



Muckaty Solar and Wind Farm

Muckaty Station Flood Study

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Executive Summary

The Muckaty Station Flood Study has been undertaken as part of Suncable's Australia-Asia Power Link Project. The study investigates existing flow paths across Muckaty Station at different Annual Exceedance Probabilities (AEPs) to guide high-level planning, cultural heritage and environmental protection works.

The study involved the development of hydrologic and hydraulic models covering Muckaty Station and upstream catchments. The hydrologic and hydraulic models were then used to develop flood height, depth and velocity maps for a range of design flood events. This report details the flood study methodology, assumptions, findings and recommendations. The associated flood risk mapping was provided electronically as GIS compatible files.

A summary of the predicted flooding impacts across the Muckaty Station catchments is provided in *Table 0-1*.

It is recommended that further model calibration, verification and sensitivity analysis is undertaken to support any future detailed design works as more site-specific data becomes available.

Table 0-1 Flooding Assessment for Muckaty Station

Event	Indicative Rainfall	Description
10% AEP	140 mm in 24 hours 180 mm in 48 hours	<ul style="list-style-type: none"> Significant inundation and ponding around flatter areas of the site, particular surrounding claypan areas with a mapped land-use as 'marshland' (evident as having standing water based on the available aerial imagery). Flow in western parts of the site broadly confined to mapped major channels.
1% AEP	240 mm in 24 hours 310 mm in 48 hours	<ul style="list-style-type: none"> Major breakouts from Tomkinson Creek with depths up to 1m across broad claypan areas, shallower depths elsewhere across site. Significant inundation of the rail-line and surrounding flat areas. Significant flow velocities (up to 2 m/s) to upper catchment areas.
0.5% AEP	280 mm in 24 hours 360 mm in 48 hours	<ul style="list-style-type: none"> Major breakouts from Tomkinson Creek and in western station areas. Lagoonal/marshland inundation across the Solar Area of over 1m depths. High velocity flows in proposed wind farm (steeper) areas.
0.2% AEP	330 mm in 24 hours 425 mm in 48 hours	<ul style="list-style-type: none"> Significant inundation across catchment area. High velocity flows across many major flowpaths.

1.2 Scope of Works

The scope of works for this study included:

- Compile the available data to support an evaluation of key drainage features across the catchment which could potentially impact flood levels for significant events
- Develop a hydrologic model of the focus catchment based on ARR2019 Guidelines to determine critical catchment inflows for the 10%, 1%, 0.2% and 0.5% Annual Exceedance Probability (AEP) flood events,
- Develop a hydraulic model of the project area which represents key flow paths and drainage features,
- Develop flood height, depth and velocity maps for design flood events under existing conditions,
- Verify the model using the available data.

1.3 Data and Information Provided

1.3.1 Spatial Data

Suncable provided the following input spatial data for this study:

- 1m grid DEM for the extent of Muckaty Station. No detailed metadata was supplied with the DEM however the data is understood to comprise of aerial LiDAR or photogrammetry survey captured during December-January 2025.
- Photos and dimensions of major structures located along the Darwin-Adelaide Rail line from recent site visits.

Additional publicly available data was sourced to support the study as follows:

- Shuttle Radar topography at a 30 m resolution and accuracy +/- 10m
- Digital cadastral database containing property boundaries and land-use data (as at December 2024)

There were no historical records of measured rainfall or water level data recorded within the vicinity of the catchment available for this study.

1.3.2 Previous Studies

Detailed flood modelling and mapping of Muckaty Station has not previously been undertaken. A previous surface water hydrological investigation of the Lake Woods catchment was undertaken as part of the *Australia-Asia Power Link Environmental Impact Statement* (February, 2022 – Appendix N).

As part of the study HEC-HMS modelling was undertaken for the three major catchments leading to Lake Woods (i.e. Newcastle Waters, Newcastle Creek and catchments to the south of Lake Woods). Flood inundation mapping for Lake Woods was undertaken using a combination of static GIS methods and hydrologic modelling. Design events up to the 0.1 (1 in 1000) Annual Exceedance Probability (AEP) were considered.

2.0 Hydrologic Model Development

2.1 Overview

A new hydrological runoff-routing model was developed to estimate flows through Muckaty Station catchment for a range of durations and AEPs. The 2019 Australian Rainfall-Runoff Guidelines (ARR2019) were followed to derive appropriate inputs to the hydrologic model, as described in the following section.

2.2 Site Drainage Overview

The Muckaty Station catchment is located at the southernmost extent of the much larger Lake Woods inland sub-basin. Lake Woods is a terminating freshwater lake, with its losses being only from evaporation and infiltration. The region drains to the north to Lake Woods via an ephemeral waterway, Tomkinson Creek, which flows approximately south-east to north-west across Muckaty Station. Northern parts of the station are drained by Burke Creek upstream of its confluence with Tomkinson Creek (

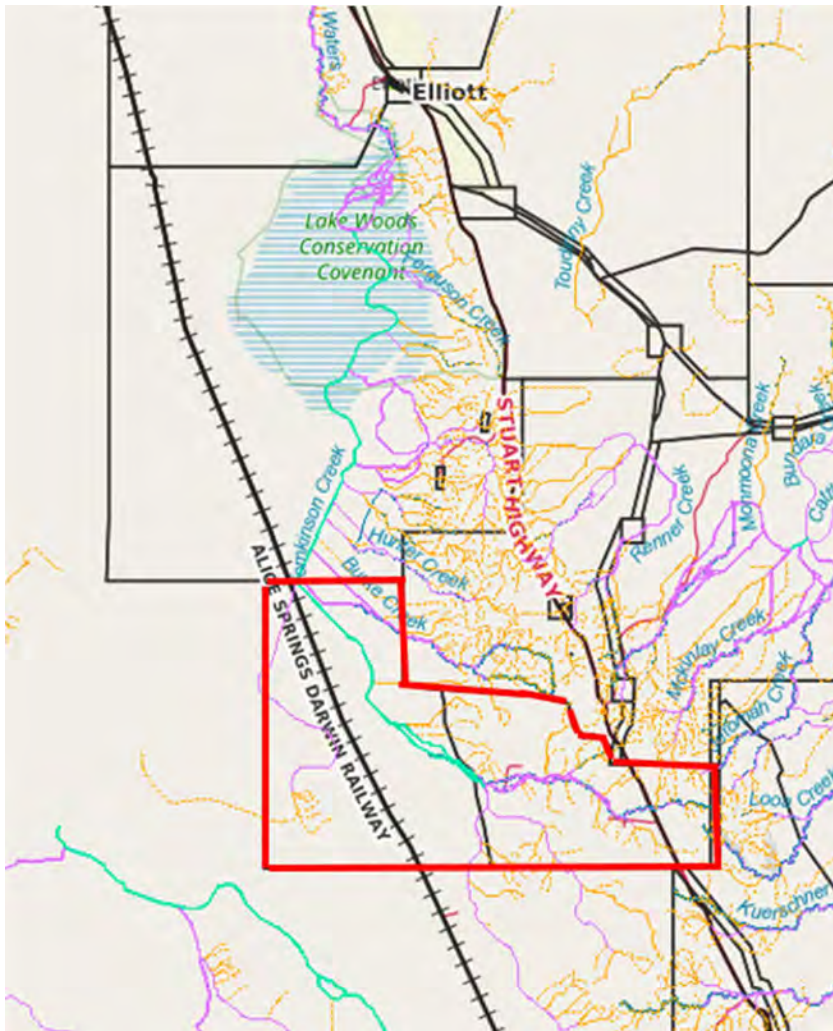


Figure 1-1).

The Muckaty area is predominately native scrubland and spinifex grasslands. The eastern parts of the station form a stony plateau within the Ashburton Range. The central parts are flat and include marsh/claypan wetlands, while to the west are stony ridges.

There has been some modification to the natural drainage characteristics of the project site, in particular due to the construction of the Adelaide-Darwin rail-line and the Stuart Highway. These two major transport alignments cross the station to the west to the east, respectively (

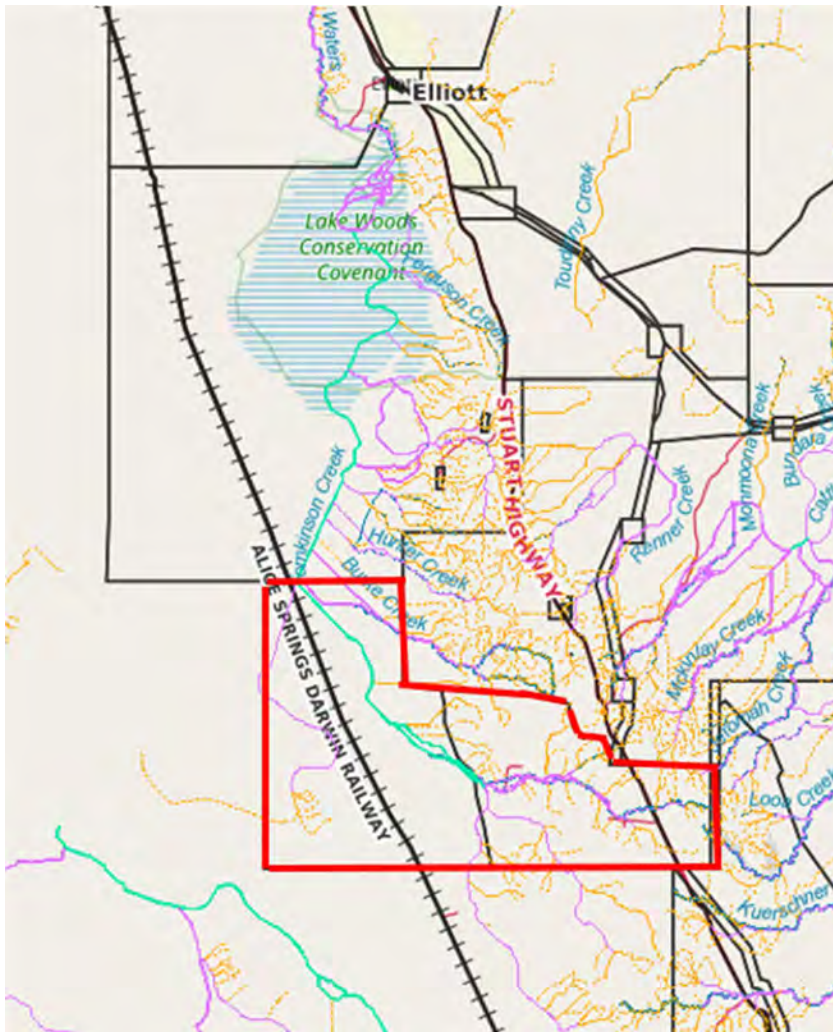


Figure 1-1). The embankment and drainage structures of the Adelaide-Darwin rail-line are a key hydraulic control through the flatter eastern parts of the station.

The region is semi-arid with a distinct wet season between January and March, during which the area receives monthly rainfall in the order of 50-125 millimetres. For the rest of the year the monthly rainfall is usually less than 10 millimetres.

2.3 Hydrologic Model

Catchment delineation was undertaken for the study area, as shown in **Error! Reference source not found.**. A RORB (v6.4.5) hydrologic model was developed for the site and an overview of the model parameters is provided in **Error! Reference source not found.**. The representative Design Rainfall Intensities (IFI) were sourced from the Bureau of Meteorology for the study catchment and are provided in *Table 2-2*.

