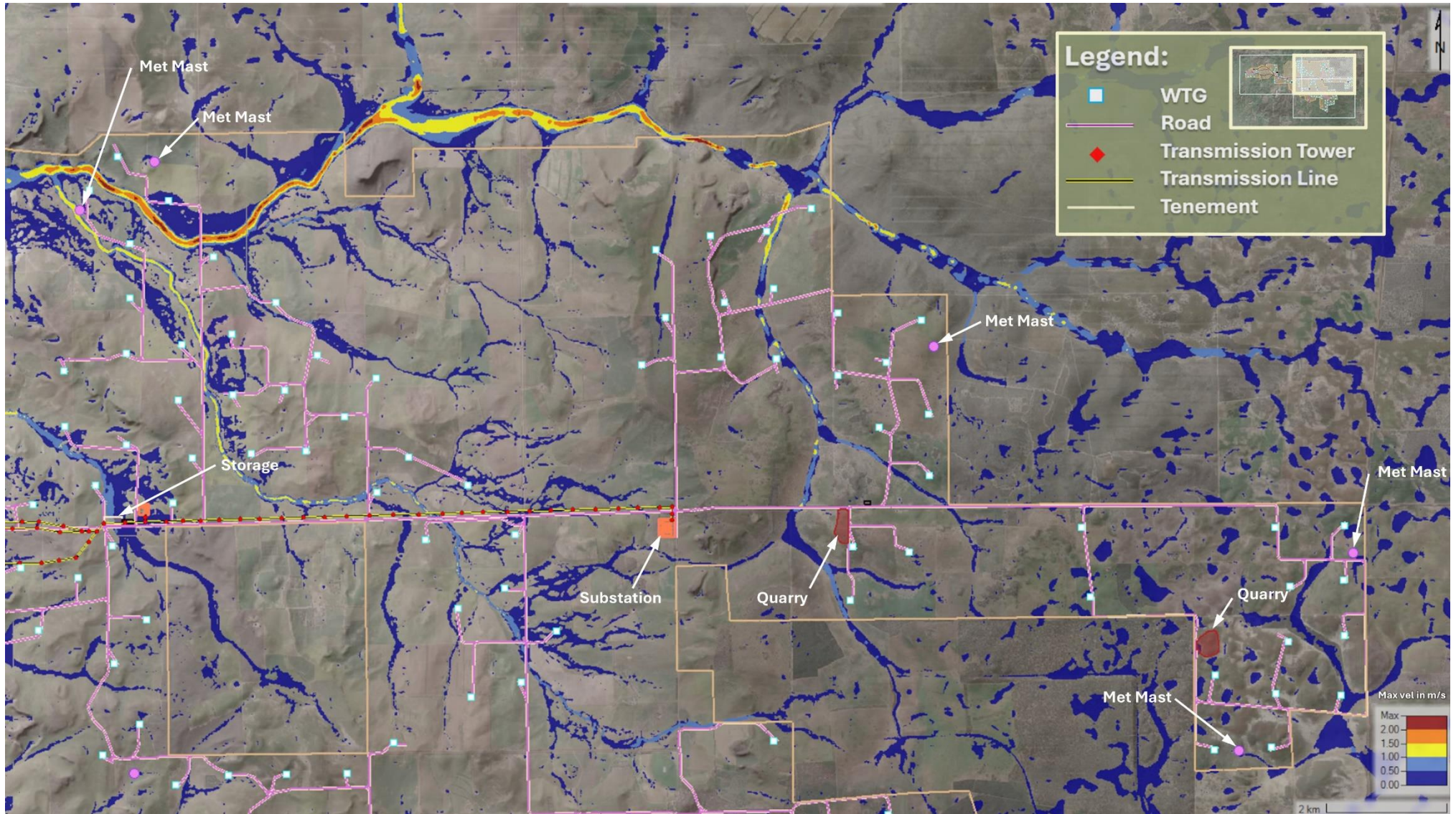


Figure 4-21: Maximum 1 in 1,000 AEP velocity (Northeast)

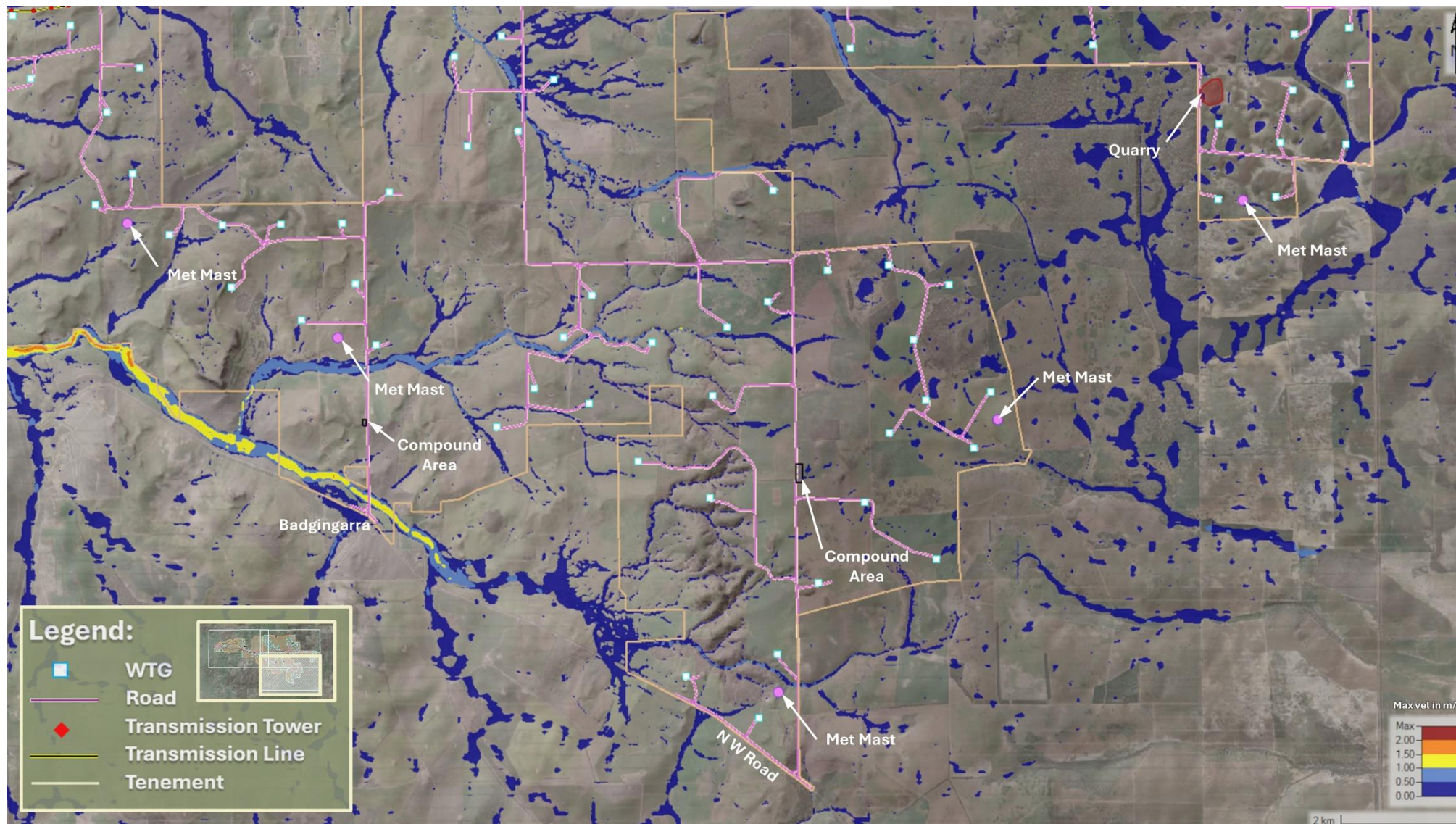


Figure 4-22: Maximum 1 in 1,000 AEP velocity (Southeast)

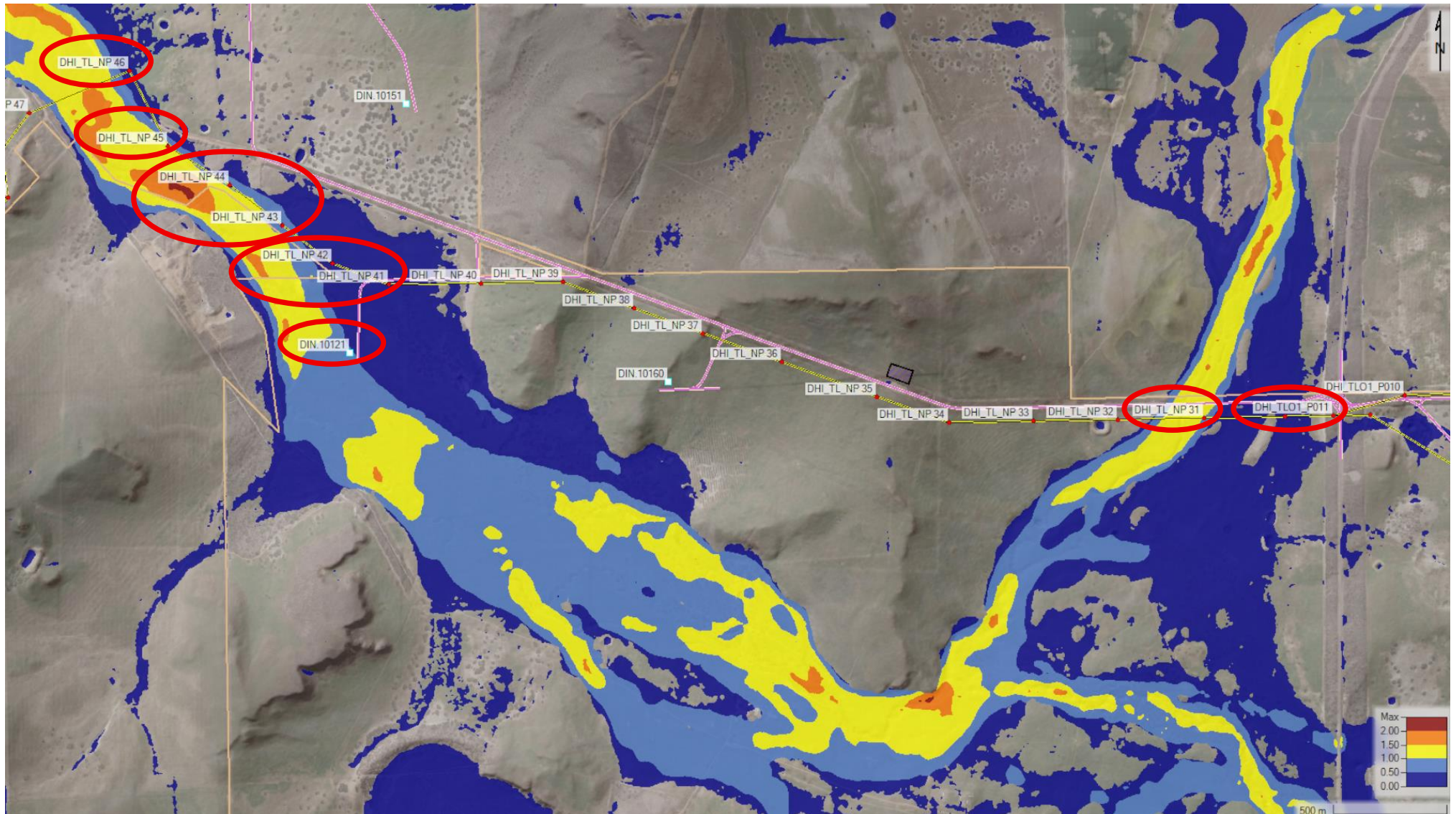


Figure 4-23: Maximum 1% AEP velocity for WTG and transmission towers in 1% AEP floodplain

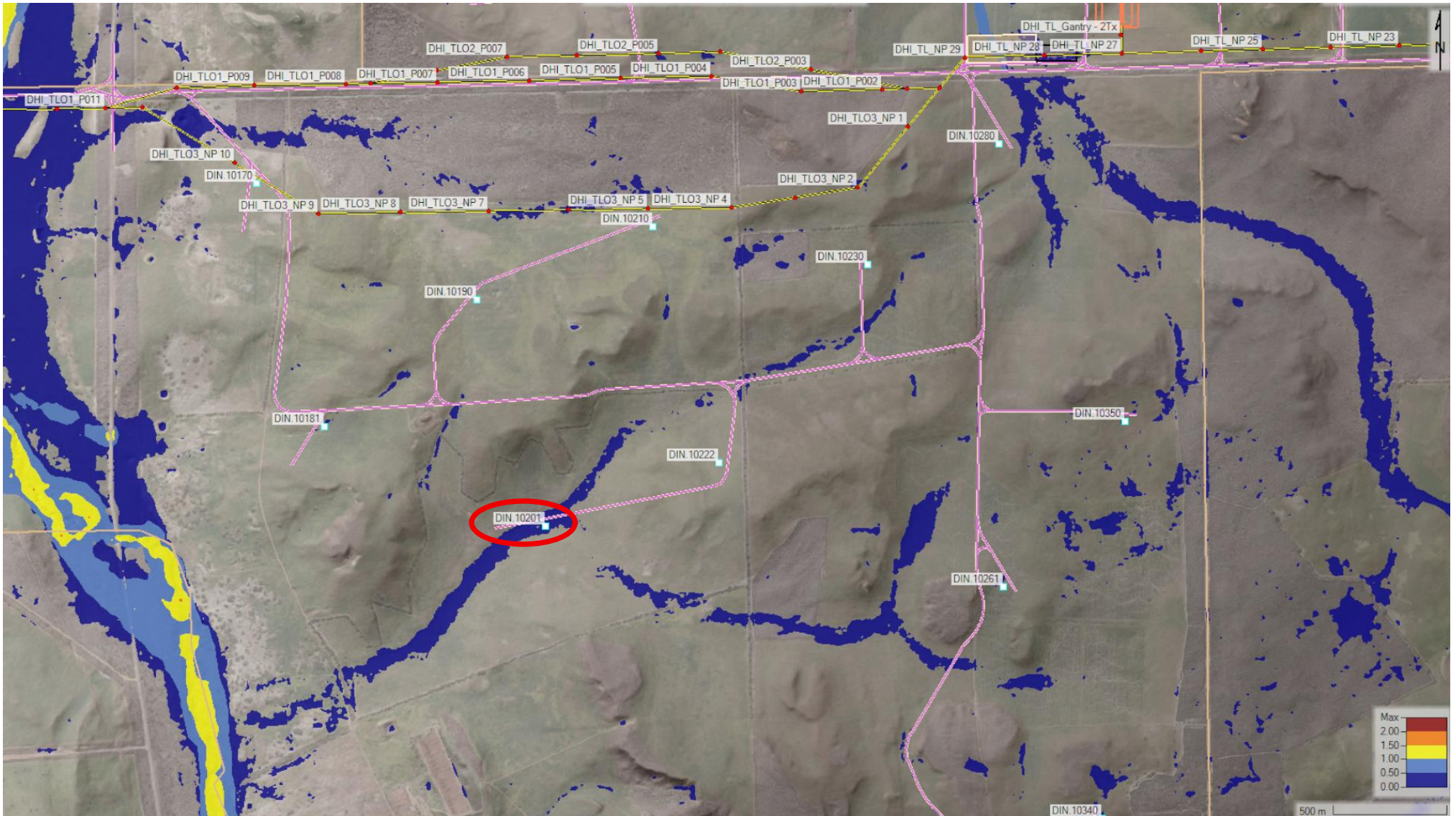


Figure 4-24: Maximum 1% AEP velocity for WTG within 1% AEP floodplain

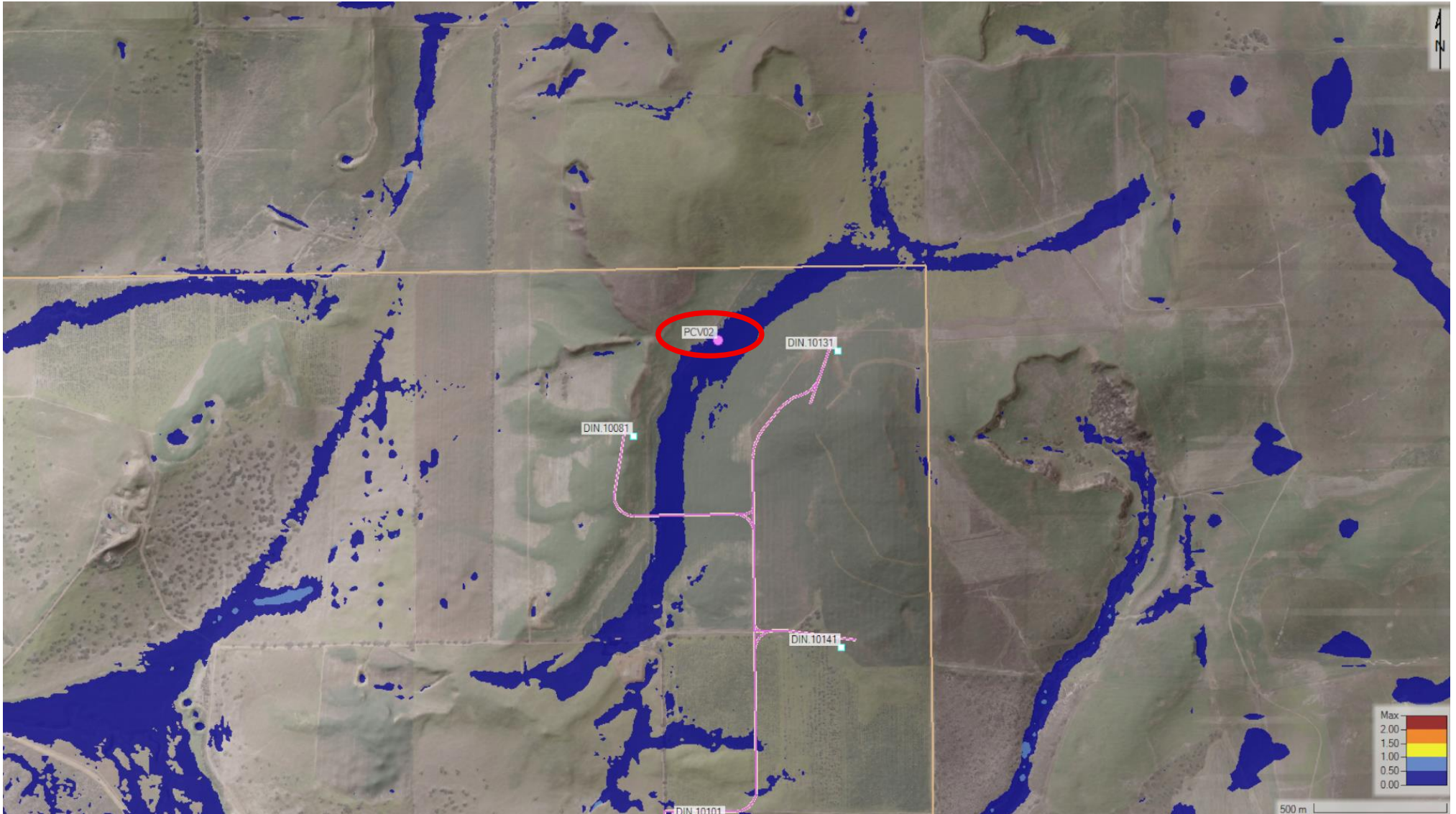


Figure 4-25: Maximum 1% AEP velocity for met mast within 1% AEP floodplain



4.3 Flood Hazard

Flood hazard categories can be defined by the depth times velocity product. **Figure 4-26** shows flood hazard categories based on ARR guidelines (Ball, et al., 2019).