The RORB model parameters required for each subcatchment are:

- Sub-catchment area
- Sub-catchment fraction impervious,
- Kc and m routing parameters.

The sub-catchment areas were determined via GIS software and the predominately rural catchment was assumed as 100% pervious, although it is noted that a significant portion of the Muckaty Station area is marshland. A standard 'm'

parameter of 0.8 was assumed, and a ‘k’ value of 128 was adopted based on the Dyer (1994) Australia-wide RORB equation.

Regional loss values for the site from the ARR19 data hub indicate initial loss value of 72 mm and a continuing loss in the order of 10 mm/hr for this rural study area. There are no streamflow gauging sites within the Tomkinson Creek catchment area or nearby in order to verify losses and calibrate the hydrologic model. The model was initially run with the standard data hub loss values and the results were then verified by comparing the predicted design flow estimates to a Regional Flood Frequency Estimate (RFFE).



Figure 2-1 Catchment Delineation Map

Table 2-1 Design Model Parameters

Hydrologic Model Parameter	Value
Software	RORB (v6.4.5)
Kc, m	128, 0.8
Design Initial Loss	40 mm (0 mm for 0.2/0.5%AEP)
Design Continuing Loss (Pervious)	2.2 mm/hr
Assessment Approach	ARR2019
BOM IFD	2016 (Refer Table 2-2)

Temporal Pattern Approach	Ensemble – Areal Temporal Patterns with smoothing applied to remove embedded bursts
Critical Temporal Pattern Selection	Median Temporal Pattern
Pre-burst	Median
AEP's assessed	10%, 1%, 0.5%, 2% AEP
Critical duration @ Tomkinson Creek inflow to site	24 hrs (TP08)

Table 2-2 Bureau of Meteorology IFDs (2016)

Duration	Water Depth- mm							
	9h	12h	18h	24h	30h	36h	48h	72h
10% AEP	105	115	129	142	152	162	177	201
1% AEP	167	186	216	240	261	278	307	348
0.2% AEP	195	216	251	278	303	324	356	399
0.5% AEP	231	256	297	331	361	386	424	472

2.3.1 Climate Change Impacts

Climate change projections indicate that there is a high likelihood of a future increase in rainfall intensity due to the impacts of global warming. Guidance that is provided in ARR2019 applies for climate change projections out to 2090 for design flood estimation. Whilst there is a significant amount of uncertainty in climate change estimates, an understanding of the potential impacts of increased rainfall intensities for large flood events is useful for planning purposes.

A climate change sensitivity assessment was undertaken based on outputs from the CSIRO Climate Futures Tool recommended by ARR2019 for the Representative Concentration Pathways (RCP) 4.5-8.5 scenarios for the year 2090. Increased inflows were simulated with the hydrologic and hydraulic model for the 10% and 1% AEP flood events in-line with the latest ARR guidance.

2.4 Model Verification

2.4.1 Regional Flood Frequency Estimate

The model predictions initially underestimated RFFE peak flow values by more than 10%, therefore reduced losses were adopted in order to increase predicted catchment inflows. A 40 mm initial loss and a 2.2 mm/hr continuing loss were adopted for the final hydraulic model runs, it is noted that this was also the case in the previously developed regional flood study for Lake Woods (refer Section 1.3.2).

2.4.2 Joint hydrologic/hydraulic modelling

A regional scale hydraulic model was developed and jointly verified with the RORB model to estimate the magnitude of catchment flows through the site during the 1% AEP flood event and determine appropriate inflow and outflow boundaries to the fine-scale model. The model assumed a single Manning roughness of 0.05 and a 60 m grid cell size (based on the resolution of the available SRTM topographic data).

3.0 Solar Farm Site Hydraulic Modelling

3.1 Overview

A fine-scale two-dimensional hydraulic model was developed to represent the Muckaty Station catchment area. All known pipe drainage structures having an equivalent cross-sectional area greater than, or equal to, that of a 900 mm diameter pipe were included as 1-dimensional elements to better represent sub-grid catchment flows and structure hydraulic losses.

A summary overview of the key model setup parameters for the hydraulic model developed in this study is provided in *Table 3-1*.

3.2 Methodology

TUFLOW 2025 release was adopted for this study. Outputs from the TUFLOW model include GIS compatible maps of flood extents, water depth, water level, flow and velocities.

It should be emphasised that there are no observed data (eg. historic rainfall, stream heights) with which to calibrate the hydraulic model developed for this study. Predictions on flood behaviour (eg. discharge, depth, velocity) are made according to relevant guidelines and/or are based on engineering judgement and results from adjacent catchments. If any calibration data becomes available in the future the model should be re-assessed to incorporate this information. It is noted from the site visit photos (refer Figure 3-2) that Aurizon appear to have remote monitoring equipment installed at key culvert crossings of the rail-line within Muckaty station.

Table 3-1 Design Model Parameters

Hydraulic Model Parameter	Value
Software	TUFLOW Version 2025-03-AA
Cell Size	10 m (with Sub-grid Sampling to 1m)
Results output Mapping Resolution	High-resolution output mapping to 2m DEM
Projection	GDA 2020 MGA Zone 53
DEM (year)	- 1 metre resolution LiDAR data (2025 capture) - Enforced rail embankment levels based on elevations extracted from LiDAR
Rainfall Parameters	Rainfall excess applied using BoM 2016 IFDs, ARR2019 data hub pre-burst
Annual Exceedance Probabilities (AEPs) Assessed	10% AEP, 1% AEP, 0.2% AEP, 0.5% AEP
Hydrologic Modelling Approach	-Distributed flows from RORB for upstream and steep catchments -Direct Rainfall Excess on flat catchments
Storm Duration and Temporal Pattern Events Simulated	- 24 hours to 48 hours for all AEPs, TP08
Roughness	Spatially varying distribution. Coefficients in line with industry standards and validated against available verification data.
Model Verification	RFFE / Regional Model Comparison
Sensitivity Analyses	- Nil
Model Outputs	-Grid and timeseries of Water level, water depth, velocity, minimum time step, hazard

3.3 Model Schematisation

3.3.1 Extents and Topography

The hydraulic model extent covers the flat and more developed areas of the Muckaty Station catchment and covers approximately 2225 km², as shown in *Figure 3-1*.

A 10 m computational grid with Sub-grid Sampling (SGS) to 1 m resolution and post-processed high-resolution output mapping to 2 m was used to resolve the topography within the study area. Sub-grid sampling (SGS) ensures that all LiDAR data points in each model grid cell are used to determine a water surface elevation versus volume relationship for the terrain for each model grid cell.

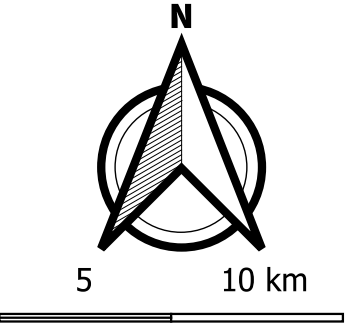
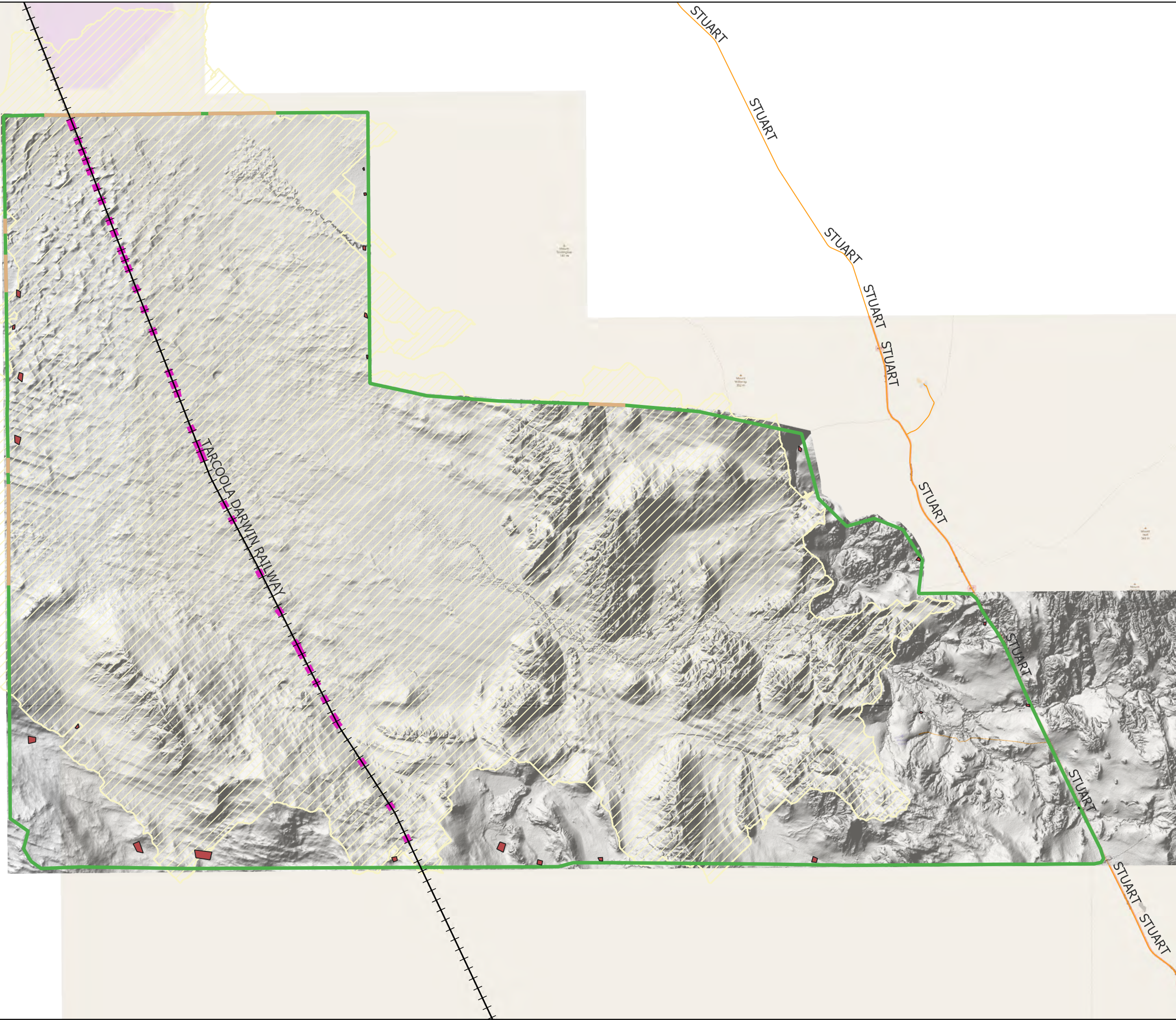
To prevent 'spilling' of flow across embankments, elevation adjustments were made to enforce crest features such as rail embankment crown levels on the basis of the rail centreline alignment, with maximum crest levels extracted from the LiDAR survey.

The model topography was derived from the available 1 m resolution aerial Light Detection and Ranging (LiDAR) supplied by Suncable for the purposes of this study. The extent of the high-resolution LiDAR is shown in *Figure 3-1*.

Due to the lack of available topographic survey and the significant (>5m) differences between the available 1 m resolution site topographic data and the freely available LiDAR/SRTM data, it was not deemed appropriate to extend the model domain and combine multiple topographic datasets within the hydraulic model domain. The selected model extents are therefore a function of the available detailed site survey extents. It is recommended that additional survey is captured prior to the detailed site design in order that updated modelling can be undertaken with model inflow and outflow boundaries located further away from the project site.

It is noted that the LiDAR DTM represents an instantaneous surface capture. LiDAR does not penetrate water surfaces and is thus does not detect the bathymetry of water storages. The elevation of any wet features and/or mobile terrains (such as claypan lagoons and marshlands) will be dependent on the conditions at the time of the LiDAR survey capture.

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- ⚓ Railways
- TUFLOW MODEL**
- █ Culvert Structures
- Model Boundary
- Boundary Conditions**
- █ HQ
- Source Points
- 2D Rainfall

MODEL STRUCTURES AND BOUNDARY CONDITIONS

MUCKATY STATION FLOOD STUDY

PROJECT Muckaty FS
 ENGINEER S Williams
 DATE 2025-04-26
 MODEL VERSION E01

FIGURE 3-1

3.3.2 Hydraulic Structures

Site visit and aerial imagery indicated that the main structures across the station were corrugated steel pipe (CSP) located along the Adelaide-Darwin Rail alignment (*Figure 3-2*). Pipe culverts larger than an equivalent diameter of 900 mm were represented in the 1d model network.

The network included 38 CSP structures along the Adelaide-Darwin Rail alignment. The locations of hydraulic structures represented within the model are shown in *Figure 3-1*.

The Stuart Highway forms the model eastern boundary and therefore inflow locations broadly match the locations of the structures along the highway, the structures were not included in the model.

No invert data was not available for any of the structures, these were interpolated from the available 1 m topographic survey data and, where required, the locations of culvert and pipe inverts were adjusted to align with an assumed location based on the available topographical information.



Figure 3-2 Typical structure on the rail-line

3.3.3 Boundary Conditions

The model boundary conditions are illustrated in *Figure 3-1*.

The direct rainfall (rain-on-grid) method was applied to the flat area areas of the Muckaty Station catchment, which includes most of the eastern and central areas. The adopted rain on grid extent is shown in *Figure 3-1*.

Probabilistic rainfall depths were sourced from the Bureau of Meteorology (BOM) Design Rainfall Data System (2016), which produces design rainfall data on a 0.025° (approximately 2.5 km) grid across all of Australia. Direct rainfall was applied as a rainfall excess based on the TUFLOW material file specification.

A reduced cell wetting/drying depth of 0.00002 m was specified within the TUFLOW model setup, as is standard best practice for direct rainfall modelling. Rainfall excess was applied to the TUFLOW model grid based on the TUFLOW material specification.

The actual pervious initial loss is specific to each storm and could potentially be zero if significant antecedent rainfall occurs in the days or hours prior to a flood-producing rainfall event. ARR 2019 describes this probabilistically through its 'pre-burst loss' dataset, this being the amount of rain occurring before the 'storm burst', which is the core of the storm that is modelled hydrologically or hydraulically. Pre-burst depths are available for the 10th, 25th, 50th (median), 75th and 90th percentiles, with the lower values corresponding to a dry catchment and the higher values to a wet catchment. For the design event simulations, the median ARR data hub pre-burst rainfall was subtracted from the initial storm loss to provide a varying initial loss for each design event and storm duration. Pre-burst data is only available for storm events which are more frequent, or equal to, a 1% AEP and therefore zero initial loss was applied to events rarer than the 1% AEP.

Other inflows included source points for steep catchments and the application of design rainfall hyetographs for flat catchments. Local source points were applied within hydraulic model to represent catchment inflows from the steep upper catchment areas. The discharge for the source points were taken from the RORB model described in Section 3. Model outflow boundaries were applied ratings curves (HQ) based on the ground slope at the outflow. It is noted that the previous regional study for Lake Woods (refer Section 1.3.2) indicated that the Muckaty Station area would not be impacted by levels in Lake Woods up to the 0.1% AEP.

3.3.4 Land Use (Material) Parameters

The spatially varying hydraulic roughness map was developed based on aerial photography, cadastre property boundaries, land-use mapping and site visit observations. A summary of the catchment roughness values adopted for varying land uses is shown in **Error! Reference source not found.**

Table 3-2 Material Parameters (Manning's Roughness and Hydrologic Loss Values)

Land Use	Manning's 'n'
Rail/Access Tracks	0.025
Waterways	0.04
Floodplain	0.05

Review of available aerial imagery indicated that vegetation within the model domain is primarily composed of sparsely grassed areas interspersed with scattered to medium density shrubs and trees. The area can generally be characterised as having moderate hydraulic roughness, however, the selection of a Manning's roughness value is complicated by the large regions of shallow sheet flow throughout the model. At shallow depths the effective roughness value is greatly increased compared to the standard values found in literature, which are designed to be applied to concentrated flows.

It is noted that hydraulic model roughness values are a fixed model parameter, the chosen values were informed by the results of the model verification process as well as being industry standard values which would represent 'average' catchment conditions during the wet season. Investigation of the sensitivity of the study results to the hydraulic model roughness assumptions is recommended but was beyond the scope of this study.

3.4 Model Verification

Unfortunately, there was no detailed flood level survey or flow data from within the catchment with which to calibrate the hydraulic model developed for this study. It is strongly recommended that the model be re-assessed in future to incorporate any available calibration data which becomes available for the Muckaty Station or nearby catchments in the future.

Similarly, additional model sensitivity analyses to understand the potential impacts of known uncertainties in the assumed surface roughness and initial/continuing loss values is recommended. It is noted from the site visit photos (refer Figure 3-2) that Aurizon appear to have remote monitoring equipment installed at key culvert crossings of the rail-line within Muckaty station.

4.0 Flood Impact Assessment

4.1 Existing Case Flooding across the Study Area

The hydraulic model was used to determine water levels, depths and velocities and flooding extents for the 10%, 1%, 0.2% and 0.5% AEP flood events. The 24-hour duration was adopted as the most critical for the western parts of the project site and the 48-hour duration was also simulated as this was most critical within the flatter areas of the station. This was based on the hydrologic model analysis of ten storm temporal patterns for all standard storm durations between 3 hours and 96 hours for the 1% AEP event.

Broad-scale flood maps showing the model predicted results for all simulated flood events are provided in Appendix A. The maps are filtered to depths above 0.1 m using TUFLOW's internal map depth cut-off. A summary of the results of flood impact assessment across the study area is shown in Table 4-1.

Table 4-1 Summary of Flood Impacts Across the Study Area

Event	Flood Impacts	Map Reference
10% AEP	<ul style="list-style-type: none"> Significant inundation and ponding around flatter areas of the site, particular surrounding claypan areas with a mapped land-use as 'marshland' (evident as having standing water based on the available aerial imagery). Flow in western parts of the site confined to mapped major flowpaths. 	Map A1 – Peak Depth Map A2 -Peak Flow Velocity Map A3 – Peak Surface Elevation
1% AEP	<ul style="list-style-type: none"> Major breakouts from Tomkinson Creek with depths up to 1m across broad claypan areas, shallower depths elsewhere across site. Significant inundation of the rail-line and surrounding flat areas. Significant flow velocities (up to 2.5 m/s) to upper catchment areas. 	Map A4 – Peak Depth Map A5 -Peak Flow Velocity Map A6 – Peak Surface Elevation
0.5% AEP	<ul style="list-style-type: none"> Major breakouts from Tomkinson Creek and in western station areas. Lagoonal/marshland inundation across the Solar Area of over 1m depths. High velocity flows in Wind Farm catchments extend beyond major flowpaths. 	Map A7 – Peak Depth Map A8 -Peak Flow Velocity Map A9 – Peak Surface Elevation
0.2% AEP	<ul style="list-style-type: none"> Significant inundation across catchment area. High velocity flows (>2.5 m/s) across many major flowpaths. 	Map A10 – Peak Depth Map A11 -Peak Flow Velocity Map A12– Peak Surface Elevation

It is noted that there is some ponding at the downstream model boundary. This broadly matches the regional modelling flood extents based on the SRTM data however, as discussed in Section 3.3.1, it is recommended that for an extended topographic dataset is captured to support an improved assessment of project site locations close to the site boundaries.

5.0 Conclusions

The Muckaty Station Flood Study is a component of Suncable's Australia-Asia Power Link project site investigations. This study has involved the development of preliminary hydrological and hydraulic models of the Muckaty Station and upstream catchments based on ARR2019 Guidelines.

The new models have been used to determine floodplain hydraulic mechanisms within the project site with detailed hydraulic modelling undertaken for a range of design storm events with Annual Exceedance Probabilities ranging from 10% AEP to the 0.5% AEP.

Significant inundation across all of the flatter (central and western) parts of the Muckaty Station was noted for all design flood events considered in this study. Flow velocities for these areas were broadly below 1m/s except in the vicinity of the rail embankment and its associated structures. For the eastern parts of the station flows were generally confined the major flow channels, however flow velocities were correspondingly increased.

The hydraulic model that was developed for this study will ultimately provide the ability to develop and support more detailed design case of the development. It should be emphasised that there are no observed data (eg. historic rainfall, stream heights) with which to calibrate the hydraulic model developed for this study. Predictions on flood behaviour (eg. discharge, depth, velocity) are made according to relevant guidelines and/or are based on engineering judgement and results from adjacent catchments.

6.0 Recommendations

The modelling undertaken for this study should be considered as preliminary and concept stage only. It is strongly recommended that the following works are undertaken as part of detailed design of Muckaty Station Solar and Wind Farm development:

- Consider the installation of at-site rainfall and level gauging for the site. This will enable future model calibration and improve confidence in future flood modelling outcomes, as well as provide important real-time information for emergency management
- Undertake hydrologic and hydraulic model sensitivity analyses to understand the potential impacts of known uncertainties in the assumed initial/continuing loss values and surface roughness
- Should any model calibration and verification data become available in the future, undertake model calibration and re-assess the major design flood events with the calibrated model parameters.
- Undertake a site visit to confirm the locations and dimensions of existing drainage structures within and also surrounding the project site
- Undertake extended topographic survey to support development of an extended hydraulic model for the Muckaty Station with siting of hydraulic model boundaries further away from the project site and to enable more detailed analysis of flows from catchments to the west of the station.