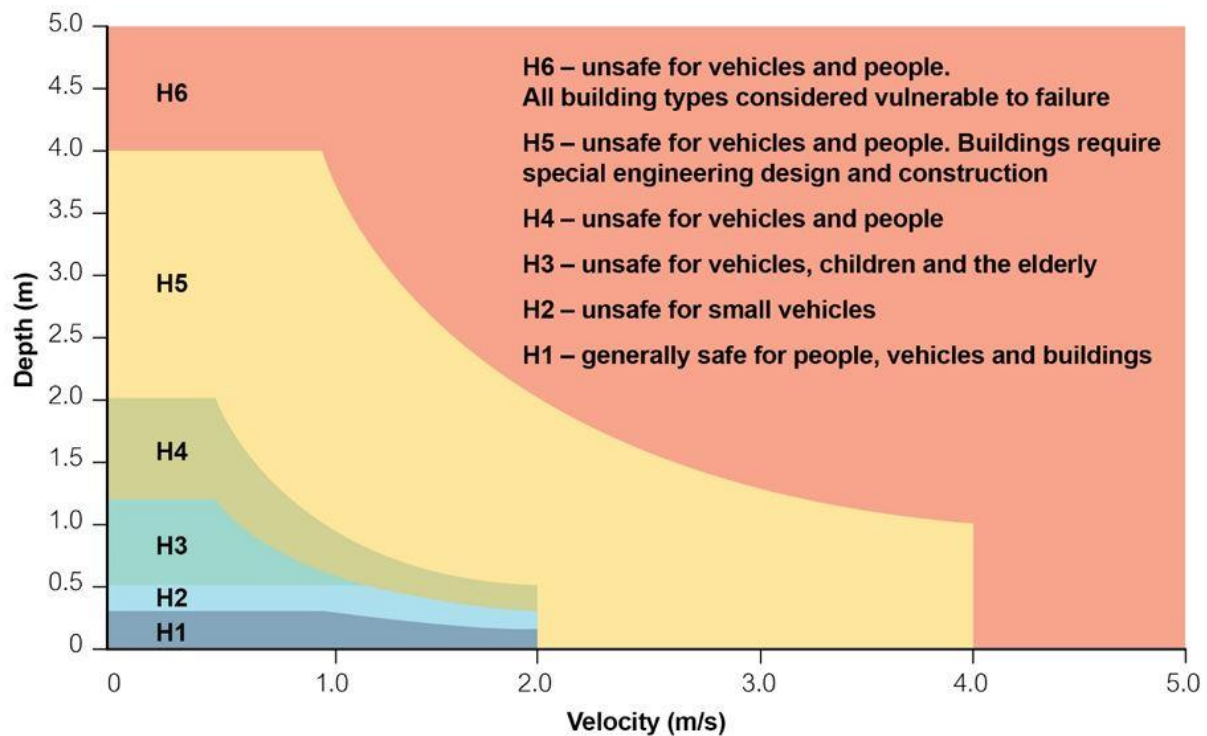


Figure 4-26: Flood hazard classification

Figure 4-27, **Figure 4-28**, and **Figure 4-29** show the maximum depth times velocity results and corresponding flood hazard categories for the 10% AEP flood event. **Figure 4-30**, **Figure 4-31**, and **Figure 4-32** show the 1% event. **Figure 4-33**, **Figure 4-34**, and **Figure 4-35** show the in 1,000 AEP event.

In general, proposed WTGs are located in sheet flow areas corresponding to the H1 flood hazard category, which is considered safe for people, vehicles, and buildings. **Figure 4-36** shows the Hill River crossing where WTG DIN.10121 is located between the H3 and H4 categories, which may be considered unsafe for vehicles and people in the 1% AEP design flood event, during which normal operational conditions would be suspended. It is recommended that the relocation or reinforcement of this WTG is considered in the detailed design stage, noting that any construction or maintenance works is very unlikely occur in a 1% AEP design flood event. **Figure 4-37** shows WTG DIN.10201 located in the H2 to H3 category.

As shown in the figures, transmission towers are generally located outside high flood hazard. The maximum flood hazard category for Transmission Tower P048 is H5. Tower foundations will need to be designed to cater for these conditions, It is noted that any construction or maintenance works is very unlikely occur in a 1% AEP design flood event. The maximum flood hazard category for all other towers is H2-H3. One meteorological mast (PCV02) is located within the 1% AEP floodplain. As shown in **Figure 4-38**., due to the relatively low maximum depths and velocities, the mast is located in the H1 flood hazard zone, which is considered generally safe for people, vehicles, and buildings as classified in **Figure 4-26**.

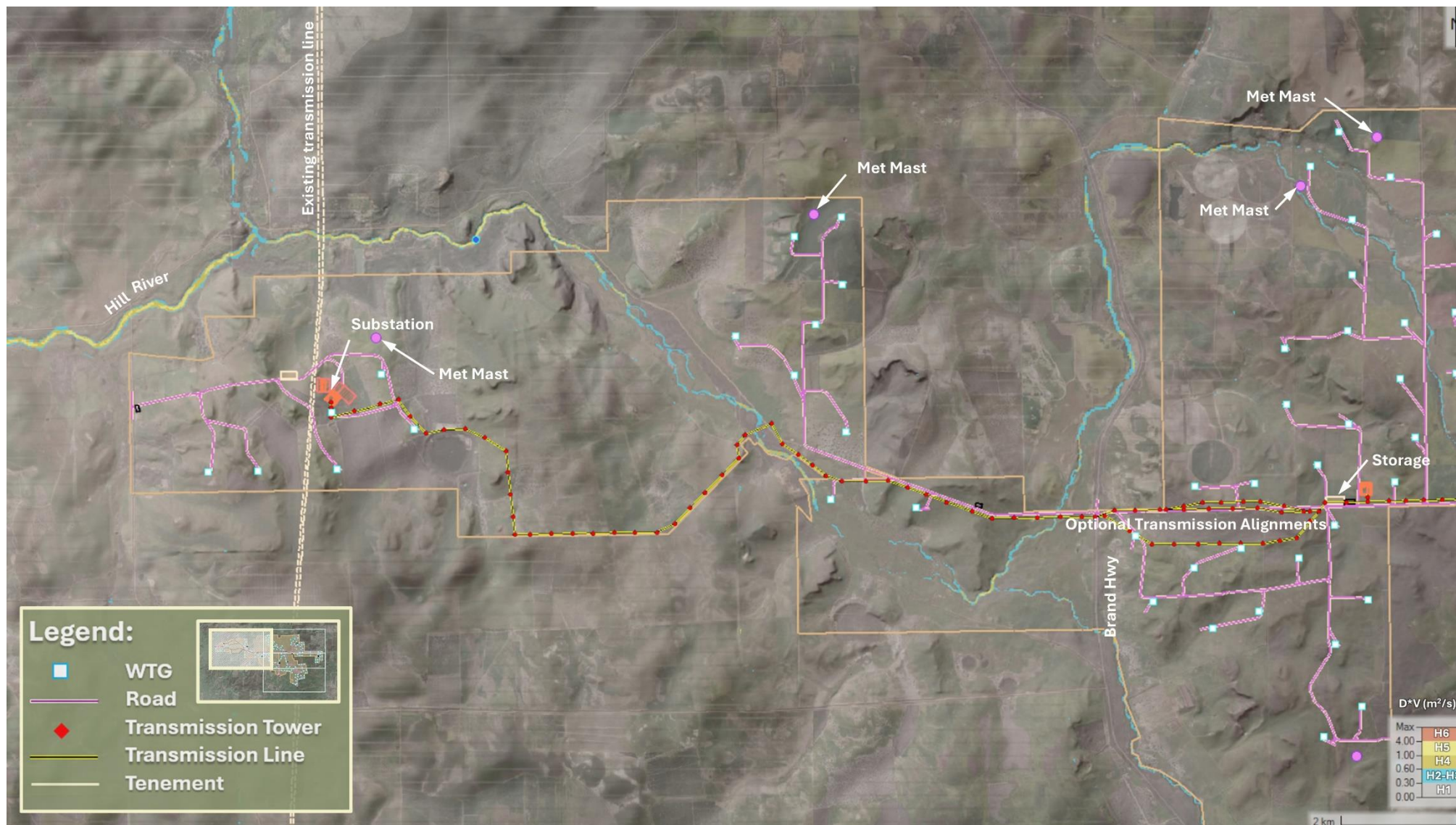


Figure 4-27: Maximum 10% AEP depth times velocity and flood hazard category (West)

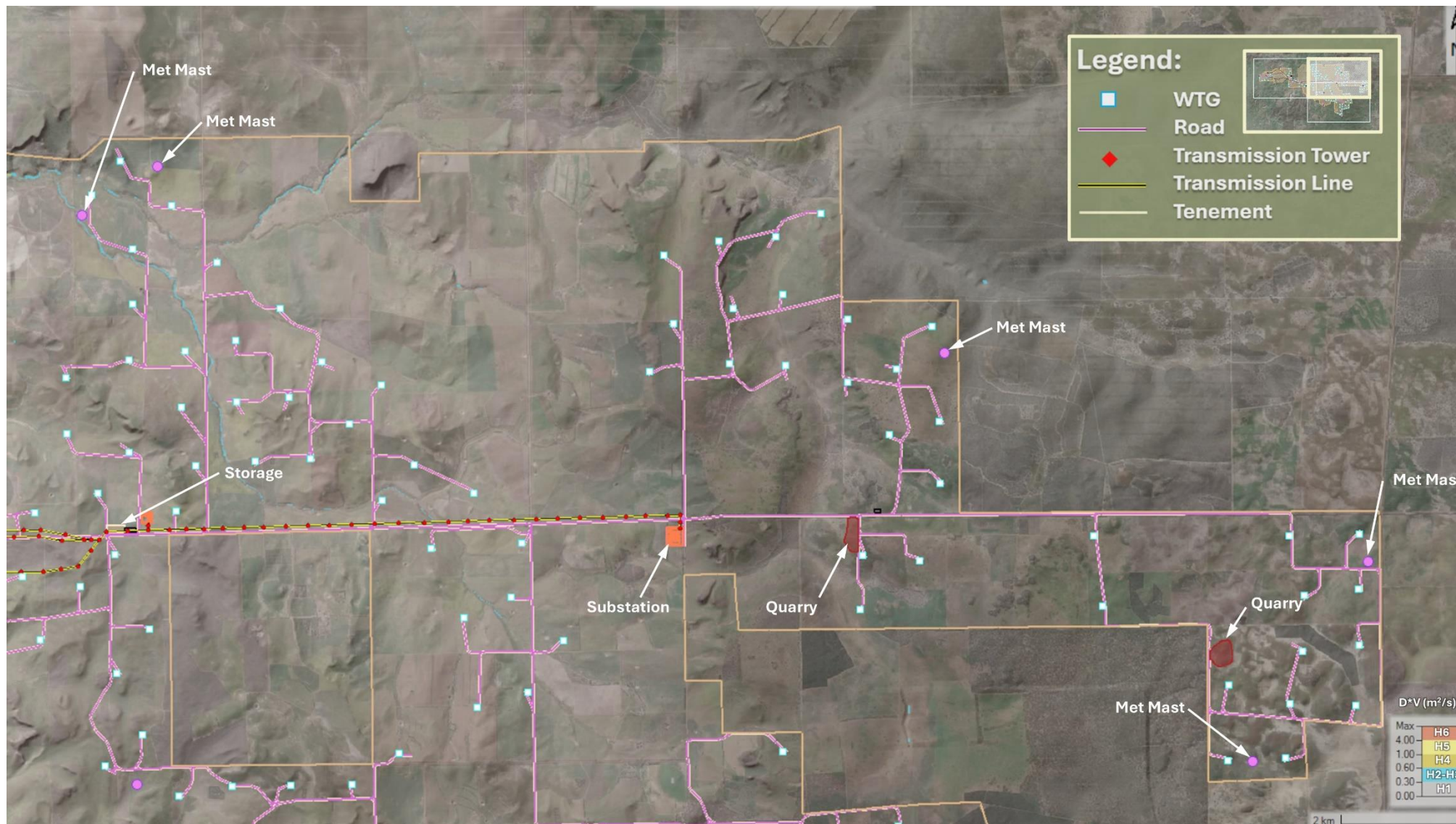


Figure 4-28: Maximum 10% AEP depth times velocity and flood hazard category (Northeast)

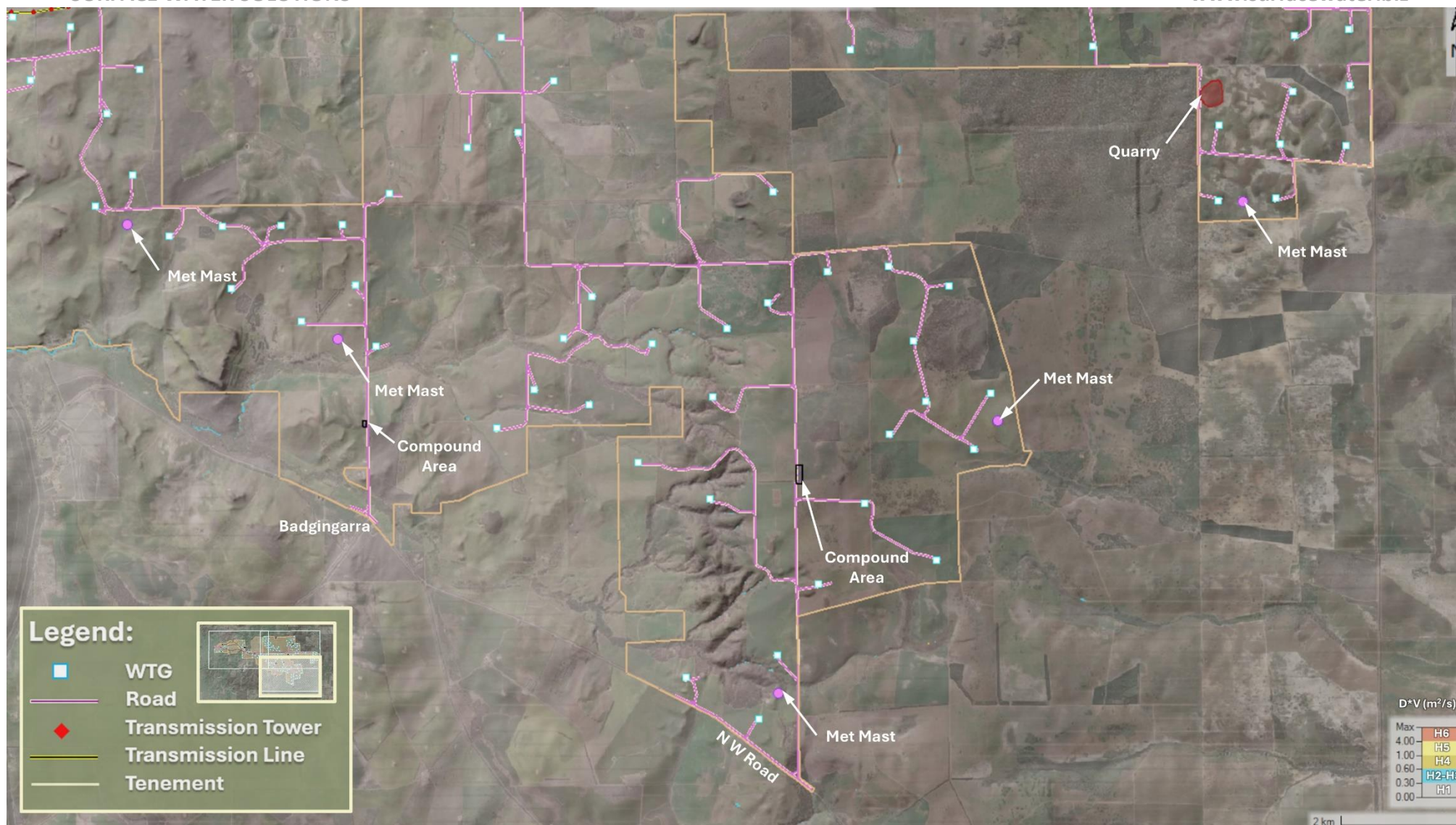


Figure 4-29: Maximum 10% AEP depth times velocity and flood hazard category (Southeast)

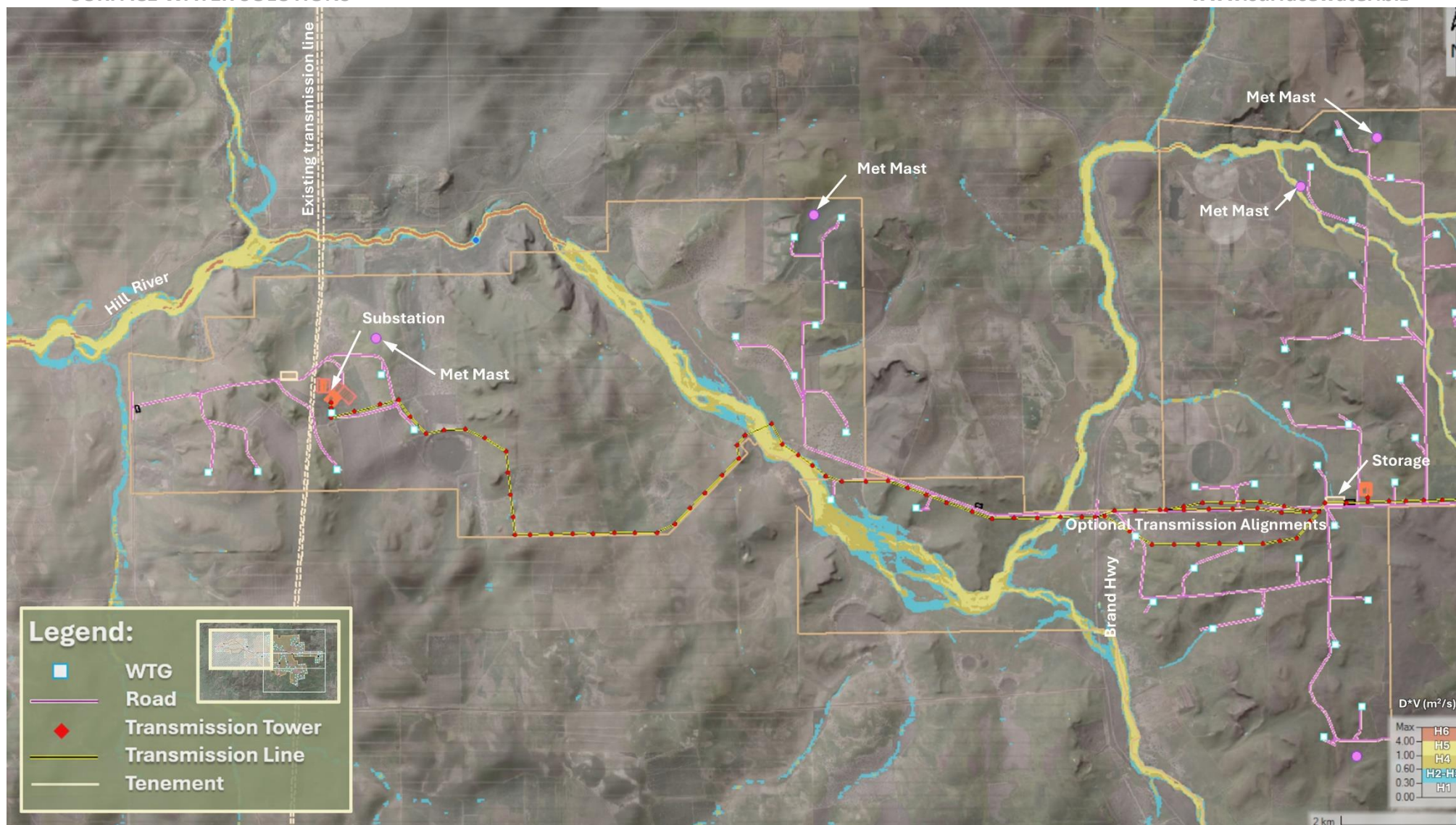


Figure 4-30: Maximum 1% AEP depth times velocity and flood hazard category (West)

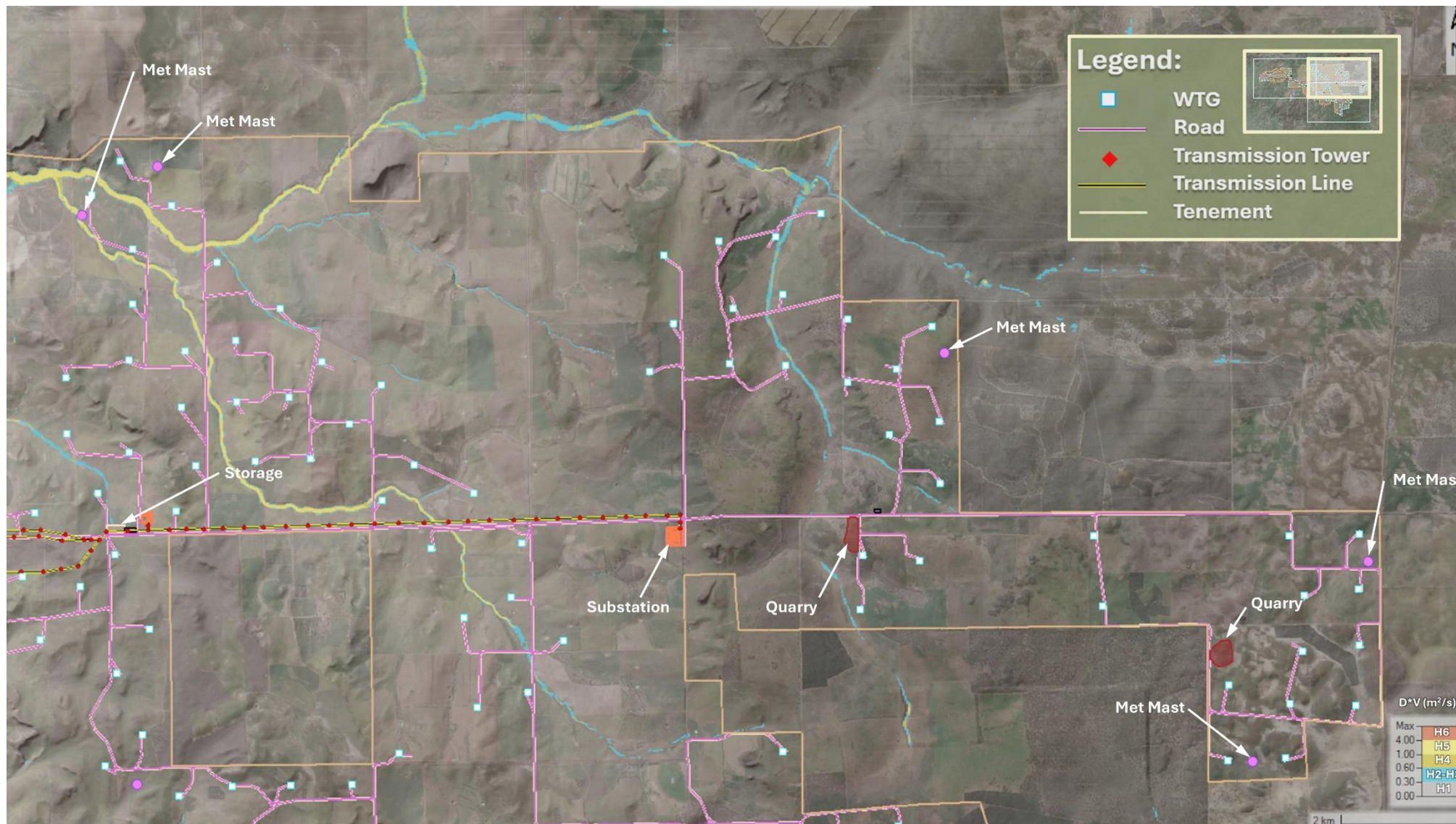


Figure 4-31: Maximum 1% AEP depth times velocity and flood hazard category (Northeast)

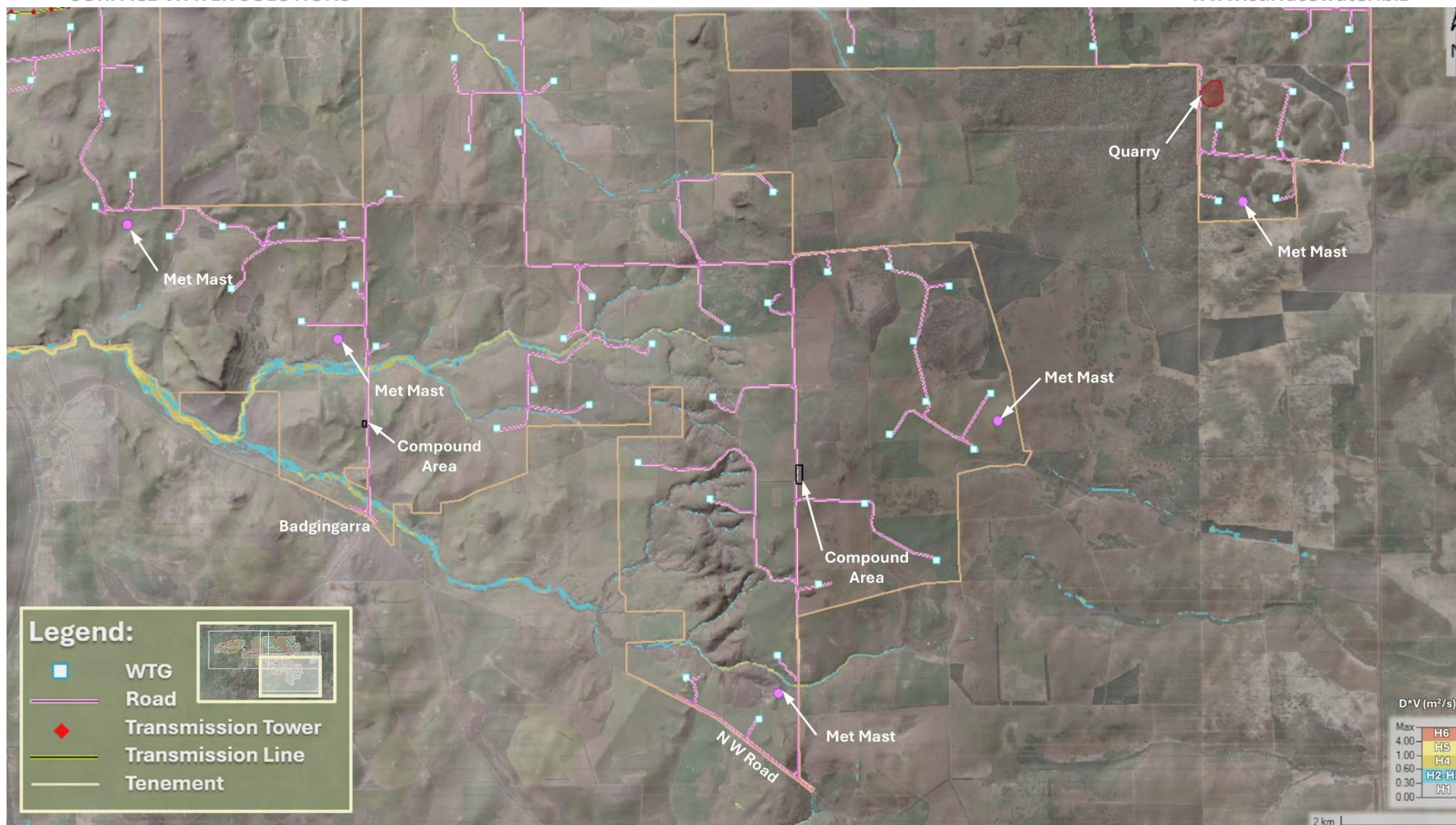


Figure 4-32: Maximum 1% AEP depth times velocity and flood hazard category (Southeast)

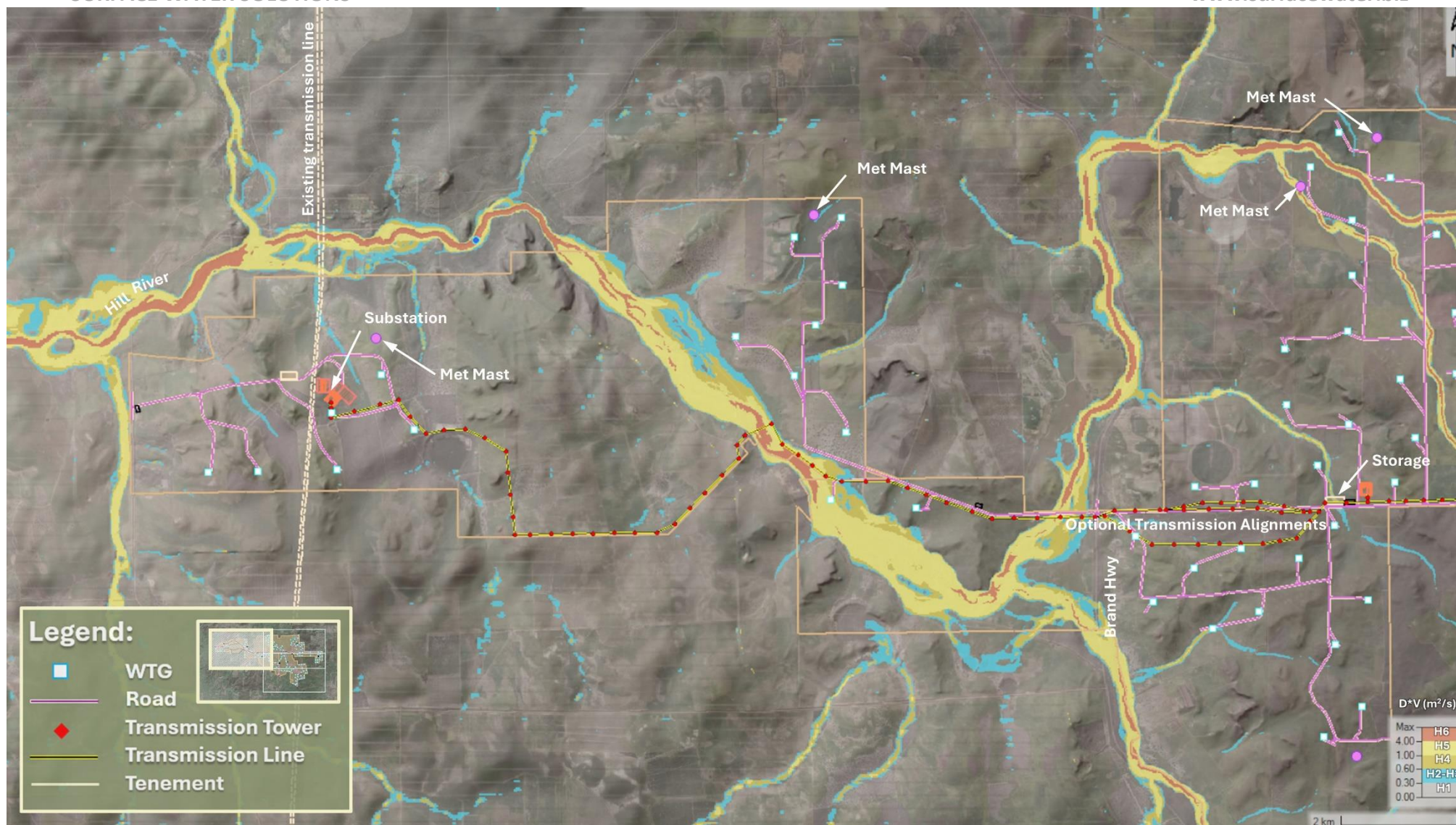


Figure 4-33: Maximum 1 in 1,000 AEP depth times velocity and flood hazard category (West)

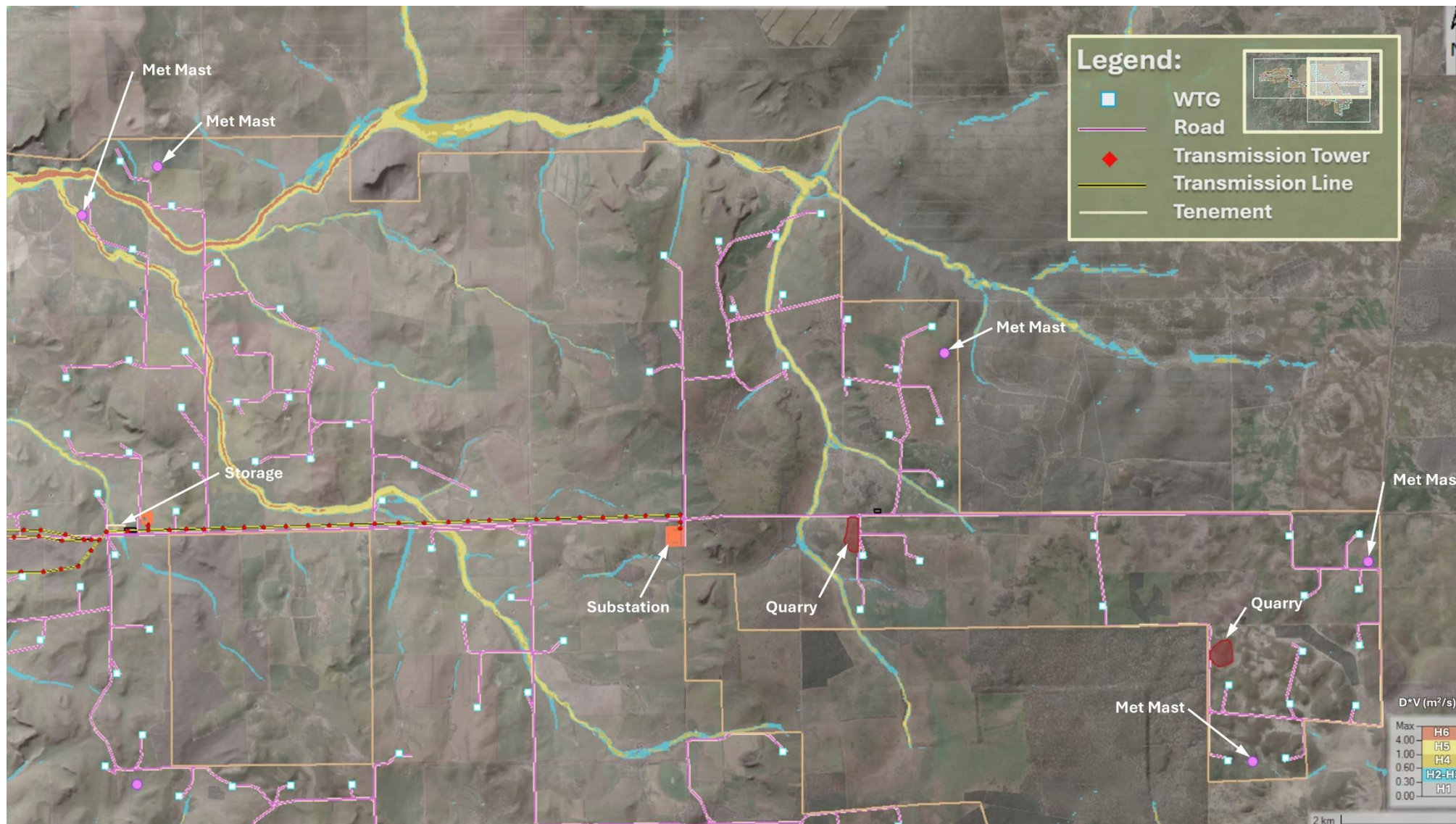


Figure 4-34: Maximum 1 in 1,000 AEP depth times velocity and flood hazard category (Northeast)