7.0 References

Black River Basin Flood Study (AECOM, 2021)

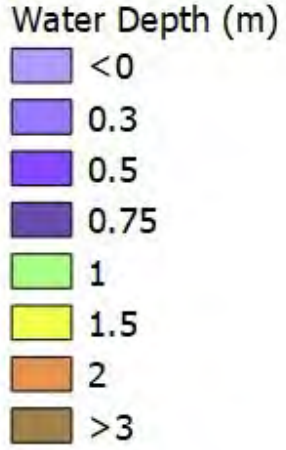
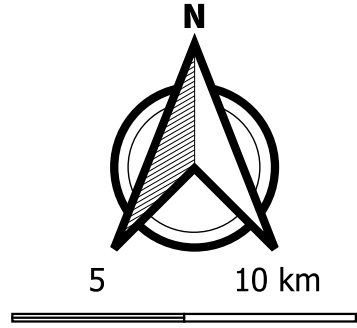
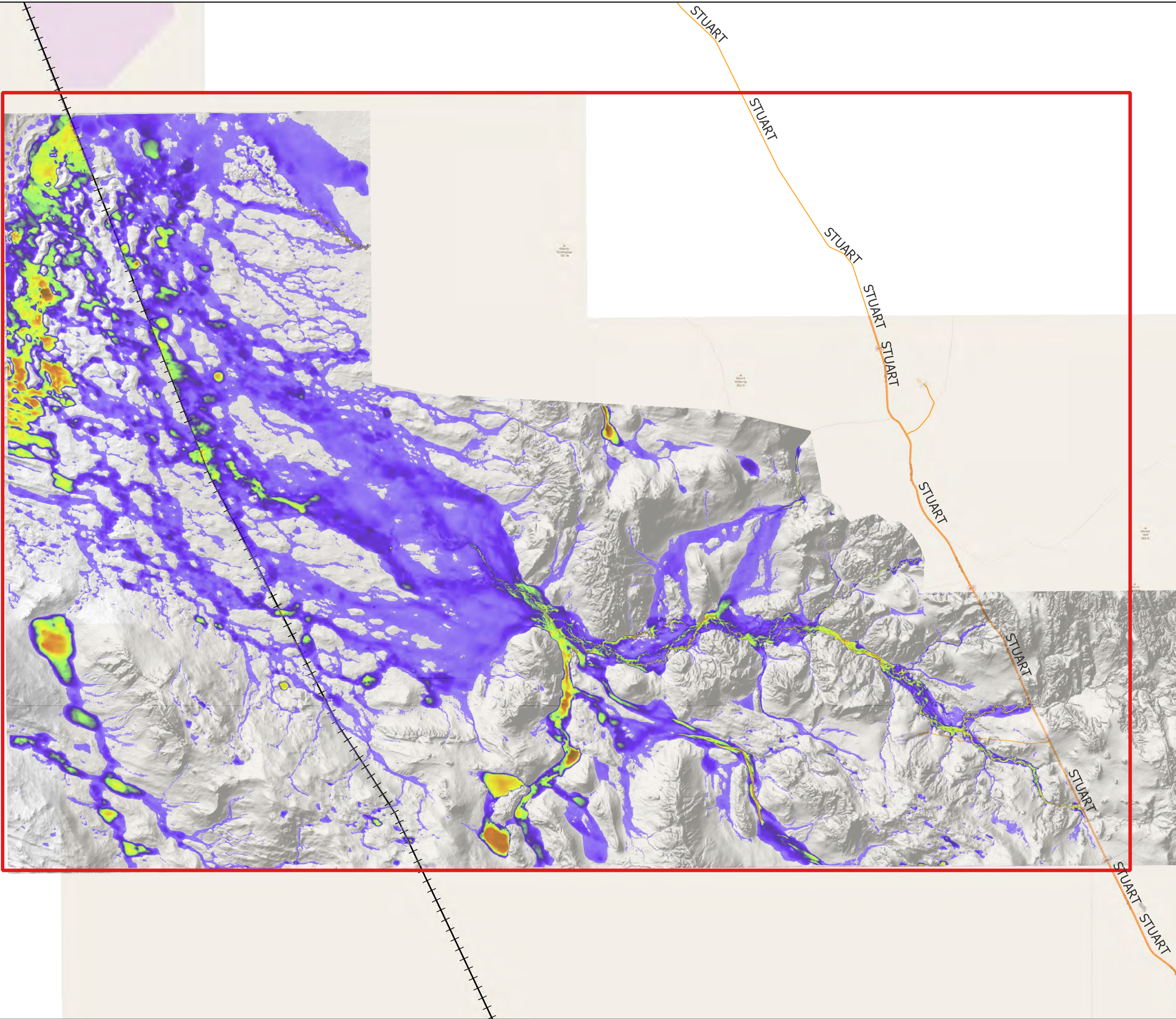
Review of Hydrological Methods for the Townsville Region - Phase 1-3. (HARC 2020).

Special Climate Statement 69—an extended period of heavy rainfall and flooding in tropical Queensland. (Bureau of Meteorology, 2019).

Townsville Region Storm Tide Study (GHD, 2012).

Appendix A Flood Mapping

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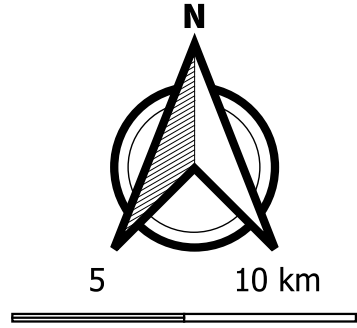
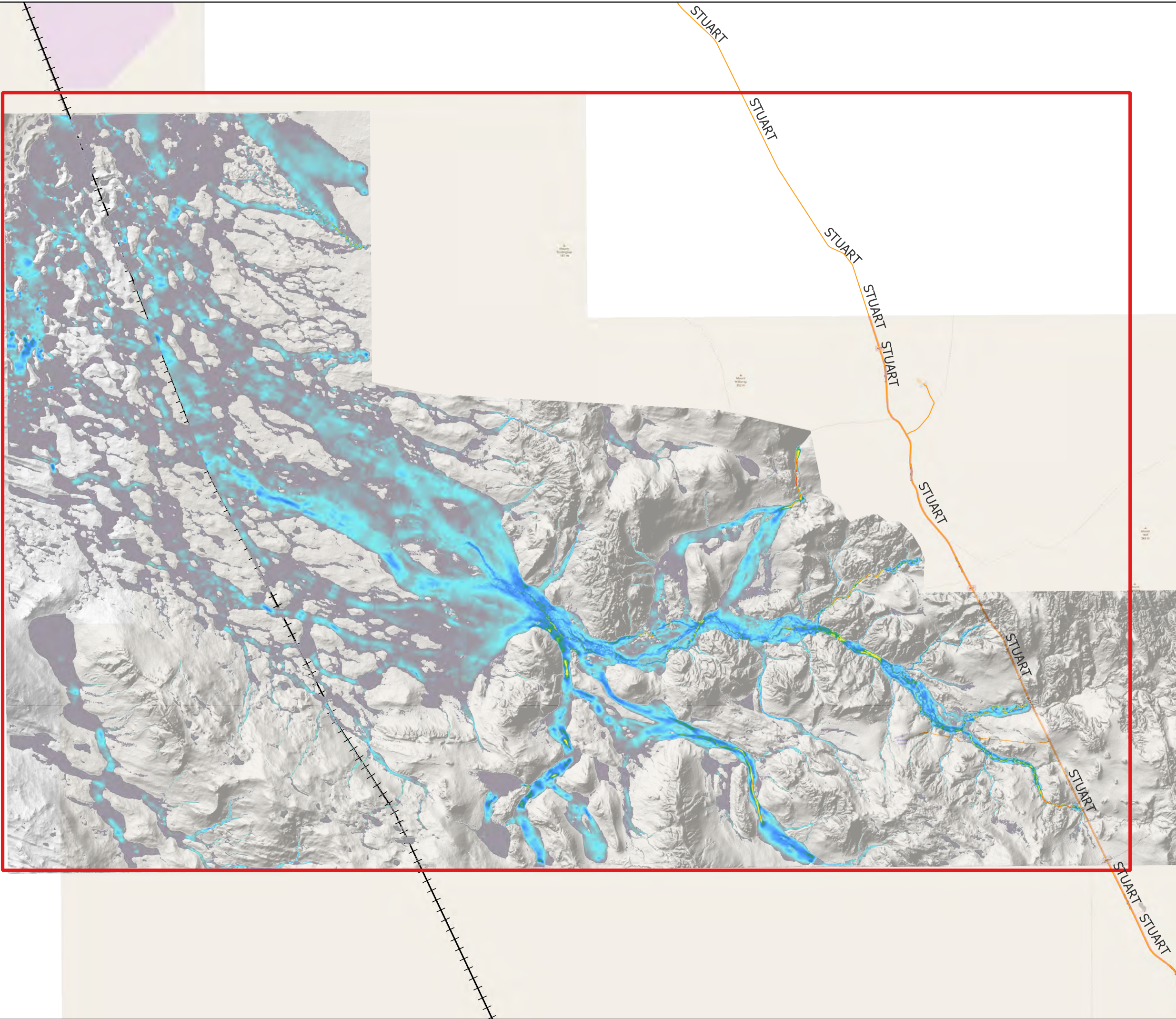
**10% AEP
WATER DEPTH**

MUCKATY STATION FLOOD STUDY

PROJECT Muckaty FS
 ENGINEER S Williams
 DATE 2025-04-26
 MODEL VERSION E01

**APPENDIX
A-1**

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Velocity (m/s)

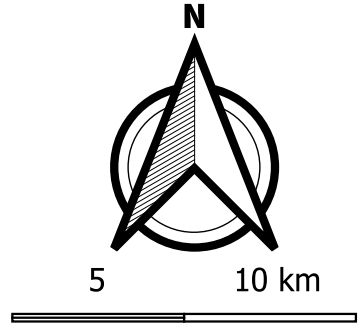
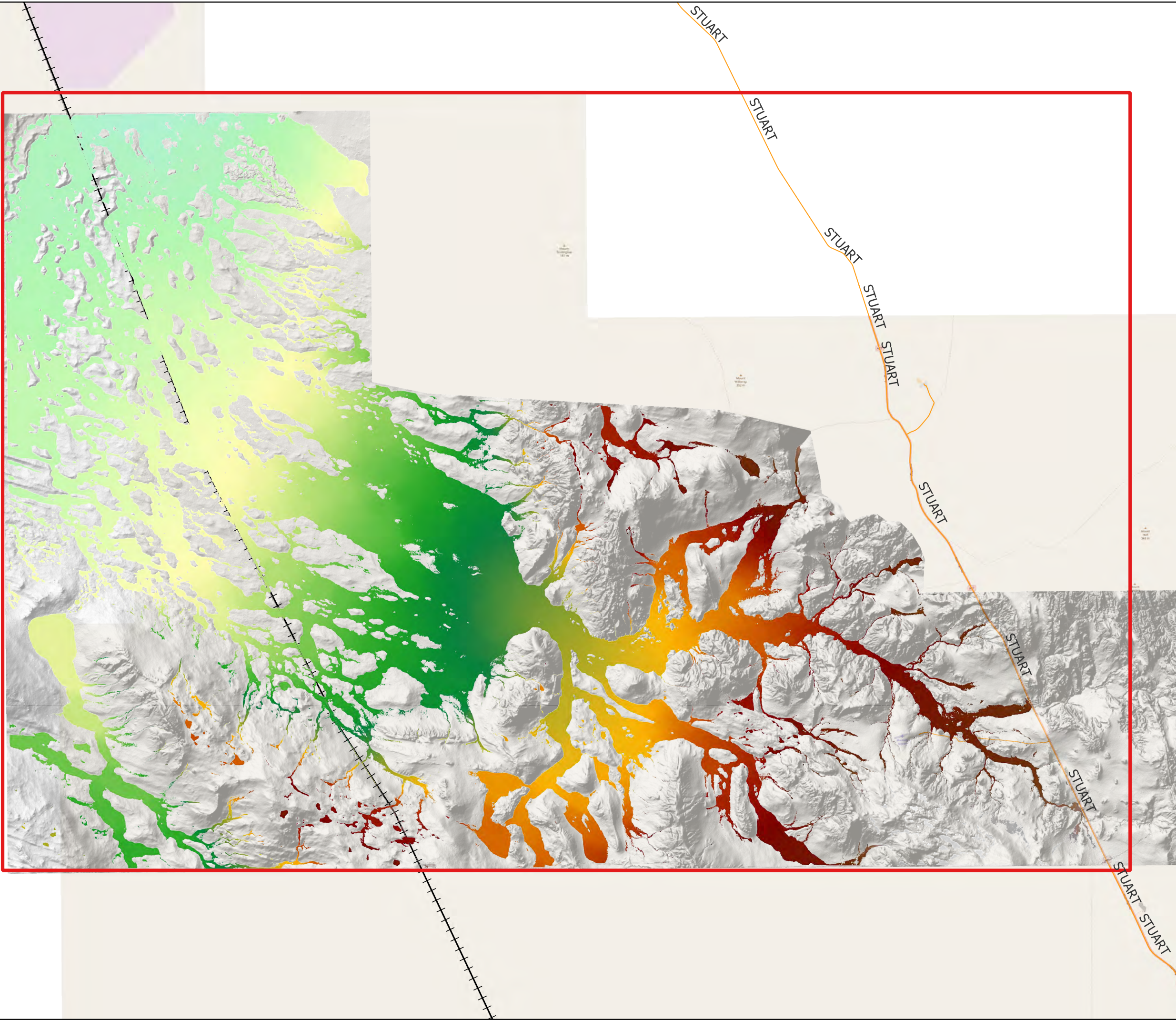
- < 0.25
- 0.25 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 1.25
- 1.25 - 1.50
- 1.50 - 2.00
- 2.00 - 2.50
- 2.50 - 3.00
- > 3.00