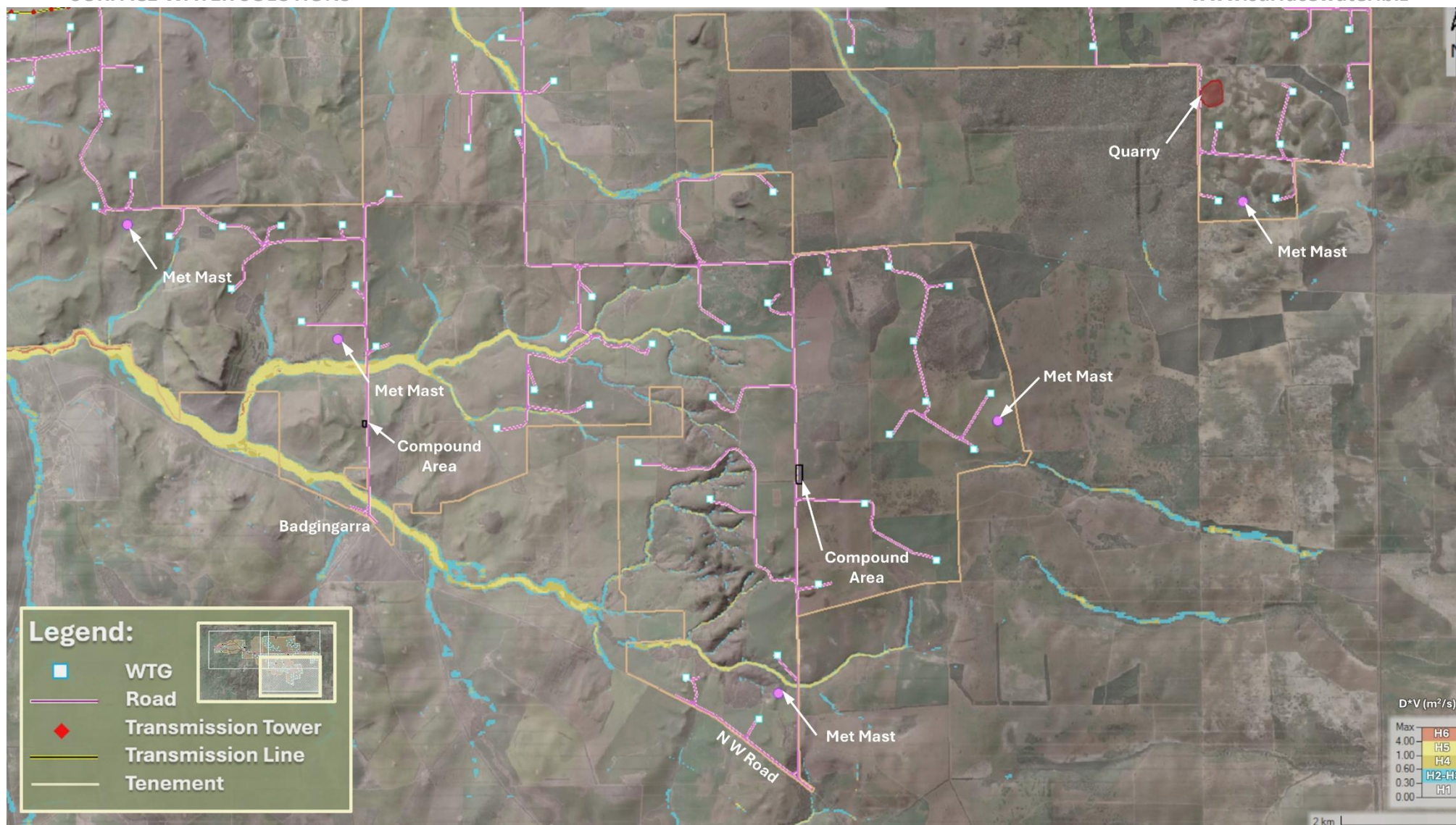


Figure 4-35: Maximum 1 in 1,000 AEP depth times velocity and flood hazard category (Southeast)



Figure 4-36: Maximum 1% AEP flood hazard for WTG and transmission towers in 1% AEP floodplain

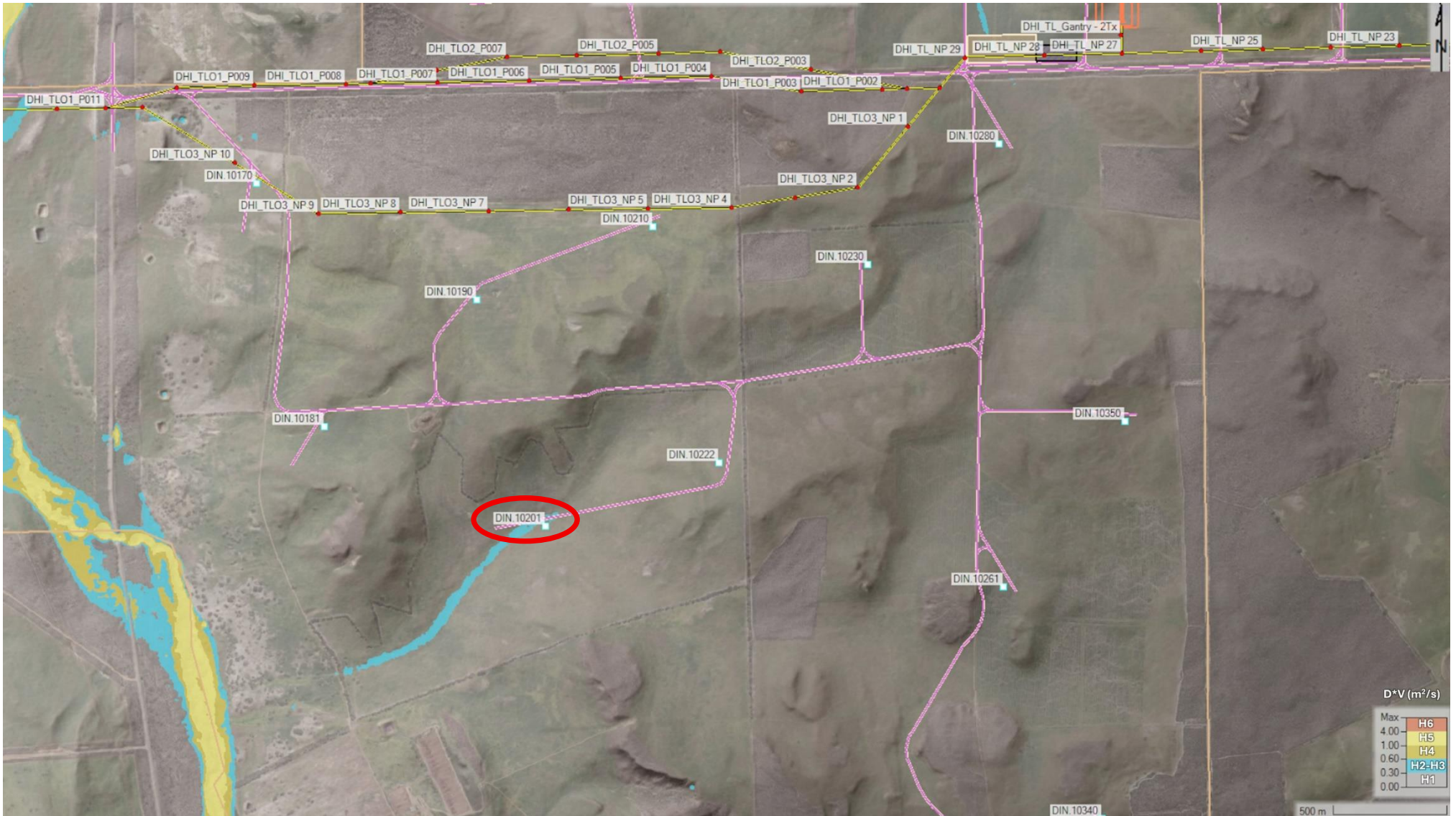


Figure 4-37: Maximum 1% AEP flood hazard for WTG in 1% AEP floodplain



Figure 4-38: Maximum 1% AEP flood hazard for met mast in 1% AEP floodplain



4.4 Scour Potential

The velocity maps above show areas in red where velocities exceed 2 m/s. **Table 4-1** below shows an excerpt from MRWA's Floodway Design Guide (MRWA 2006), which is derived from 1994 Austroads tables and highlights the recommended rock class and section thicknesses associated with specified velocity ranges. **Table 4-2** defines the gradation and size ranges for standard rock classes from Specification 406 for rock protection (MRWA 2017). **Figure 4-39** shows the tabulated values graphically.

Batter slopes should be protected with coarse material appropriate for the design slope and pad size to protect against erosion from local rainfall runoff. Based on the predicted velocities, no armour rock is required within the development footprint to protect against external, impinging flows except where noted above. Batter slopes should use standard erosion protection measures. Any flow concentration related to non-modelled features may require localised scour protection.

The Project will be supported by a Construction Environmental Management Plan which will include sediment erosion control and management measures.

Table 4-1: Design of rock slope protection (from Table 3.11, Austroads 2023, Table 5.1, MRWA 2006)

Velocity (m/s)	Class of rock protection (tonne)	Section thickness, <i>T</i> (m)
< 2	None	–
2.0–2.6	Facing	0.50
2.6–2.9	Light	0.75
2.9–3.9	¼	1.00
3.9–4.5	½	1.25
4.5–5.1	1.0	1.60
5.1–5.7	2.0	2.00
5.7–6.4	4.0	2.50
> 6.4	Special	–



Table 4-2: Standard classes of rock slope protection (from Austroads 2023 and MRWA 2006)

Rock class	Rock size ⁽¹⁾ (m)	Rock mass (kg)	Minimum percentage of rock larger than
Facing	0.40	100	0
	0.30	35	50
	0.15	2.5	90
Light	0.55	250	0
	0.40	100	50
	0.20	10	90
¼ tonne	0.75	500	0
	0.55	250	50
	0.30	35	90
½ tonne	0.90	1000	0
	0.70	450	50
	0.40	100	90
1 tonne	1.15	2000	0
	0.60	1000	50
	0.55	250	90
2 tonne	1.45	4000	0
	1.15	2000	50
	0.75	500	90
4 tonne	1.80	8000	0
	1.45	4000	50
	0.90	100	90

Table 4-3: Standard classes of rock slope protection (from Table 406.1, MRWA 2009)

Rock Class	Rock Size (m) *	Approximate Rock Mass (kg)	Percentage of Rock Larger than Rock Size in the Second Column	Typical Use (Examples Only)
Type A	0.20 0.10 0.075		0 50 90	Catchpit Surrounds
Type B1	0.30 0.20 0.10		0 50 90	Culvert Outlets
Type B (Facing)	0.40 0.30 0.15	100 35 2.5	0 50 90	Culvert Outlets
Light	0.55 0.40 0.20	250 100 10	0 50 90	Floodway Batters
Quarter Tonne	0.75 0.55 0.30	500 250 35	0 50 90	Floodway Batters
One Tonne	1.15 0.90 0.55	2000 1000 250	0 50 90	Floodway Batters
Two Tonne	1.45 1.15 0.75	4000 2000 500	0 50 90	Floodway Batters
Rock Pitching	0.40 x 0.40 x 0.20 0.15 x 0.15 x 0.15		60 100	Landscaped Slopes (Typically Limestone)

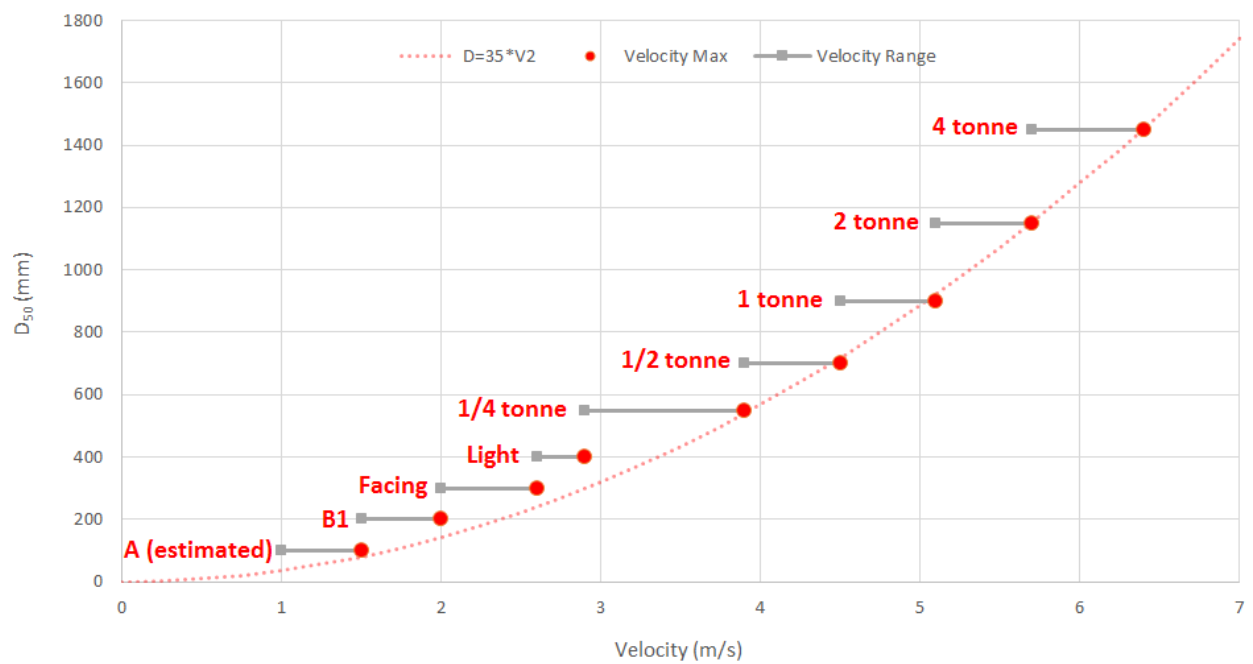


Figure 4-39 Velocity vs. median stone size (based on Austroads 2023)



5. Proposed Condition Hydraulic Results

5.1 Terrain adjustments

A proposed conditions hydraulic model was developed with terrain modifications applied in areas with proposed infrastructure. The proposed WTGs were modelled using a 6-metre diameter obstruction. BESS facilities and other infrastructure areas were raised by 500 mm to estimate maximum impacts to external flows. WTG foundations are assumed to be below ground level with no flow obstructions. Hydraulic modelling results indicate that the flow obstruction has negligible impacts on downstream flow volumes and inundation extents.

The design model assumes that temporary crane pads, laydown areas, and storage areas will be rehabilitated to pre-project grading following construction. Access roads are assumed to be at grade without a raised formation that would affect surface water runoff.

5.2 Profile results

Figure 5-1 shows the existing condition water surface elevation profiles for the 10% AEP, 1% AEP, and 1 in 1,000 AEP flood events across the Hill River at the WTG DIN.10121 location. The chainage and alignment reference for the profile line is shown in **Figure 4-11**.

Figure 5-2 compares the existing condition and project condition maximum water surface elevation profiles across the same profile alignment for the 1% AEP event.

Figure 5-3 shows the existing condition water surface elevation profiles for the 10% AEP, 1% AEP, and 1 in 1,000 AEP flood events across the Hill River tributary at the WTG DIN.10201 location. The chainage and alignment reference for the profile line is shown in **Figure 4-12**.

Figure 5-4 compares the existing condition and project condition maximum water surface elevation profiles across the same profile alignment for the 1% AEP event.

5.3 Existing vs. proposed condition comparison

The results show that the difference in maximum water surface elevation between existing and proposed conditions is negligible. There are no discernible impacts on downstream inundation extents, peak flow rates, or cumulative volume resulting from the presence of the proposed features; as such, the existing conditions hydraulic results presented above are considered applicable to the project conditions.

The relocation of WTGs located in the 1% AEP floodplain is recommended (DIN.10121 and DIN.10201). Alternatively, these WTGs may require additional armouring or raised pads. The detailed design stage of the Project will consider the most appropriate method to adopt.

Some ponding up to 20 cm in depth occurs at other WTG and transmission tower locations. The placement of minor fill may be warranted in these areas to facilitate local drainage and reduce required maintenance.