**10% AEP
PEAK FLOW VELOCITY**
MUCKATY STATION FLOOD STUDY

PROJECT Muckaty FS
ENGINEER S Williams
DATE 2025-04-26
MODEL VERSION E01

**APPENDIX
A-2**

DISCLAIMER: Imbris Australia PTY LTD bears no responsibility or liability for any errors, defects or omissions in the information displayed in this map. No warranties are made regarding the accuracy or completeness of the data displayed.

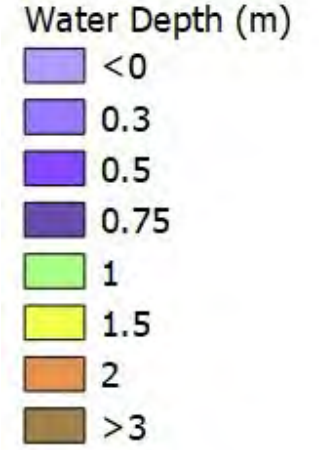
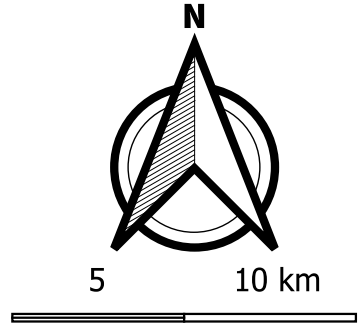
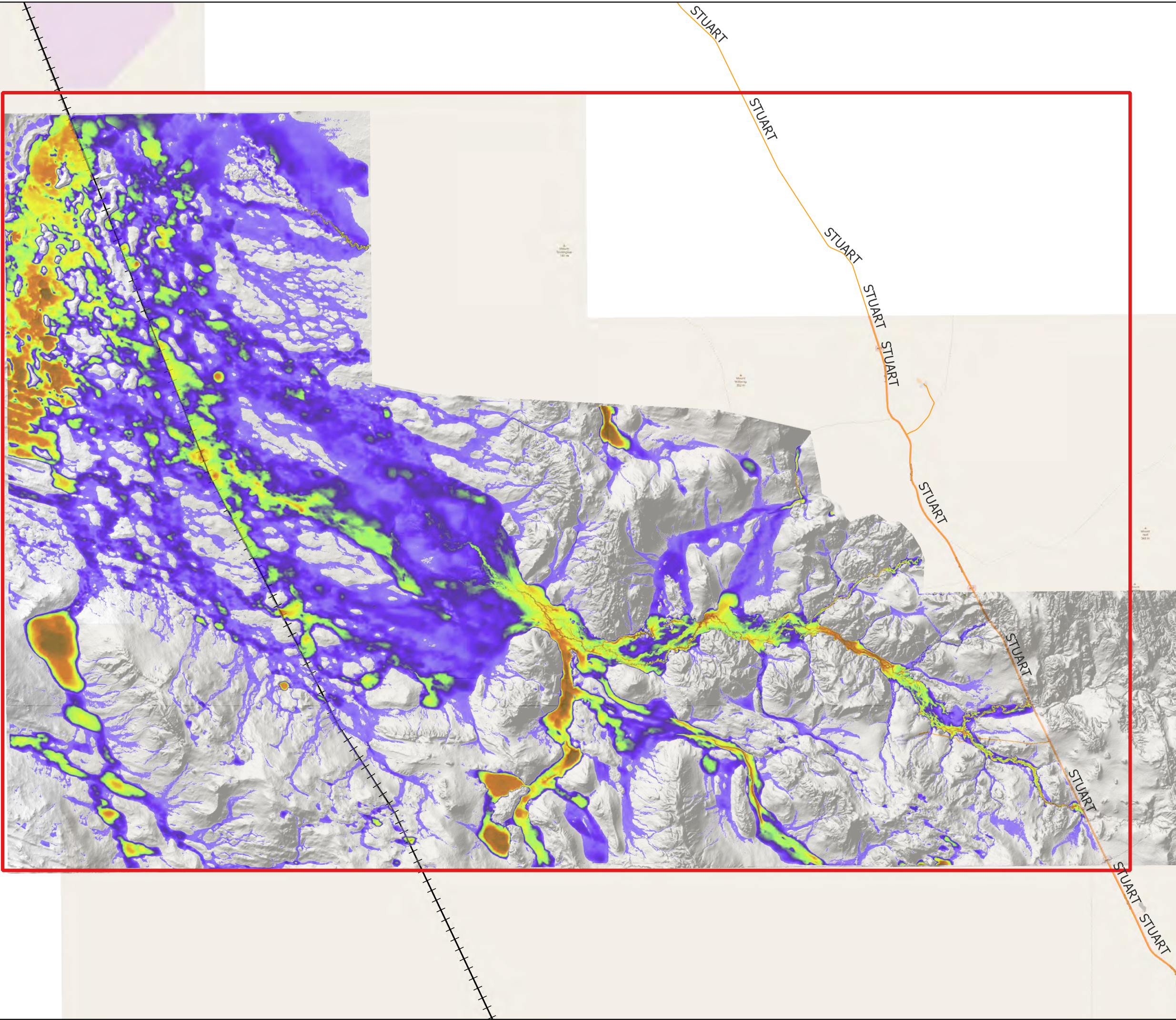


**10% AEP
WATER SURFACE ELEVATION
MUCKATY STATION FLOOD STUDY**

PROJECT Muckaty FS
ENGINEER S Williams
DATE 2025-04-26
MODEL VERSION E01

**APPENDIX
A-3**

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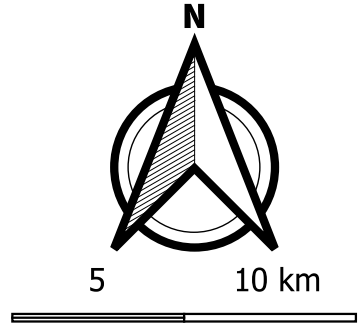
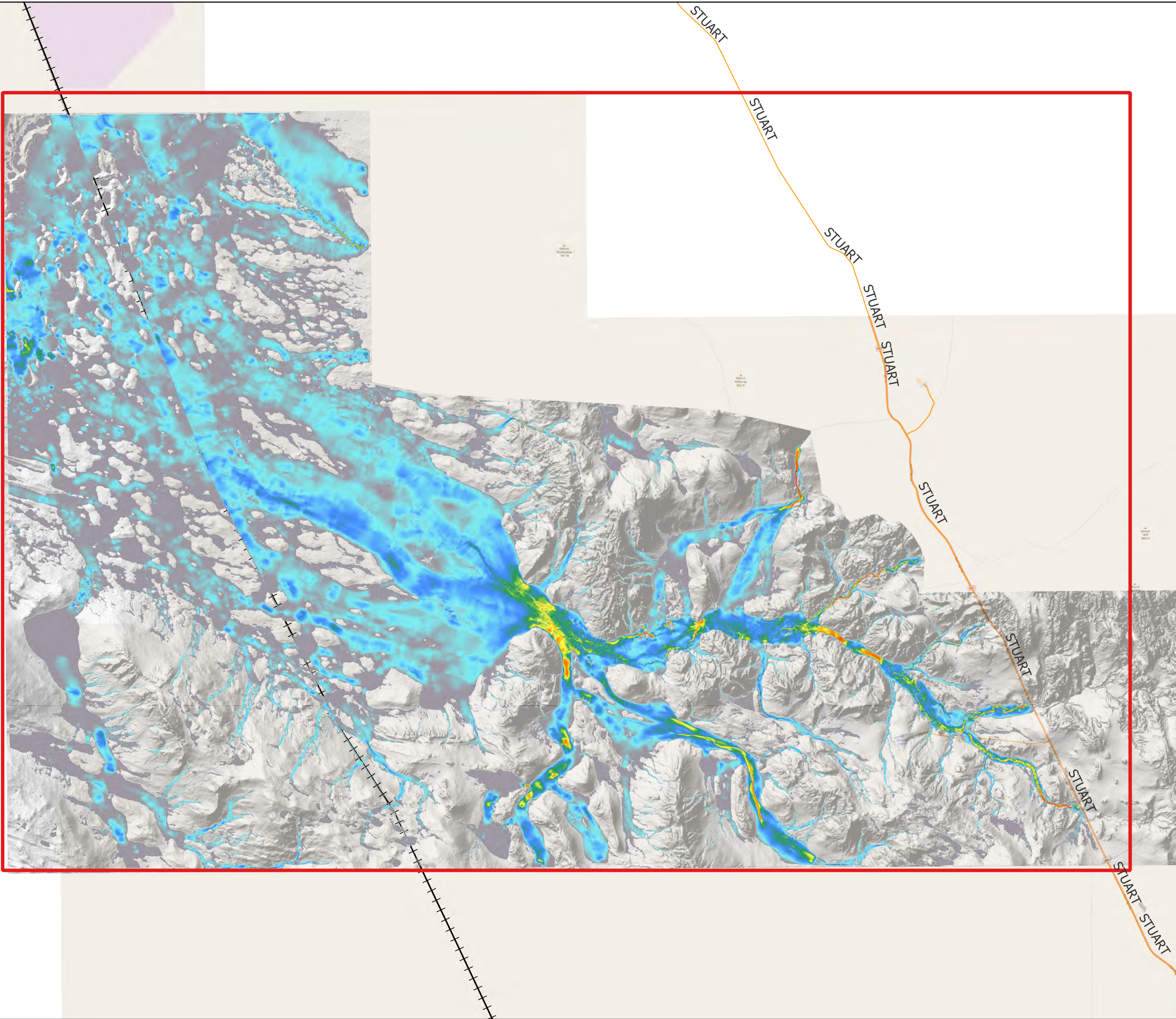


1% AEP
WATER DEPTH
MUCKATY STATION FLOOD STUDY

PROJECT Muckaty FS
ENGINEER S Williams
DATE 2025-04-26
MODEL VERSION E01

APPENDIX
A-4

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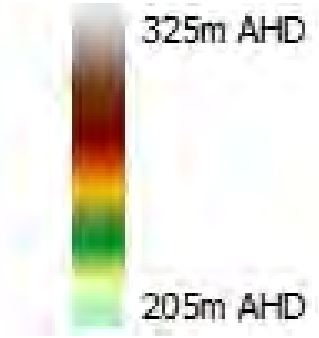
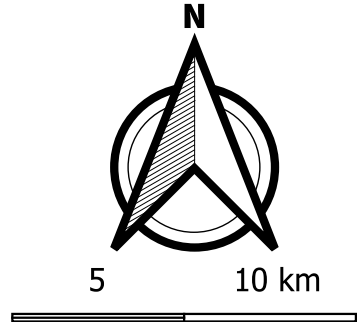
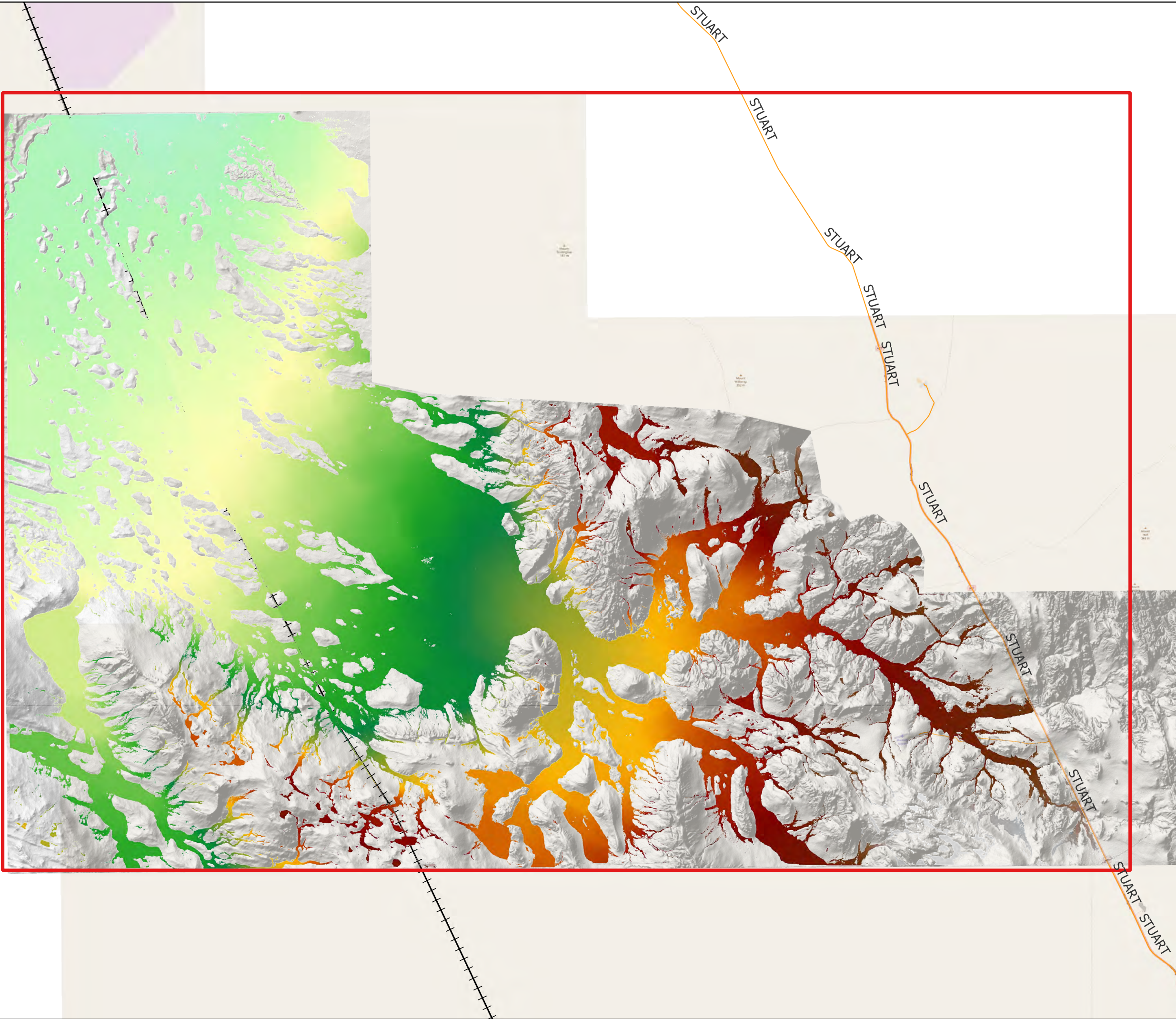


1% AEP
PEAK FLOW VELOCITY
MUCKATY STATION FLOOD STUDY

PROJECT Muckaty FS
ENGINEER S Williams
DATE 2025-04-26
MODEL VERSION E01

APPENDIX
A-5

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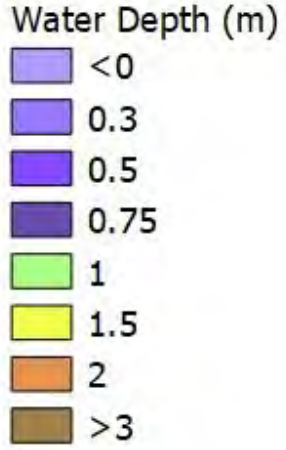
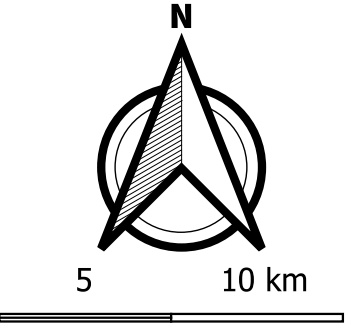
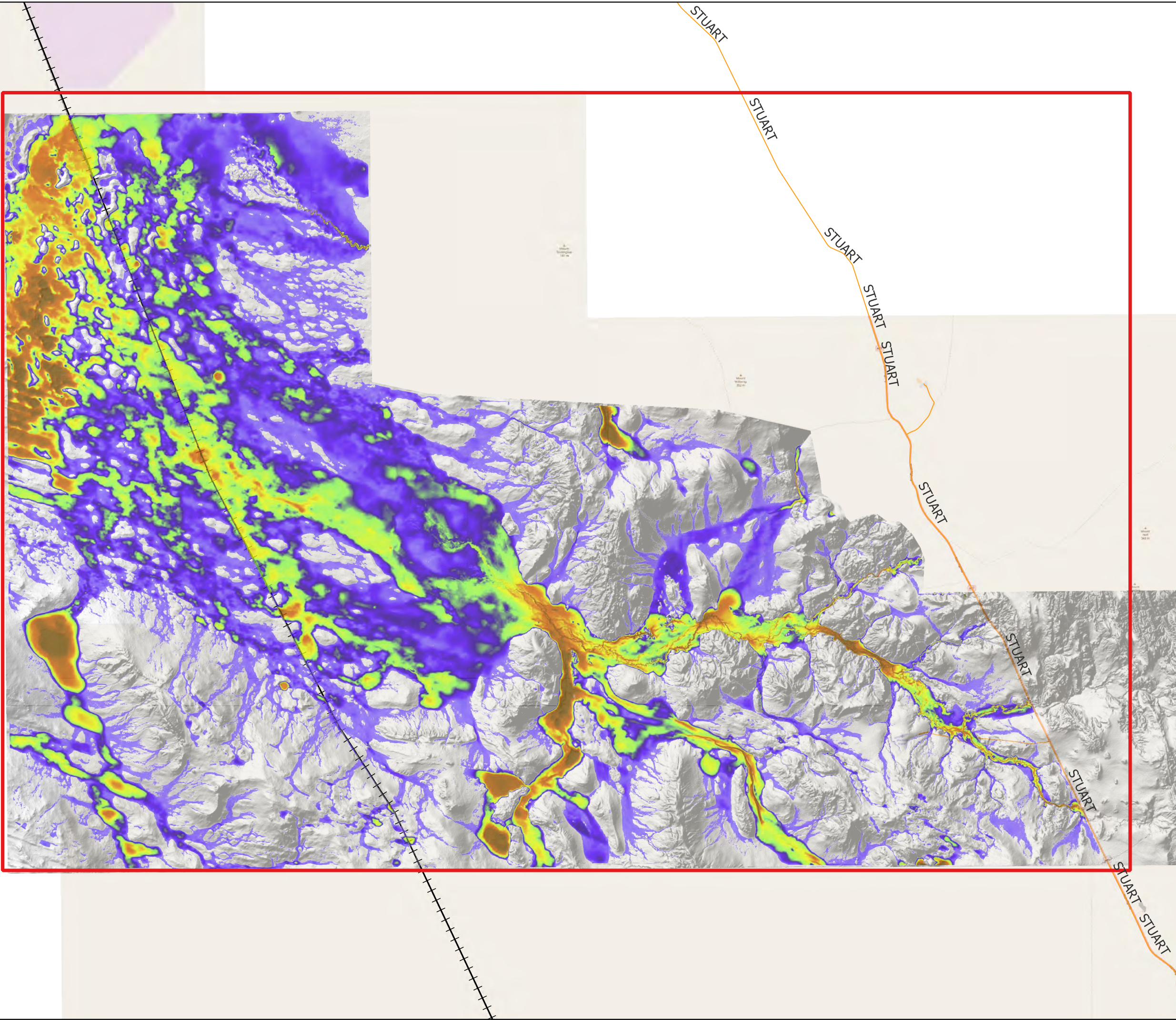