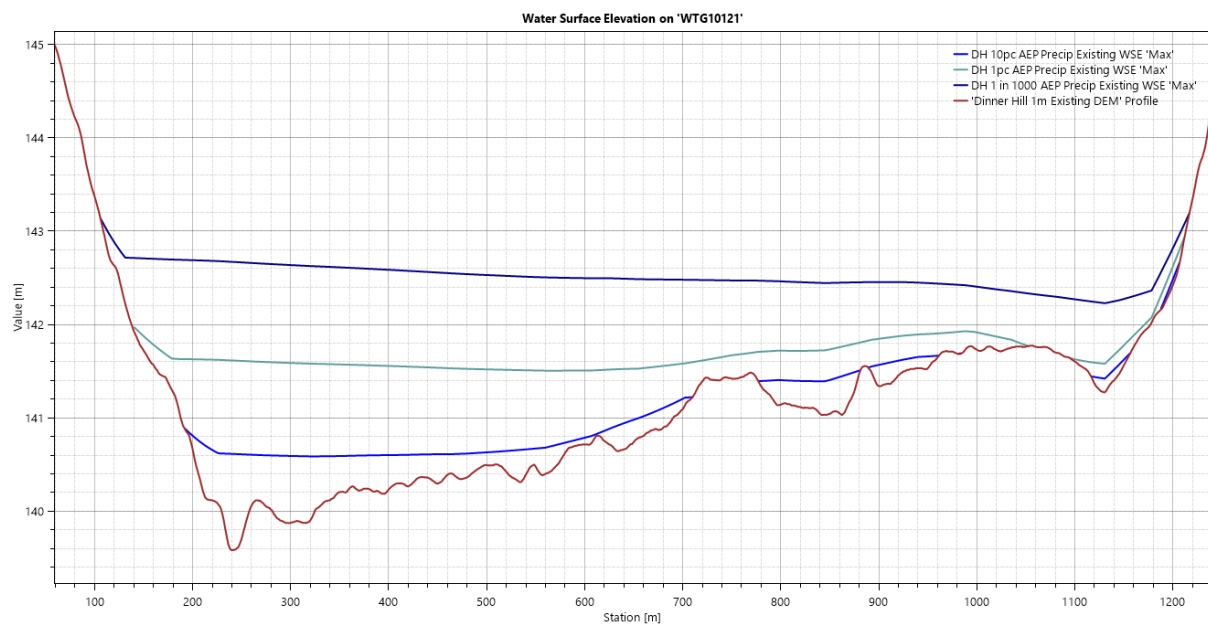


Figure 5-1 Existing condition maximum water surface elevation profiles at WTG DIN.10121

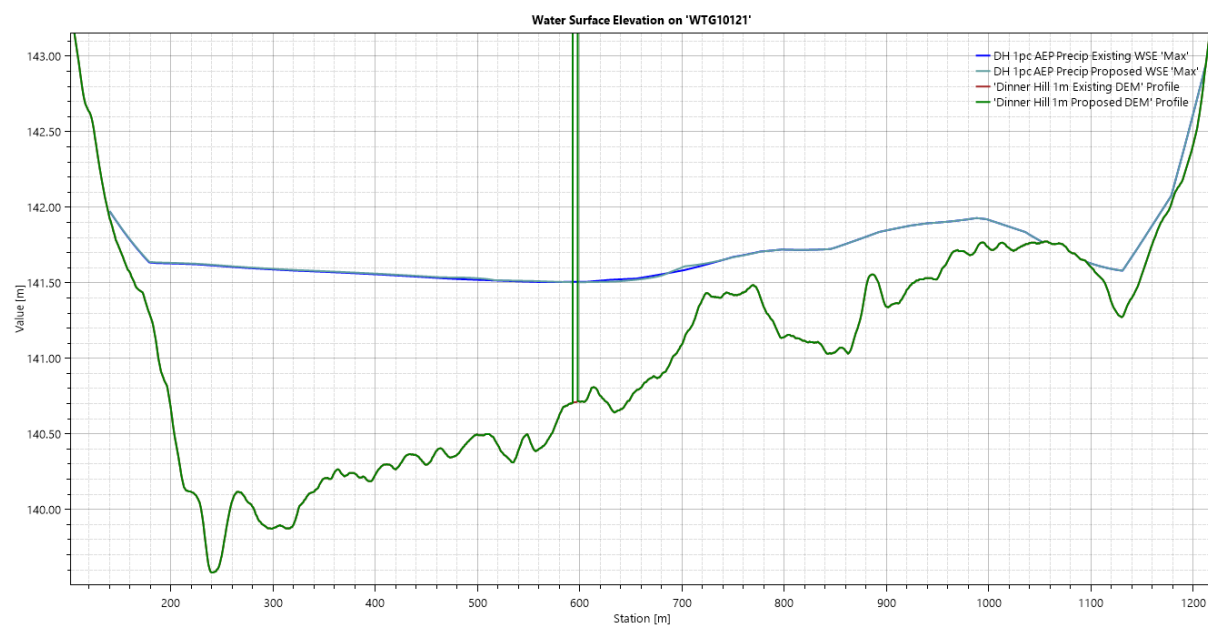


Figure 5-2 Existing and proposed maximum 1% AEP water surface elevation profiles at WTG DIN.10121

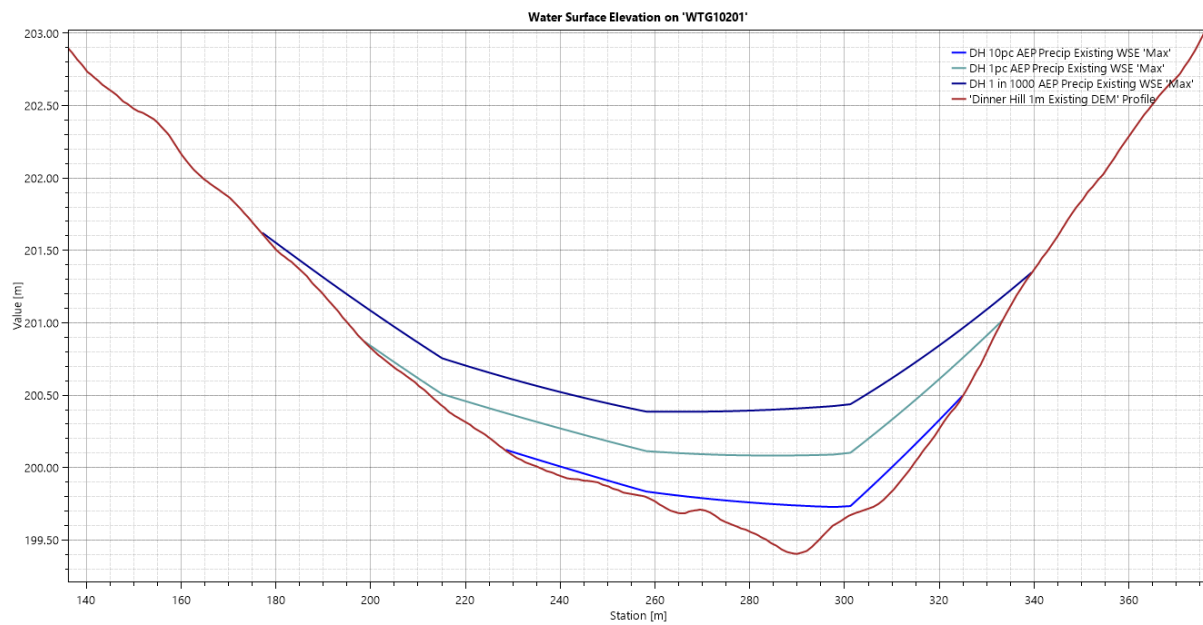


Figure 5-3 Existing condition maximum water surface elevation profiles at WTG DIN.10201

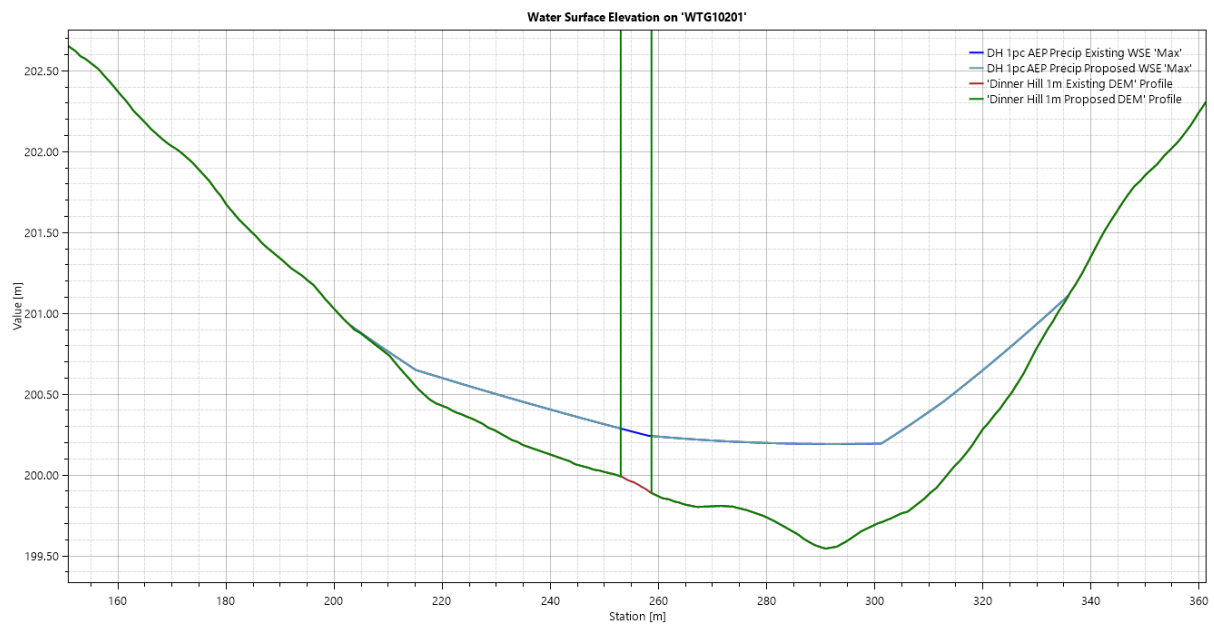


Figure 5-4 Existing and proposed condition maximum 1% AEP water surface elevations at WTG DIN.10201



6. Discussion and Recommendations

6.1 Wind Farm Impacts

Transmission towers and WTG foundations are generally located outside of concentrated flow channels. Pads are generally subject to local sheet flow runoff only without intercepting substantial external runoff. Any concentrated, localised flows should be directed around the outside of the pads, with gradients preventing the accumulation of standing water.

Maximum velocities in the modelled area occur within the Hill River channel. Flood levels at the selected site features do not appear to be influenced by the larger Northern Branch inflows. Proposed site infrastructure areas are subject to local rainfall, runoff, infiltration, and evapotranspiration. Outside of the river channels, velocities are generally less than 0.5 m/s, and the hydraulic results do not indicate a need for rip rap scour protection around the Project infrastructure. Although the modelled maximum velocity results indicate that rip rap scour protection is not needed around pad perimeters, excavated slopes or fill embankments should be lined with vegetation, matting, or coarse material appropriate for the design slope and pad size to protect against erosion from local rainfall runoff.

In isolated creek crossing areas, access track inundation is up to 2 m deep in the 1% AEP event; some access tracks cross through depressions without outlets, so additional fill or re-routing of the access track alignments may be required. The desired level of flood protection and freeboard may be adjusted with detailed design updates in coordination with the design team.

The relocation of WTGs located in the 1% AEP floodplain is recommended (#10121 and #10201). Alternatively, these WTGs may require additional armouring or raised pads. The most appropriate mitigation will be confirmed in the detailed design stage of the Project. Some ponding up to 20 cm in depth occurs at other WTG and transmission tower locations. The placement of minor fill may be warranted in these areas to facilitate local drainage and reduce required maintenance.

6.2 BESS Impacts

As shown in the maximum depth, velocity, and flood hazard figures, the Project BESS is located outside the 1 in 1,000 AEP floodplain. Local drainage around the Project BESS facilities does not have a discernible impact on the downstream floodplain extents, flow velocities, or runoff volumes.

6.3 Limitations

Model results are based on assumed infiltration rates. A reduction in the assumed initial loss values, reflecting more saturated antecedent conditions or less pervious soils, may result in an increase in the predicted inundation extents. Future gauging and calibration efforts may allow for increased confidence through further refinement of roughness coefficients, infiltration rates, and other parameters.



Vertical discrepancies in the adopted terrain data are generally less than 0.5 m in areas with LiDAR coverage. The hydraulic results are highly sensitive to the adopted terrain data, which has been shown to have vertical discrepancies of up to +/- 5 m in areas with satellite-based coverage outside the detailed terrain coverage area. Detailed LiDAR data covering all project features will be acquired to support detail design.

Roughness coefficients and loss rates were adjusted to provide a reasonable match between the applied rain-on-grid model results and available regional flood estimation procedures. Annual evaporation exceeds annual rainfall by a factor of five in the Project Area. Ponded water levels in internally draining areas are expected to drop relatively rapidly over time through infiltration and evapotranspiration based on the assumed site soil properties. Some additional silts from construction activities may settle in depressions over time, and ongoing maintenance or rehabilitation of exposed slopes may be required during operations.

6.4 Summary

The results show that there are no discernible impacts on downstream inundation extents, peak flow rates, or cumulative flow volumes resulting from the presence of the proposed features; as such, the existing conditions hydraulic results presented in this report are effectively applicable to the project conditions. The difference in maximum water surface elevation between existing and proposed conditions is negligible, indicating that the Project does not affect flood behaviour in a way that is expected to impact surrounding environment or communities.



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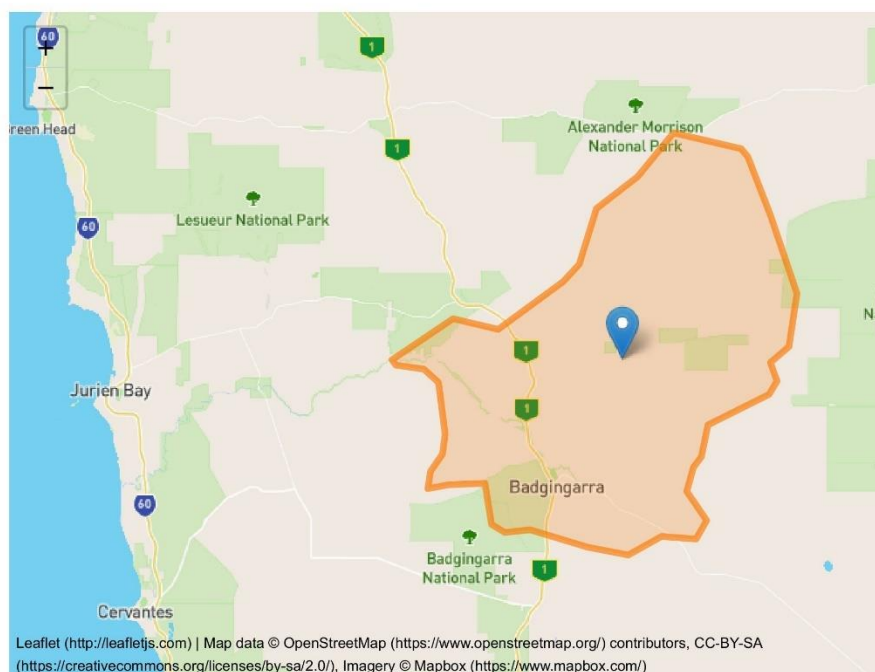
Appendix A: ARR Data Hub and Climate Change



Australian Rainfall & Runoff Data Hub - Results

Input Data

Longitude	115.569
Latitude	-30.276
Selected Regions (clear)	
River Region	show
ARF Parameters	show
Storm Losses	show
Temporal Patterns	show
Areal Temporal Patterns	show
BOM IFDs	show
Median Preburst Depths and Ratios	show
10% Preburst Depths	show
25% Preburst Depths	show
75% Preburst Depths	show
90% Preburst Depths	show
Climate Change Factors	show
Baseflow Factors	show





Data

River Region

Division	South West Coast
River Number	14
River Name	Moore-Hill Rivers
Shape Intersection (%)	100.0

Layer Info

Time Accessed	08 July 2025 03:51PM
Version	2016_v1

ARF Parameters

$$ARF = Min \left\{ 1, \left[1 - a \left(Area^b - c \log_{10} Duration \right) Duration^{-d} \right. \right. \\ \left. \left. + e Area^f Duration^g \left(0.3 + \log_{10} AEP \right) \right. \right. \\ \left. \left. + h 10^{i Area \frac{Duration}{1440}} \left(0.3 + \log_{10} AEP \right) \right] \right\}$$

Zone	a	b	c	d	e	f	g	h	i	Shape Intersection (%)
SW WA	0.183	0.259	0.271	0.33	3.85e-06	0.41	0.55	0.00817	-0.00045	100.0

Short Duration ARF

$$ARF = Min \left[1, 1 - 0.287 \left(Area^{0.265} - 0.439 \log_{10} (Duration) \right) . Duration^{-0.36} \right. \\ \left. + 2.26 \times 10^{-3} \times Area^{0.226} . Duration^{0.125} \left(0.3 + \log_{10} (AEP) \right) \right. \\ \left. + 0.0141 \times Area^{0.213} \times 10^{-0.021 \frac{(Duration-180)^2}{1440}} \left(0.3 + \log_{10} (AEP) \right) \right]$$

Layer Info

Time Accessed	08 July 2025 03:51PM
Version	2016_v1

Storm Losses

Note: Burst Loss = Storm Loss - Preburst

Note: These losses are only for rural use and are **NOT FOR DIRECT USE** in urban areas

Storm Initial Losses (mm)	58.0
Storm Continuing Losses (mm/h)	7.9

Layer Info

Time Accessed	08 July 2025 03:51PM
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Version	2016_v1
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Temporal Patterns | Download (.zip) (static/temporal_patterns/TP/FLTwest.zip)

code	FLTwest
------	---------

Label	Southern and South Western Flatlands (West)
-------	---

Shape Intersection (%)	100.0
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Layer Info

Time Accessed	08 July 2025 03:51PM
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Version	2016_v2
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Areal Temporal Patterns | Download (.zip)
(./static/temporal_patterns/Areal/Areal_FLTwest.zip)

code	FLTwest
------	---------

arealabel	Southern and South Western Flatlands (West)
-----------	---

Shape Intersection (%)	100.0
------------------------	-------

Layer Info

Time Accessed	08 July 2025 03:51PM
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Version	2016_v2
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BOM IFDs

Click here (http://www.bom.gov.au/water/designRainfalls/revised-ifd/?year=2016&coordinate_type=dd&latitude=-30.2763497145&longitude=115.569258443&sadmin=true&schr=true&sdday=true&user=) to obtain the IFD depths for catchment centroid from the BoM website

Layer Info

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Median Preburst Depths and Ratios

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	2.6 (0.168)	3.2 (0.153)	3.6 (0.144)	4.0 (0.136)	4.3 (0.122)	4.6 (0.114)
90 (1.5)	2.4 (0.134)	4.0 (0.168)	5.1 (0.179)	6.1 (0.185)	5.8 (0.143)	5.5 (0.119)
120 (2.0)	1.9 (0.095)	2.8 (0.106)	3.4 (0.108)	3.9 (0.108)	5.3 (0.120)	6.3 (0.125)
180 (3.0)	0.8 (0.034)	2.2 (0.072)	3.1 (0.086)	4.0 (0.094)	4.2 (0.082)	4.4 (0.075)
360 (6.0)	0.3 (0.011)	1.1 (0.029)	1.6 (0.035)	2.2 (0.039)	1.8 (0.026)	1.5 (0.019)
720 (12.0)	0.0 (0.000)	0.1 (0.003)	0.2 (0.004)	0.3 (0.004)	0.9 (0.010)	1.3 (0.013)
1080 (18.0)	0.0 (0.000)	0.0 (0.001)	0.1 (0.001)	0.1 (0.001)	0.4 (0.003)	0.6 (0.005)
1440 (24.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

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Version 2018_v1

Note Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.



10% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
90 (1.5)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
120 (2.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
180 (3.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
360 (6.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
720 (12.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1080 (18.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1440 (24.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

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Version 2018_v1

Note Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.



25% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	0.0 (0.003)	0.1 (0.002)	0.1 (0.002)	0.1 (0.002)	0.2 (0.005)	0.2 (0.006)
90 (1.5)	0.1 (0.003)	0.1 (0.002)	0.0 (0.002)	0.0 (0.001)	0.1 (0.003)	0.2 (0.004)
120 (2.0)	0.0 (0.001)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.1 (0.003)	0.3 (0.005)
180 (3.0)	0.0 (0.000)	0.0 (0.001)	0.0 (0.001)	0.0 (0.001)	0.0 (0.000)	0.0 (0.000)
360 (6.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
720 (12.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1080 (18.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1440 (24.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

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Version 2018_v1

Note Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.



75% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	10.8 (0.698)	12.2 (0.583)	13.1 (0.526)	14.0 (0.480)	15.3 (0.434)	16.3 (0.404)
90 (1.5)	9.3 (0.522)	11.3 (0.474)	12.6 (0.445)	13.9 (0.419)	12.7 (0.317)	11.9 (0.258)
120 (2.0)	10.9 (0.556)	11.7 (0.445)	12.2 (0.390)	12.7 (0.347)	13.8 (0.312)	14.7 (0.289)
180 (3.0)	8.1 (0.357)	9.3 (0.307)	10.1 (0.280)	10.8 (0.257)	11.0 (0.216)	11.2 (0.191)
360 (6.0)	5.2 (0.178)	7.1 (0.184)	8.5 (0.182)	9.7 (0.177)	11.3 (0.169)	12.5 (0.163)
720 (12.0)	3.6 (0.098)	5.1 (0.101)	6.1 (0.101)	7.0 (0.098)	9.1 (0.104)	10.6 (0.105)
1080 (18.0)	3.7 (0.087)	3.5 (0.061)	3.4 (0.049)	3.3 (0.040)	5.1 (0.051)	6.5 (0.056)
1440 (24.0)	2.1 (0.044)	2.5 (0.040)	2.9 (0.037)	3.2 (0.035)	5.2 (0.046)	6.7 (0.052)
2160 (36.0)	0.5 (0.009)	1.3 (0.019)	1.9 (0.022)	2.5 (0.025)	5.6 (0.045)	8.0 (0.055)
2880 (48.0)	0.1 (0.001)	1.9 (0.025)	3.1 (0.034)	4.3 (0.040)	3.8 (0.029)	3.5 (0.023)
4320 (72.0)	0.0 (0.000)	1.6 (0.019)	2.7 (0.027)	3.7 (0.032)	3.2 (0.023)	2.9 (0.018)

Layer Info

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Version 2018_v1

Note Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.



90% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	32.0 (2.072)	31.9 (1.527)	31.8 (1.276)	31.7 (1.088)	31.9 (0.906)	32.1 (0.796)
90 (1.5)	22.7 (1.280)	27.0 (1.133)	29.8 (1.051)	32.6 (0.980)	37.8 (0.941)	41.7 (0.907)
120 (2.0)	23.0 (1.175)	24.1 (0.920)	24.8 (0.796)	25.6 (0.699)	33.4 (0.754)	39.2 (0.772)
180 (3.0)	18.9 (0.837)	23.8 (0.790)	27.1 (0.754)	30.2 (0.718)	32.2 (0.630)	33.7 (0.574)
360 (6.0)	19.3 (0.665)	23.5 (0.604)	26.3 (0.565)	29.0 (0.529)	30.7 (0.460)	32.0 (0.416)
720 (12.0)	21.1 (0.566)	20.2 (0.401)	19.7 (0.325)	19.1 (0.268)	23.8 (0.272)	27.4 (0.270)
1080 (18.0)	14.4 (0.337)	14.7 (0.254)	14.9 (0.214)	15.1 (0.184)	20.3 (0.201)	24.3 (0.206)
1440 (24.0)	21.0 (0.452)	16.3 (0.257)	13.1 (0.172)	10.1 (0.112)	19.1 (0.172)	25.9 (0.200)
2160 (36.0)	23.1 (0.445)	21.7 (0.307)	20.9 (0.245)	20.0 (0.200)	25.2 (0.203)	29.1 (0.200)
2880 (48.0)	11.9 (0.213)	18.3 (0.241)	22.5 (0.248)	26.6 (0.250)	27.6 (0.209)	28.3 (0.183)
4320 (72.0)	5.9 (0.096)	12.3 (0.149)	16.5 (0.169)	20.6 (0.181)	25.7 (0.182)	29.4 (0.180)

Layer Info

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Version 2018_v1

Note Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.



Climate Change Factors

Rainfall Factors

SSP1-2.6

Year	<1 hour	1.5 Hours	2 Hours	3 Hours	4.5 Hours	6 Hours	9 Hours	12 Hours	18 Hours	>24 Hours
2030	1.18	1.17	1.16	1.14	1.13	1.12	1.12	1.11	1.1	1.1
2040	1.21	1.19	1.17	1.16	1.15	1.14	1.13	1.12	1.11	1.11
2050	1.22	1.2	1.18	1.17	1.15	1.15	1.14	1.13	1.12	1.11
2060	1.23	1.21	1.2	1.18	1.17	1.16	1.15	1.14	1.13	1.12
2070	1.24	1.22	1.2	1.18	1.17	1.16	1.15	1.14	1.13	1.12
2080	1.23	1.21	1.2	1.18	1.17	1.16	1.15	1.14	1.13	1.12
2090	1.23	1.21	1.2	1.18	1.17	1.16	1.15	1.14	1.13	1.12
2100	1.22	1.2	1.19	1.17	1.16	1.15	1.14	1.13	1.12	1.12

SSP2-4.5

Year	<1 hour	1.5 Hours	2 Hours	3 Hours	4.5 Hours	6 Hours	9 Hours	12 Hours	18 Hours	>24 Hours
2030	1.18	1.17	1.16	1.14	1.13	1.12	1.12	1.11	1.1	1.1
2040	1.22	1.2	1.19	1.17	1.16	1.15	1.14	1.13	1.12	1.12
2050	1.27	1.24	1.23	1.21	1.19	1.18	1.17	1.16	1.15	1.14
2060	1.3	1.27	1.25	1.23	1.21	1.2	1.19	1.18	1.16	1.16
2070	1.33	1.3	1.28	1.26	1.24	1.22	1.21	1.19	1.18	1.17
2080	1.37	1.33	1.31	1.28	1.26	1.24	1.22	1.21	1.2	1.19
2090	1.4	1.36	1.34	1.31	1.28	1.26	1.24	1.23	1.21	1.2
2100	1.41	1.37	1.35	1.32	1.29	1.27	1.25	1.24	1.22	1.21

SSP3-7.0

Year	<1 hour	1.5 Hours	2 Hours	3 Hours	4.5 Hours	6 Hours	9 Hours	12 Hours	18 Hours	>24 Hours
2030	1.18	1.17	1.16	1.14	1.13	1.12	1.12	1.11	1.1	1.1
2040	1.23	1.21	1.2	1.18	1.17	1.16	1.15	1.14	1.13	1.12
2050	1.29	1.26	1.24	1.22	1.2	1.19	1.18	1.17	1.16	1.15
2060	1.35	1.32	1.3	1.27	1.25	1.23	1.22	1.2	1.19	1.18
2070	1.42	1.38	1.35	1.32	1.29	1.28	1.26	1.24	1.22	1.21
2080	1.5	1.45	1.42	1.38	1.35	1.33	1.3	1.28	1.26	1.25
2090	1.59	1.53	1.49	1.44	1.4	1.38	1.35	1.33	1.3	1.29
2100	1.66	1.59	1.55	1.5	1.45	1.42	1.39	1.37	1.34	1.32



SSP5-8.5

Year	<1 hour	1.5 Hours	2 Hours	3 Hours	4.5 Hours	6 Hours	9 Hours	12 Hours	18 Hours	>24 Hours
2030	1.2	1.18	1.17	1.16	1.14	1.13	1.13	1.12	1.11	1.11
2040	1.26	1.24	1.22	1.2	1.18	1.17	1.16	1.15	1.14	1.14
2050	1.34	1.31	1.29	1.26	1.24	1.23	1.21	1.2	1.18	1.18
2060	1.42	1.38	1.35	1.32	1.29	1.28	1.26	1.24	1.22	1.21
2070	1.52	1.47	1.43	1.4	1.36	1.34	1.31	1.29	1.27	1.26
2080	1.63	1.57	1.52	1.48	1.43	1.4	1.37	1.35	1.33	1.31
2090	1.77	1.69	1.64	1.58	1.52	1.49	1.45	1.42	1.39	1.37
2100	1.86	1.77	1.71	1.64	1.58	1.54	1.5	1.47	1.43	1.41

Loss Factors

Initial Loss (Adjustment Factors)

	Losses SSP1-2.6	Losses SSP2-4.5	Losses SSP3-7.0	Losses SSP5-8.5
2030	1.05	1.05	1.05	1.06
2040	1.06	1.06	1.07	1.08
2050	1.07	1.08	1.08	1.1
2060	1.07	1.09	1.1	1.12
2070	1.07	1.1	1.12	1.14
2080	1.07	1.1	1.14	1.17
2090	1.07	1.11	1.16	1.19
2100	1.07	1.11	1.17	1.22

Continuing Loss (Adjustment Factors)

	Losses SSP1-2.6	Losses SSP2-4.5	Losses SSP3-7.0	Losses SSP5-8.5
2030	1.07	1.07	1.07	1.07
2040	1.08	1.08	1.09	1.09
2050	1.08	1.09	1.1	1.12
2060	1.09	1.11	1.12	1.15
2070	1.09	1.12	1.15	1.18
2080	1.09	1.13	1.17	1.21
2090	1.08	1.14	1.2	1.24
2100	1.08	1.14	1.22	1.27

Temperature Changes (Degrees, Relative to 1961-1990 Baseline)



Year	SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
2030	1.2	1.2	1.2	1.3
2040	1.3	1.4	1.5	1.6
2050	1.4	1.7	1.8	2.1
2060	1.5	1.9	2.2	2.5
2070	1.5	2.1	2.5	3
2080	1.5	2.2	2.9	3.5
2090	1.5	2.4	3.3	4.1
2100	1.4	2.5	3.6	4.5

Layer Info

Time Accessed 08 July 2025 03:51PM

Version 2024_v1

Note Updated climate change factors for IFD Initial loss and continuing loss based on IPCC AR6 temperature increases from the updated Climate Change Considerations (Book 1: Chapter 6) in ARR (Version 4.2). ARR recommends the use of Current and near-term (2030 midpoint), Medium-term (2050 midpoint) and Long-term (2090 midpoint)

Baseflow Factors

Downstream 8555

Area (km2) 781.970432

Catchment Number 8541

Volume Factor 0.198022

Peak Factor 0.141544

Shape Intersection (%) 77.3

Layer Info

Time Accessed 08 July 2025 03:51PM

Version 2016_v1



Appendix B: Regional Flood Frequency Estimation Results

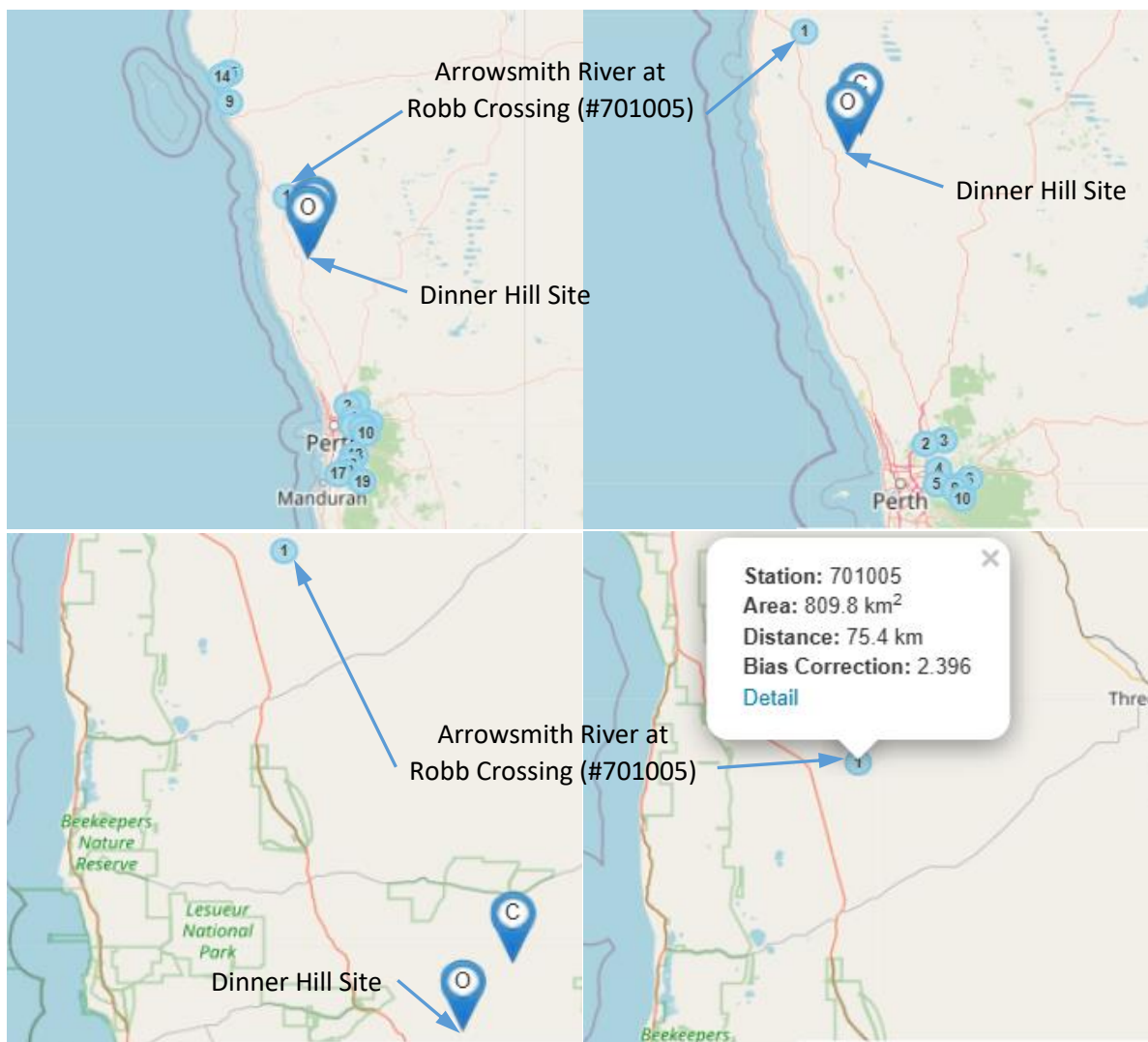
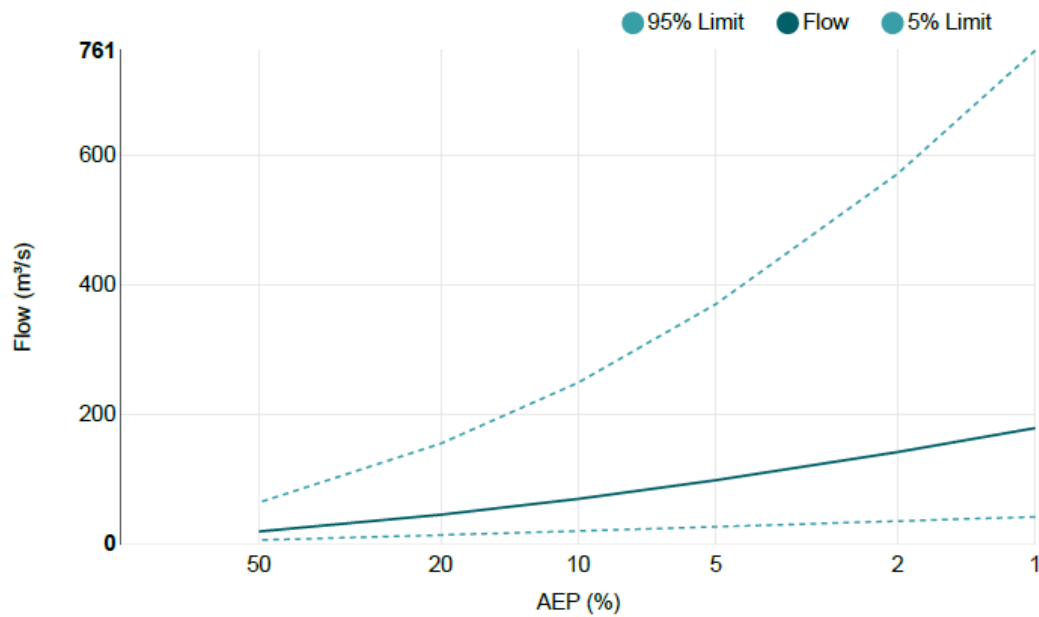