**1% AEP
WATER SURFACE ELEVATION
MUCKATY STATION FLOOD STUDY**

PROJECT Muckaty FS
ENGINEER S Williams
DATE 2025-04-26
MODEL VERSION E01

**APPENDIX
A-6**

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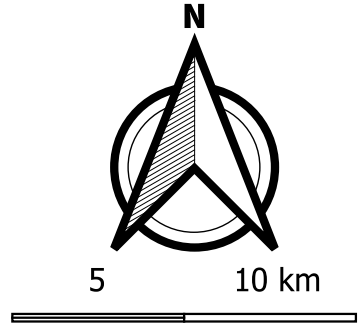
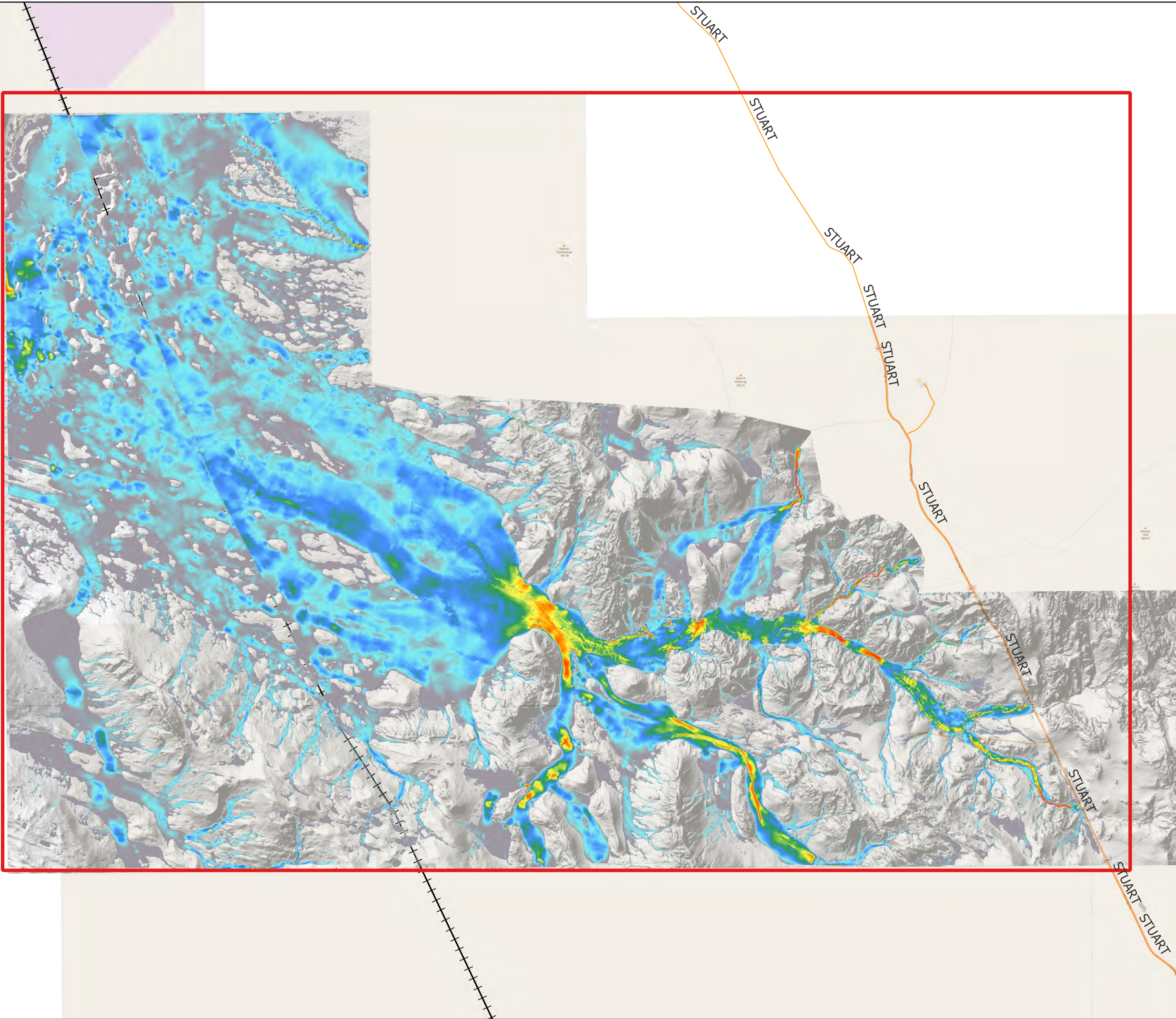
**0.5% AEP
WATER DEPTH**

MUCKATY STATION FLOOD STUDY

PROJECT Muckaty FS
 ENGINEER S Williams
 DATE 2025-04-26
 MODEL VERSION E01

**APPENDIX
A-7**

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Velocity (m/s)

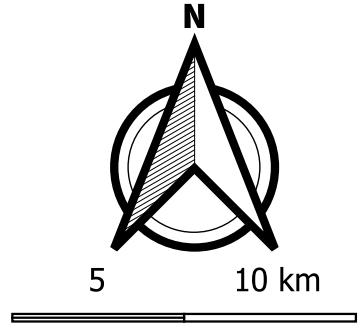
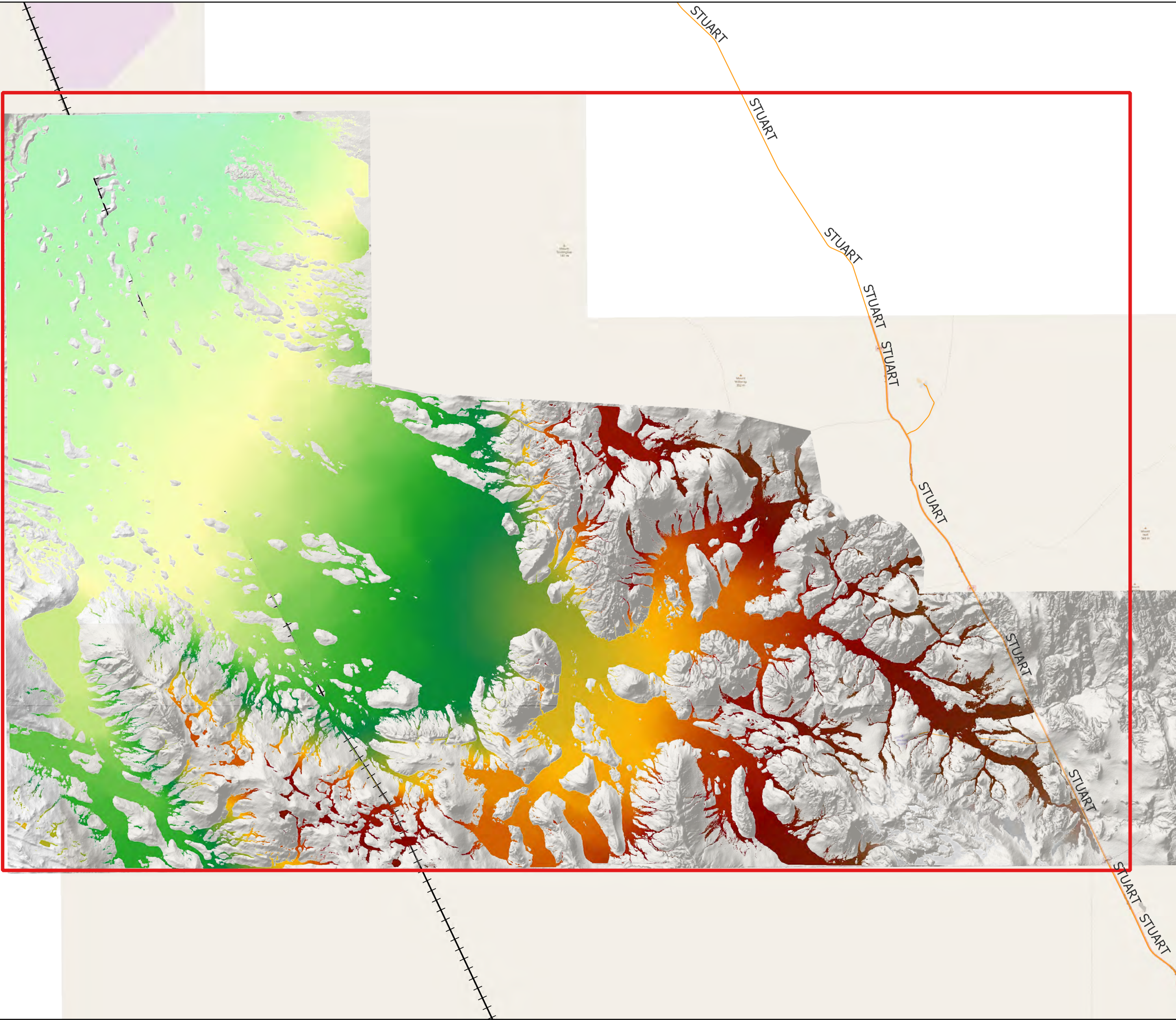
Light Blue	< 0.25
Blue	0.25 - 0.50
Dark Blue	0.50 - 0.75
Green	0.75 - 1.00
Yellow	1.00 - 1.25
Orange	1.25 - 1.50
Red	1.50 - 2.00
Pink	2.00 - 2.50
Purple	2.50 - 3.00
Dark Purple	> 3.00

0.5% AEP
PEAK FLOW VELOCITY
MUCKATY STATION FLOOD STUDY

PROJECT Muckaty FS
ENGINEER S Williams
DATE 2025-04-26
MODEL VERSION E01

APPENDIX
A-8

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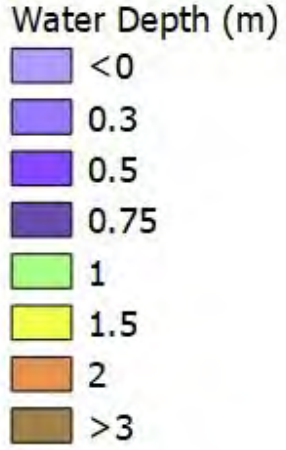
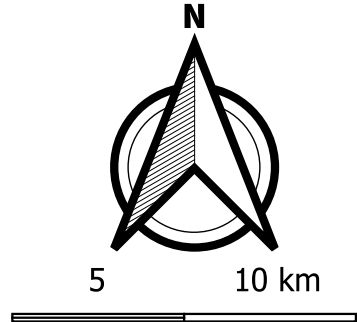
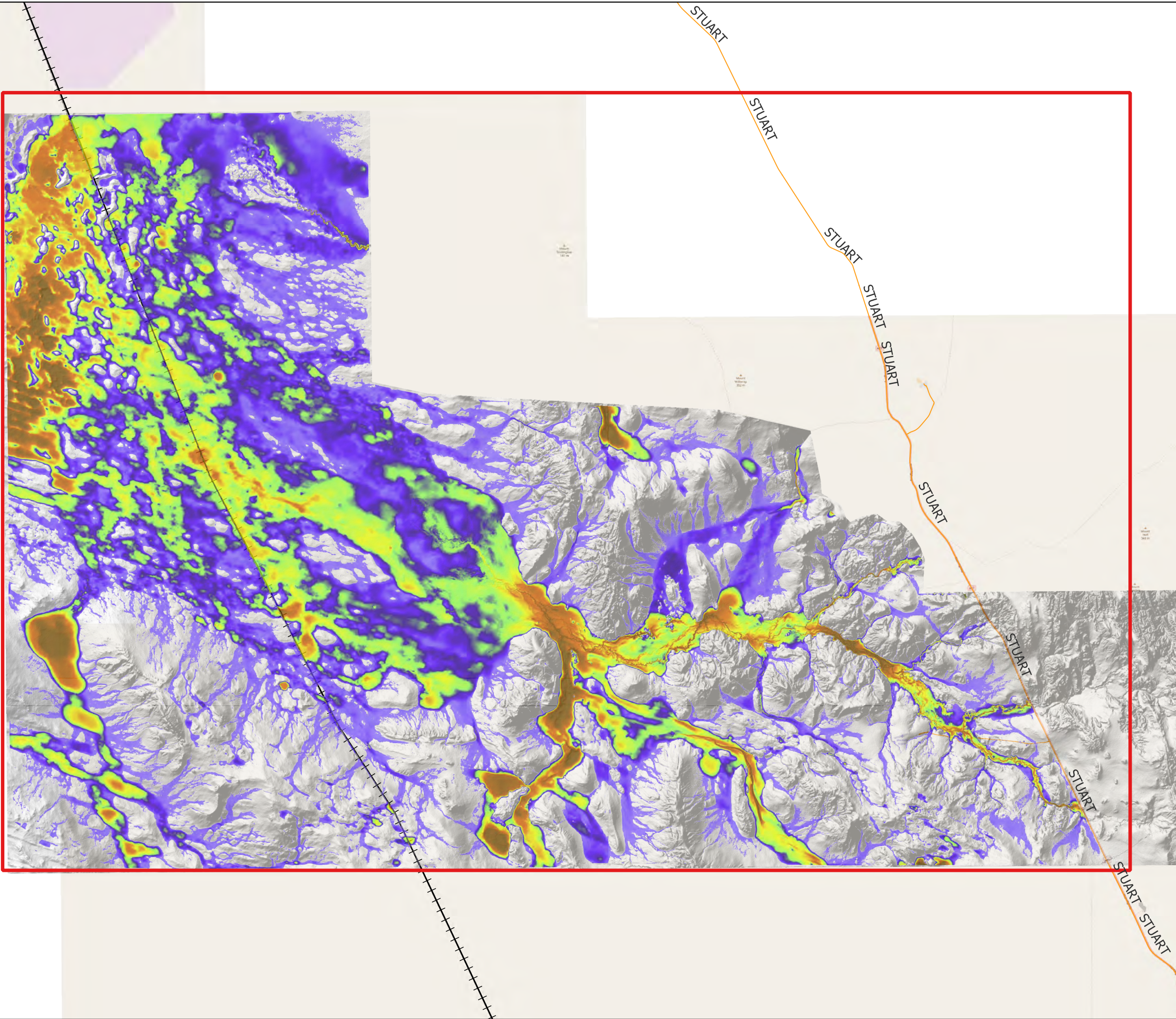