Figure B-1. RFFE 2015 gauge locations



Dinner Hill RFFE 2015

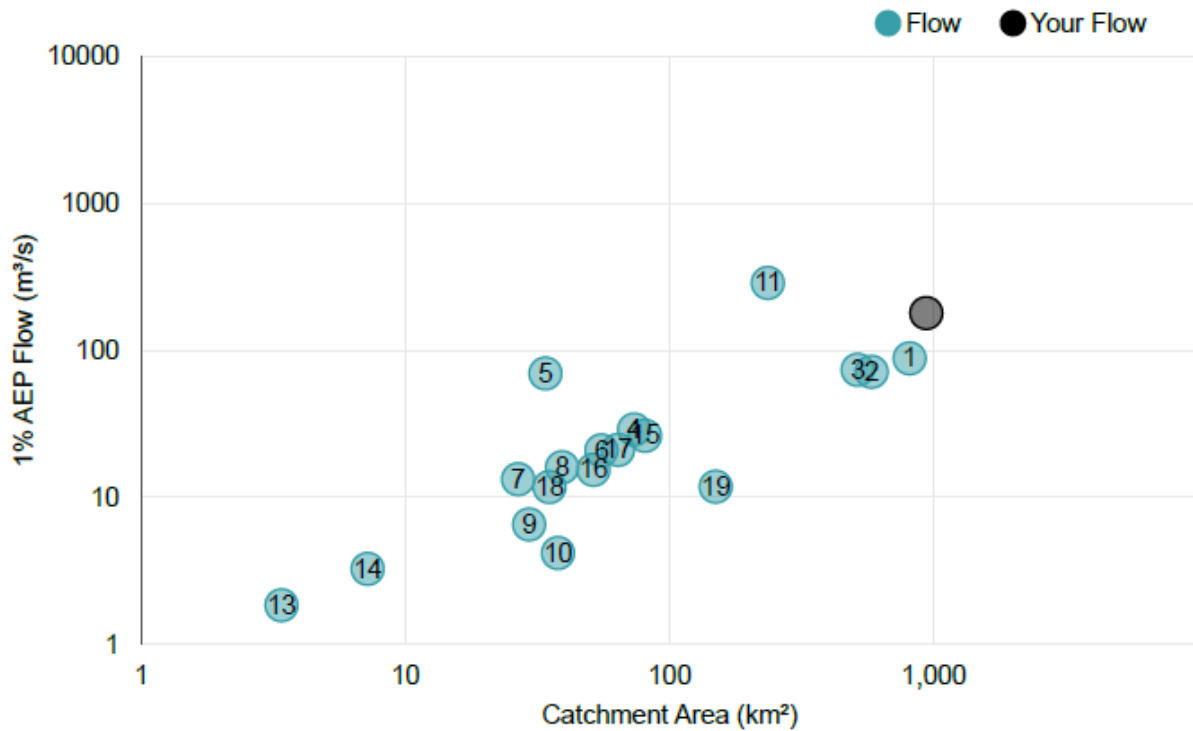
Results | Regional Flood Frequency Estimation Model



AEP (%)	Discharge (m³/s)	Lower Confidence Limit (5%) (m³/s)	Upper Confidence Limit (95%) (m³/s)
50	19.5	6.23	64.1
20	45.4	14.1	155
10	69.8	20.3	249
5	98.6	26.8	370
2	142	35.6	571
1	179	42.2	761



1% AEP Flow vs Catchment Area

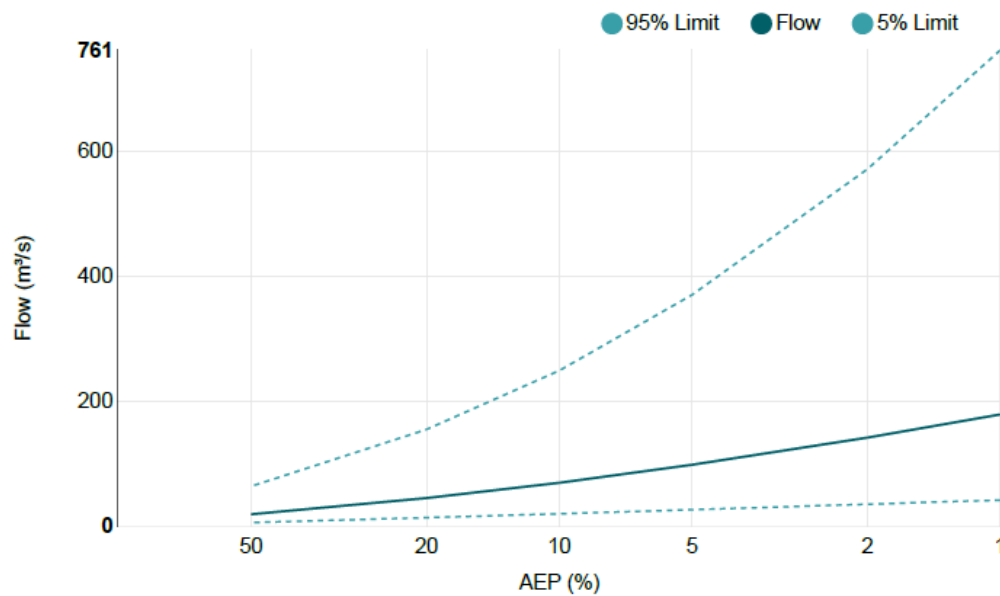


Catchment Name	Dinner East
Latitude (Outlet)	-30.27666
Longitude (Outlet)	115.33183
Latitude (Centroid)	-30.27597
Longitude (Centroid)	115.56957
Catchment Area (km ²)	936.0
Distance to Nearest Gauged Catchment (km)	73.13
50% AEP 6 Hour Rainfall Intensity (mm/h)	4.801115
2% AEP 6 Hour Rainfall Intensity (mm/h)	10.988425
Rainfall Intensity Source (User/Auto)	Auto
Region	Fringe SW WA & Pilbara
Region Version	RFFE Model 2016 v1
Region Source (User/Auto)	Auto
Shape Factor	0.75
Interpolation Method	Natural Neighbour
Bias Correction Value	1.979



Dinner Hill East RFFE 2015

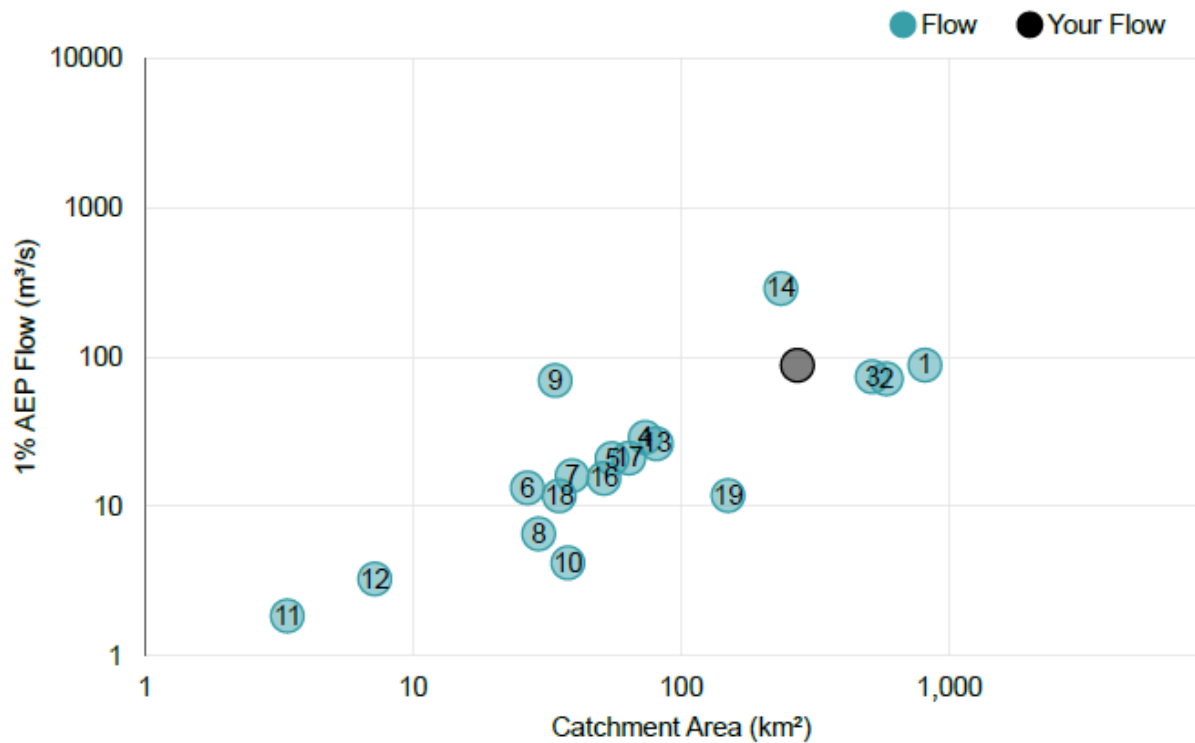
Results | Regional Flood Frequency Estimation Model



AEP (%)	Discharge (m³/s)	Lower Confidence Limit (5%) (m³/s)	Upper Confidence Limit (95%) (m³/s)
50	19.5	6.23	64.1
20	45.4	14.1	155
10	69.8	20.3	249
5	98.6	26.8	370
2	142	35.6	571
1	179	42.2	761



1% AEP Flow vs Catchment Area

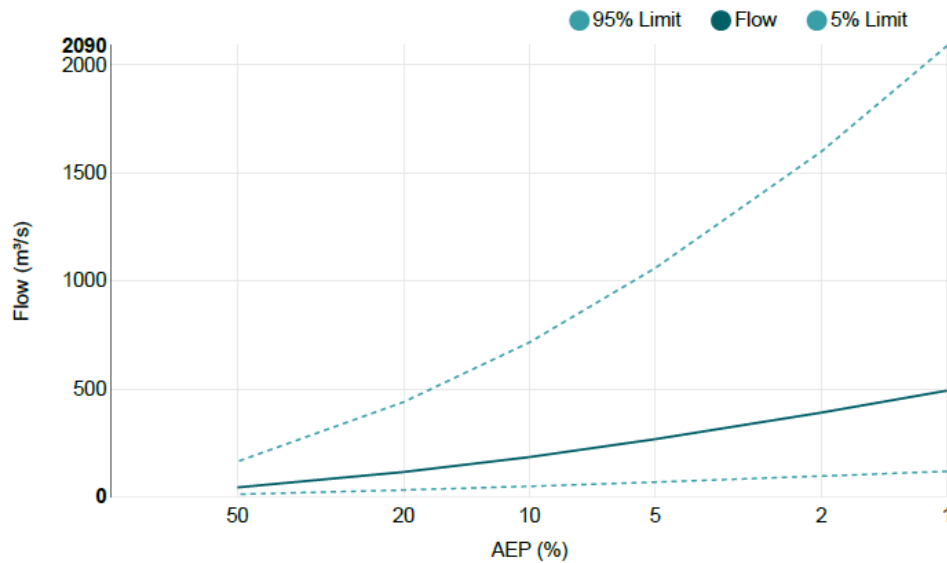


Catchment Name	Dinner East
Latitude (Outlet)	-30.2574
Longitude (Outlet)	115.55645
Latitude (Centroid)	-30.16719
Longitude (Centroid)	115.62995
Catchment Area (km ²)	271.0
Distance to Nearest Gauged Catchment (km)	75.38
50% AEP 6 Hour Rainfall Intensity (mm/h)	4.782211
2% AEP 6 Hour Rainfall Intensity (mm/h)	11.314019
Rainfall Intensity Source (User/Auto)	Auto
Region	Fringe SW WA & Pilbara
Region Version	RFFE Model 2016 v1
Region Source (User/Auto)	Auto
Shape Factor	0.75
Interpolation Method	Natural Neighbour
Bias Correction Value	1.979



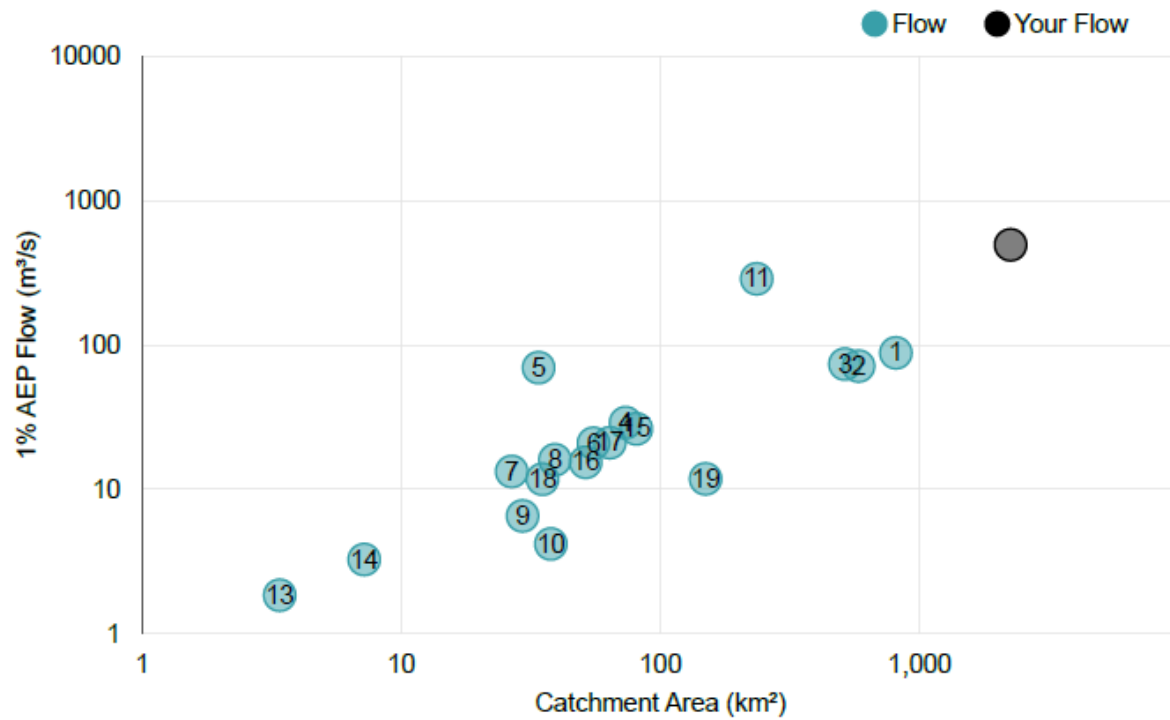
Dinner Hill North RFFE 2015

Results | Regional Flood Frequency Estimation Model



*The catchment is outside the recommended catchment size of 0.5 to 1,000 km². Results have lower accuracy and may not be directly applicable in practice.

AEP (%)	Discharge (m ³ /s)	Lower Confidence Limit (5%) (m ³ /s)	Upper Confidence Limit (95%) (m ³ /s)
50	44.5	12.7	164
20	116	32.4	440
10	185	49.8	716
5	268	69.4	1060
2	391	97.0	1600
1	493	119	2090



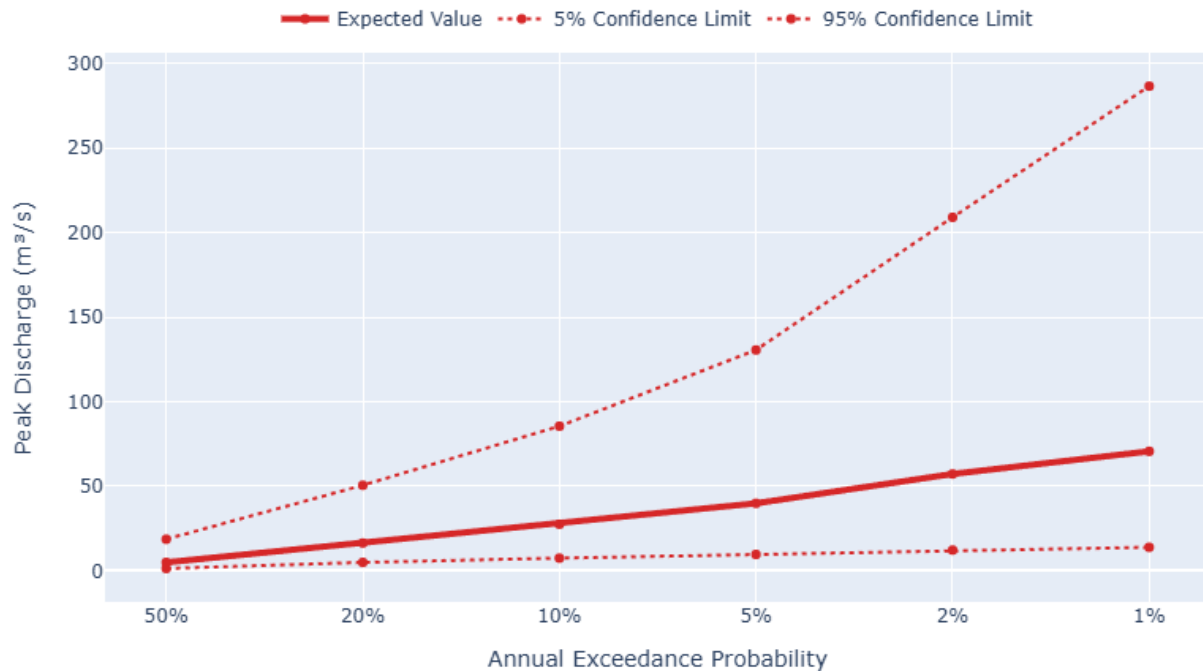
Catchment Name	Dinner North
Latitude (Outlet)	-30.27003
Longitude (Outlet)	115.33507
Latitude (Centroid)	-29.93352
Longitude (Centroid)	115.5117
Catchment Area (km ²)	2243.0*
Distance to Nearest Gauged Catchment (km)	72.41
50% AEP 6 Hour Rainfall Intensity (mm/h)	4.882739
2% AEP 6 Hour Rainfall Intensity (mm/h)	11.722615
Rainfall Intensity Source (User/Auto)	Auto
Region	Fringe SW WA & Pilbara
Region Version	RFFE Model 2016 v1
Region Source (User/Auto)	Auto
Shape Factor	0.87
Interpolation Method	Natural Neighbour
Bias Correction Value	1.983



Figure B-2. RFFE 2021 gauge locations (beta only)



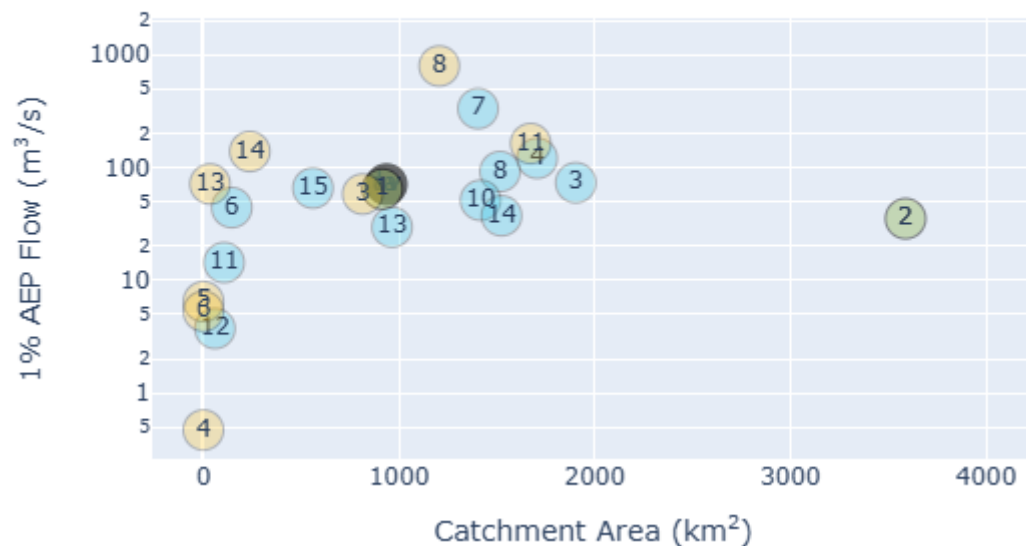
Dinner Hill RFFE 2021



AEP (%)	Expected Value (m³/s)	Lower Confidence Limit (m³/s)	Upper Confidence Limit (m³/s)
50%	5.00	1.41	18.72
20%	16.46	5.01	50.63
10%	27.57	7.53	85.55
5%	39.94	9.71	130.62
2%	57.30	12.29	209.05
1%	70.69	13.95	286.60

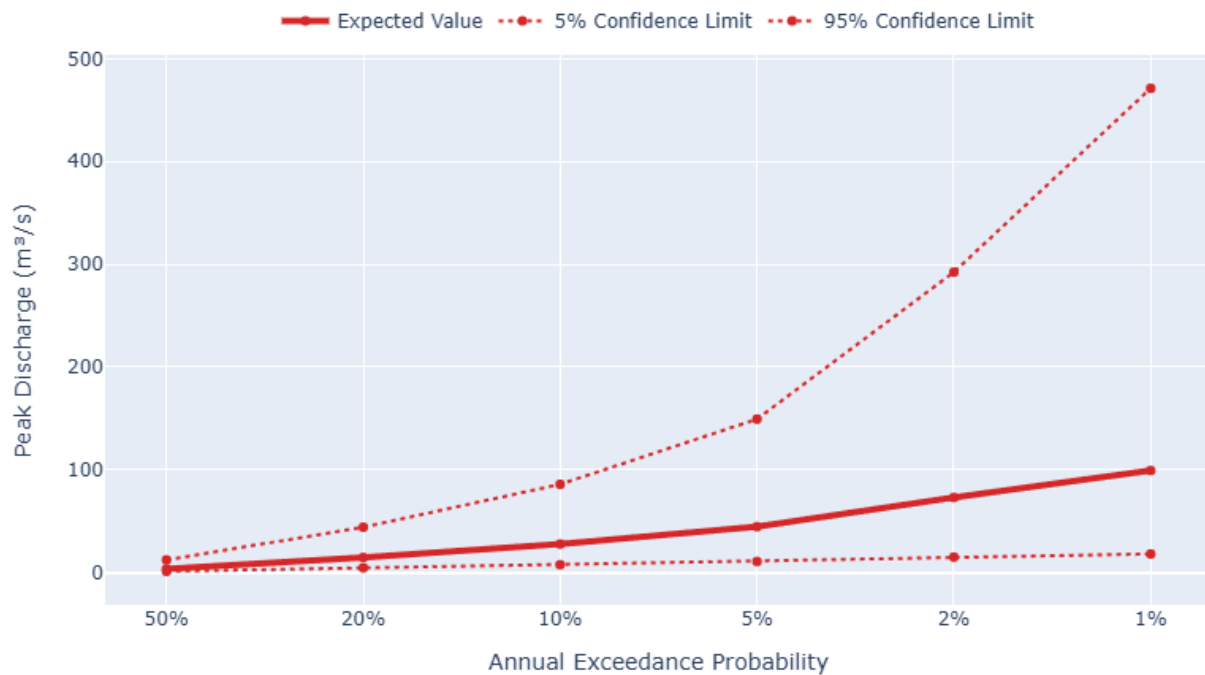
1% AEP Flow vs Catchment Area

Aa Chosen Catchment Aa Region 5 - Surrounding Stations
Aa Region 6 - Surrounding Stations





Dinner Hill East RFFE 2021



AEP (%)	Expected Value (m^3/s)	Lower Confidence Limit (m^3/s)	Upper Confidence Limit (m^3/s)
50%	3.34	0.99	12.14
20%	14.51	4.43	43.96
10%	27.57	7.45	85.70
5%	44.49	10.62	149.13
2%	72.89	14.89	292.19
1%	99.15	17.91	471.11

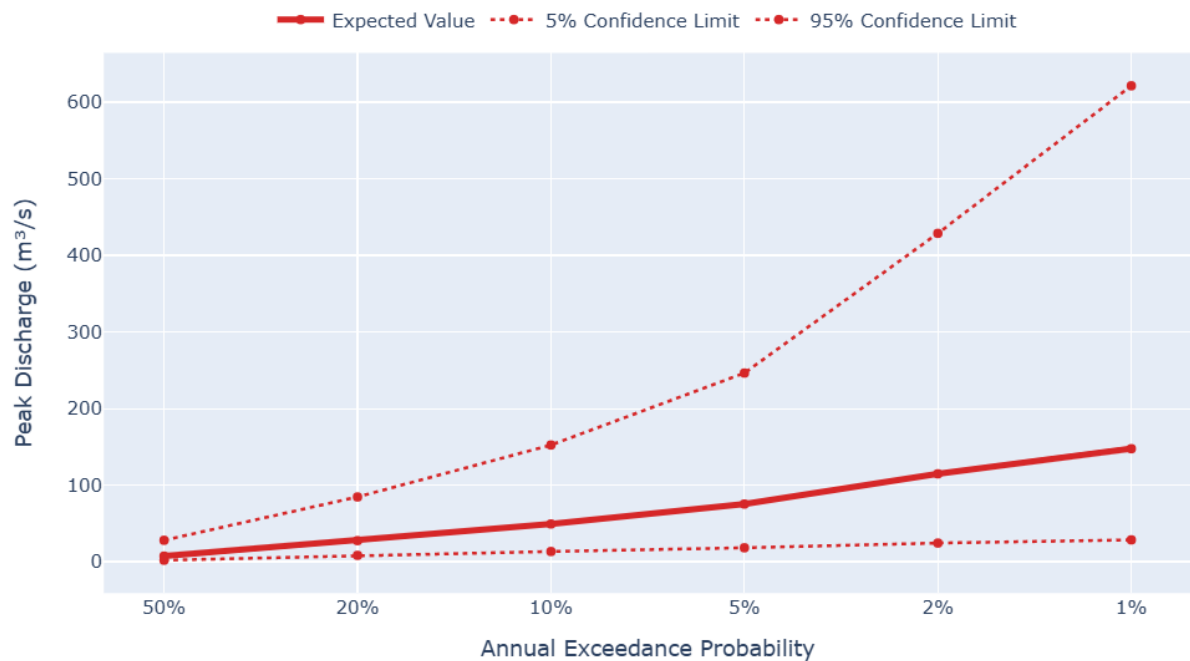
1% AEP Flow vs Catchment Area

- Aa Chosen Catchment Aa Region 5 - Surrounding Stations
Aa Region 6 - Surrounding Stations



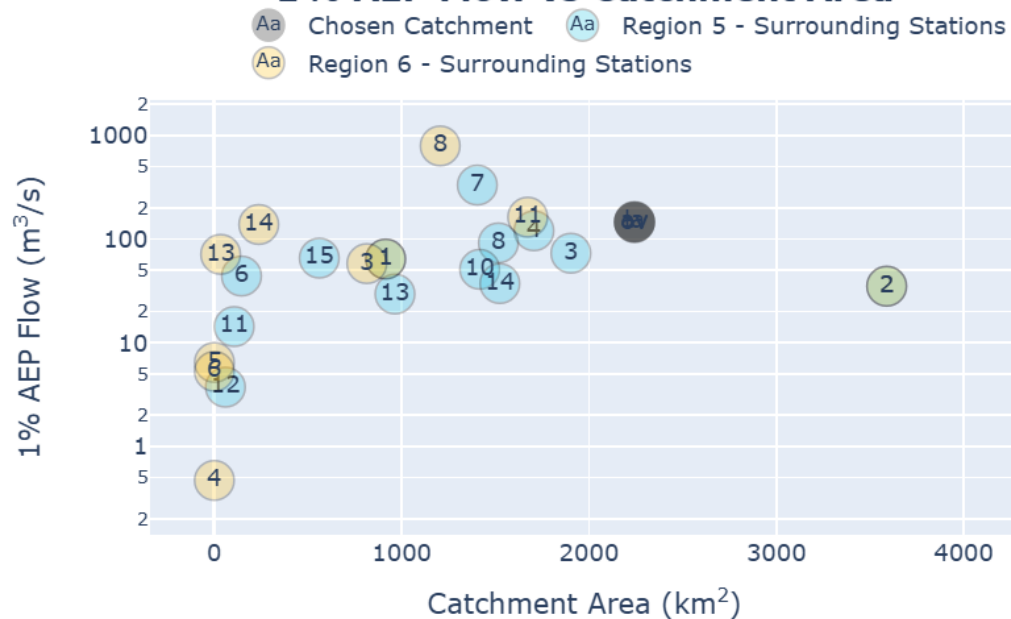


Dinner Hill North RFFE 2021



AEP (%)	Expected Value (m³/s)	Lower Confidence Limit (m³/s)	Upper Confidence Limit (m³/s)
50%	7.44	2.09	28.13
20%	27.65	8.43	84.69
10%	49.39	13.48	152.49
5%	75.42	18.30	246.47
2%	114.87	24.49	428.82
1%	147.65	28.66	621.50

1% AEP Flow vs Catchment Area





Appendix C: Flood Frequency Analysis Results



Arrowsmith River (814 km²)

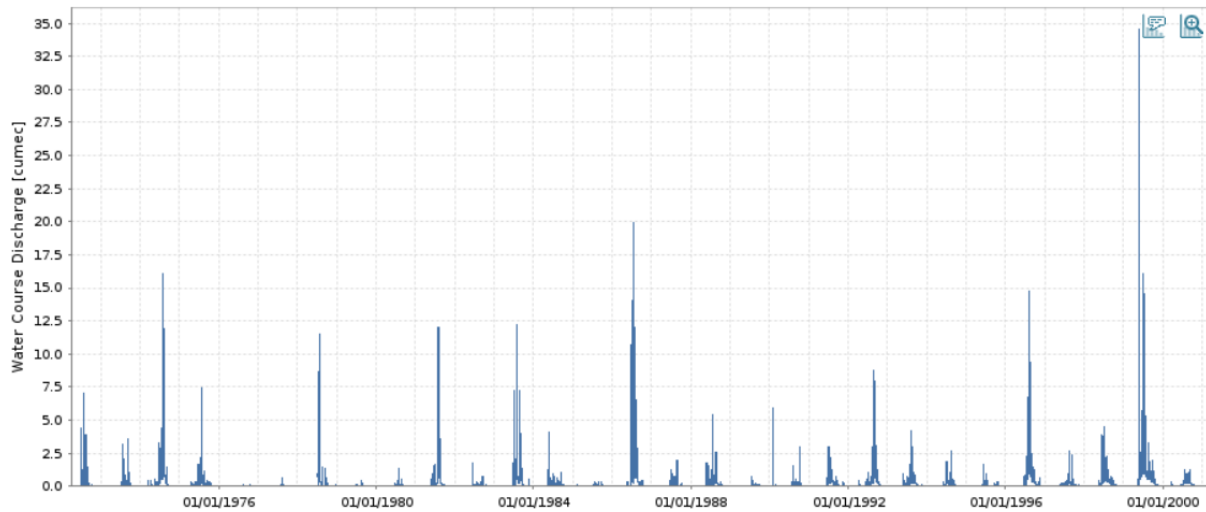


Figure C-1. Arrowsmith River mean daily discharge record

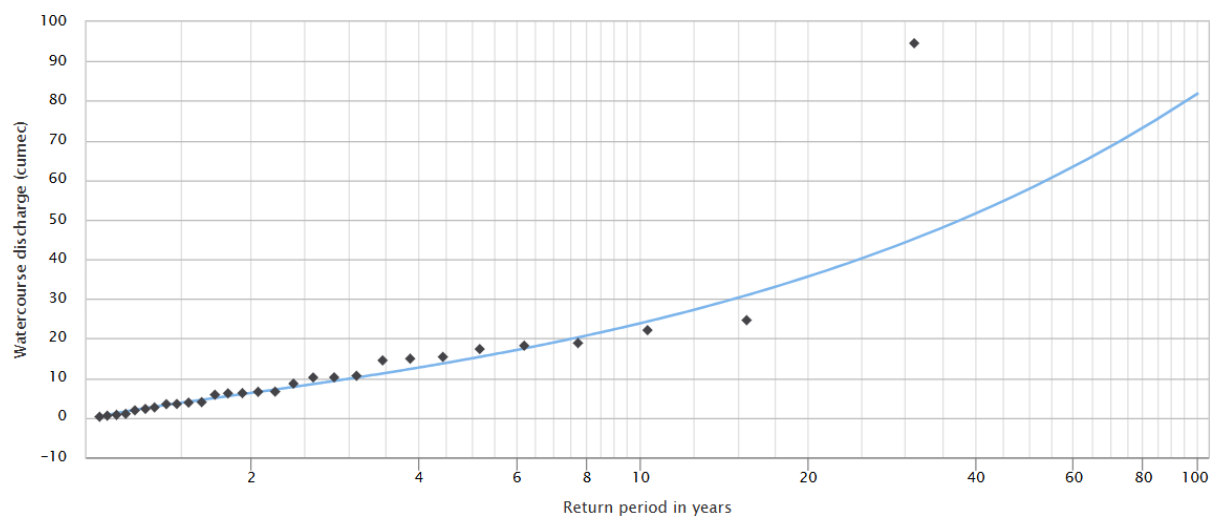


Figure C-2. Arrowsmith River flood frequency analysis



Hill River Gauge (915 km²)

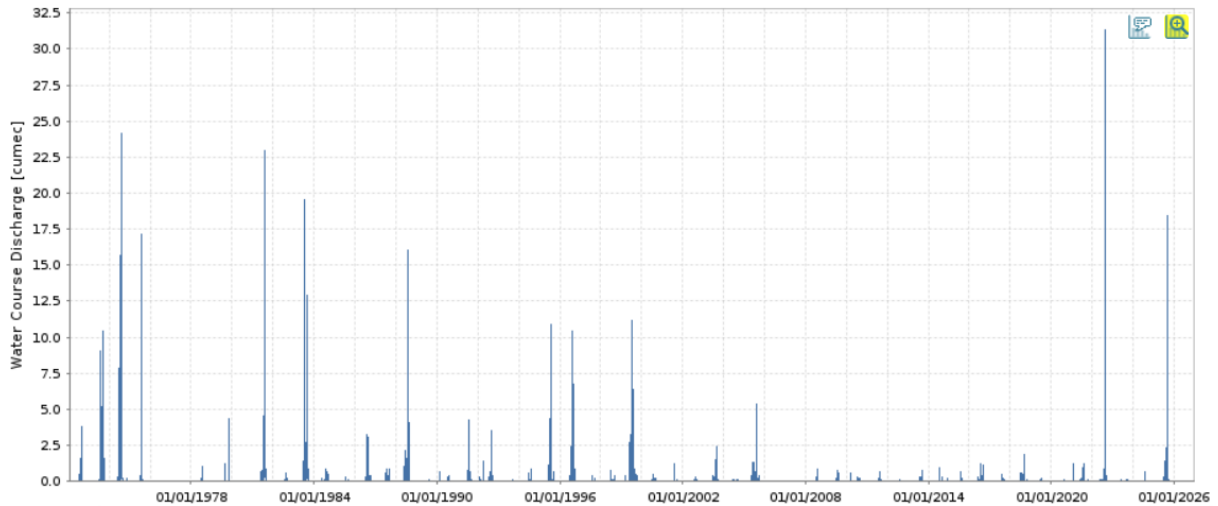


Figure C-3. Hill River mean daily discharge record

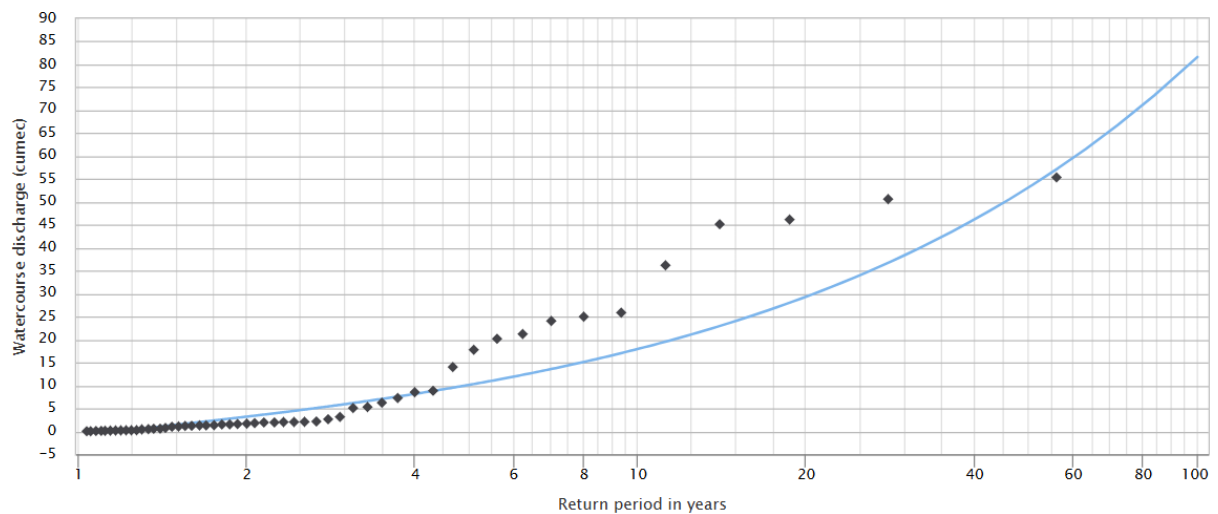


Figure C-4. Hill River flood frequency analysis