**0.5% AEP
WATER SURFACE ELEVATION
MUCKATY STATION FLOOD STUDY**

PROJECT Muckaty FS
ENGINEER S Williams
DATE 2025-04-26
MODEL VERSION E01

**APPENDIX
A-9**

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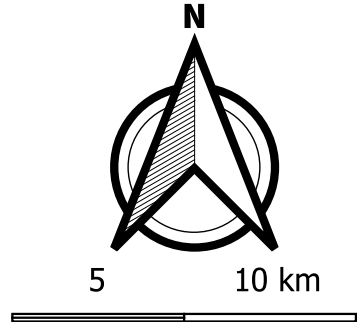
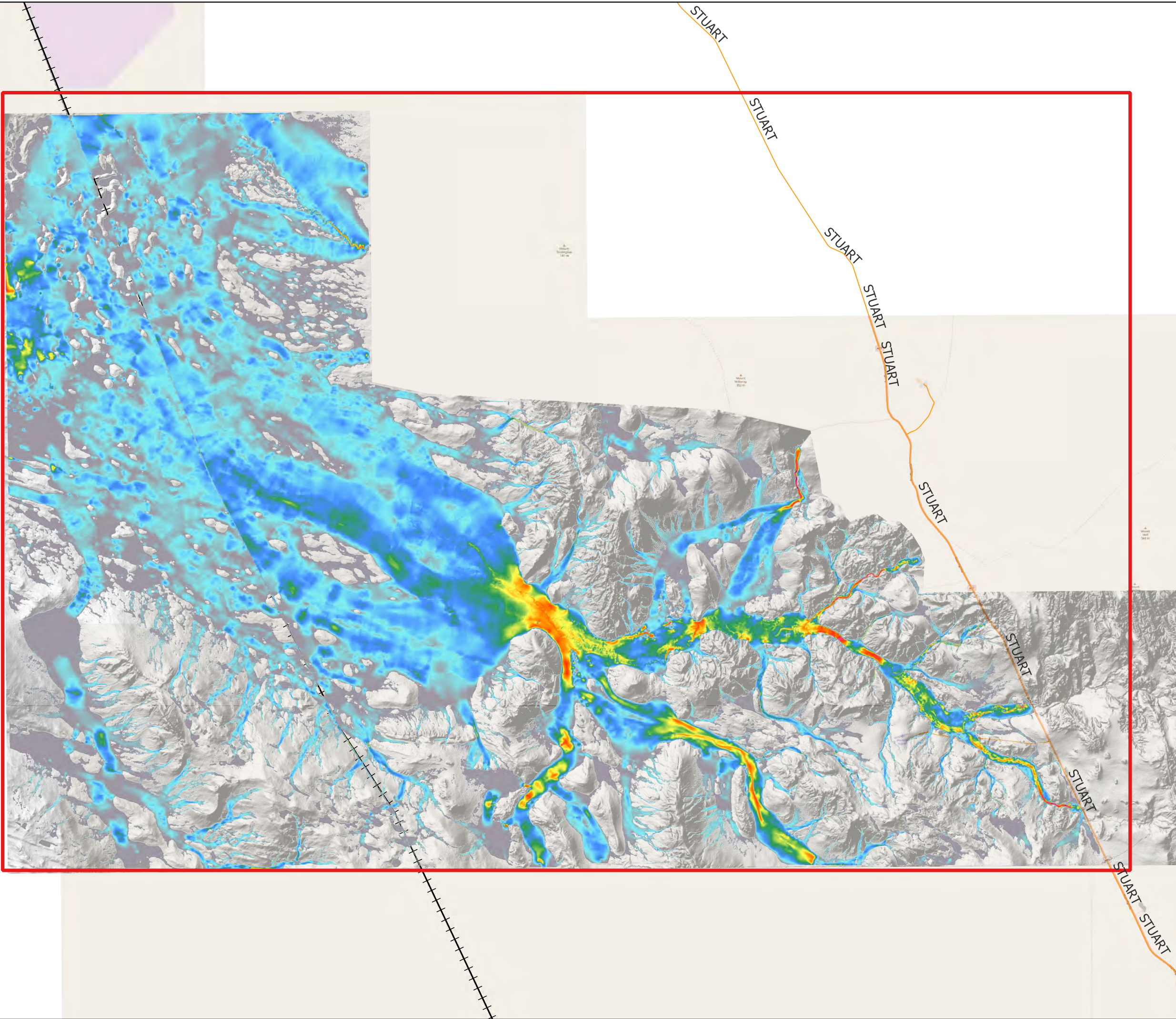


**0.2% AEP
WATER DEPTH**
MUCKATY STATION FLOOD STUDY

PROJECT Muckaty FS
ENGINEER S Williams
DATE 2025-04-26
MODEL VERSION E01

**APPENDIX
A-10**

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Velocity (m/s)

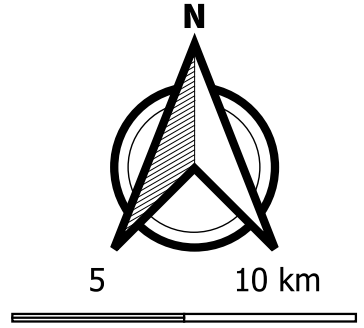
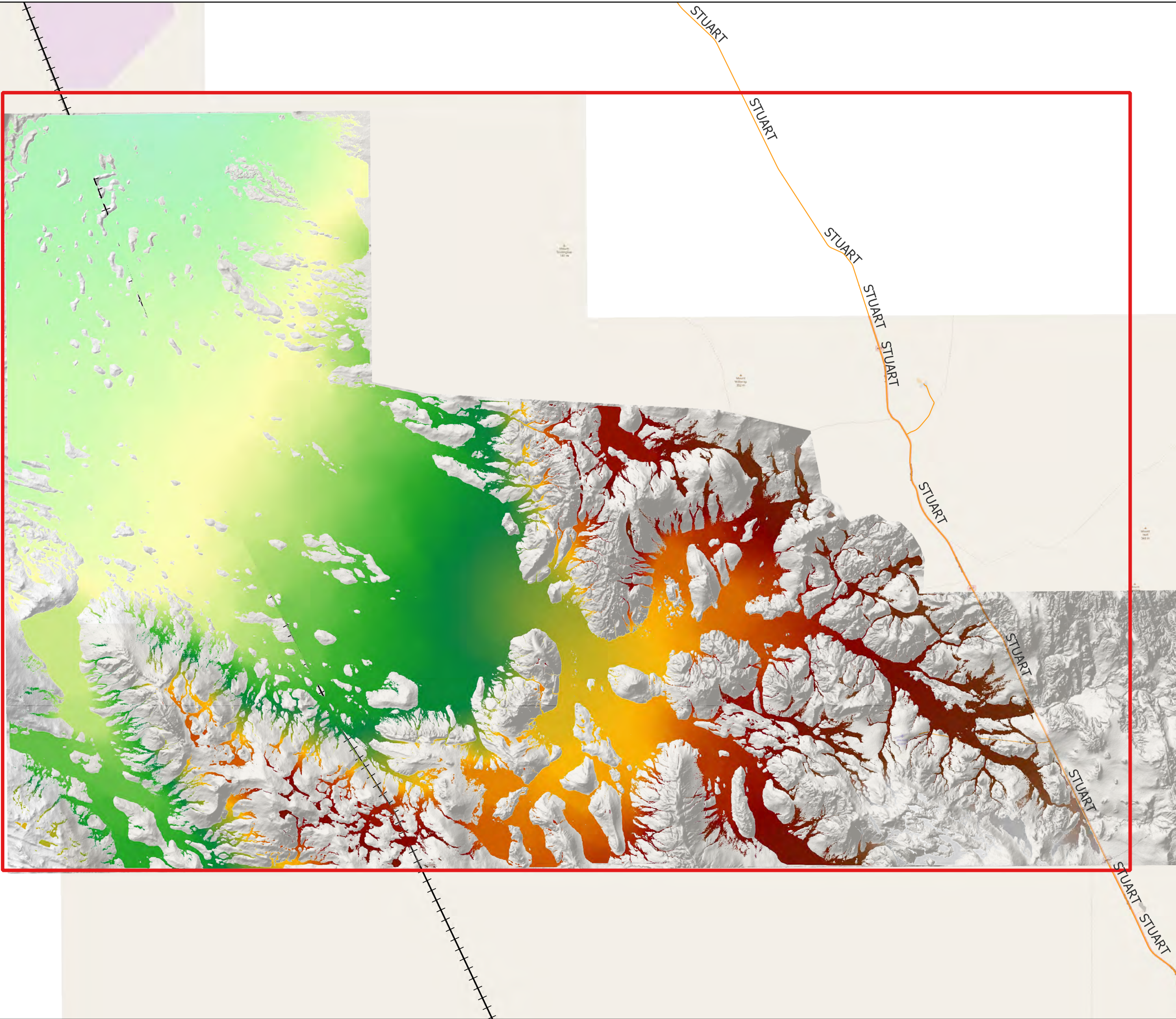
-  < 0.25
-  0.25 - 0.50
-  0.50 - 0.75
-  0.75 - 1.00
-  1.00 - 1.25
-  1.25 - 1.50
-  1.50 - 2.00
-  2.00 - 2.50
-  2.50 - 3.00
-  > 3.00

**0.2% AEP
PEAK FLOW VELOCITY**
MUCKATY STATION FLOOD STUDY

PROJECT Muckaty FS
ENGINEER S Williams
DATE 2025-04-26
MODEL VERSION E01

**APPENDIX
A-11**

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**0.2% AEP
WATER SURFACE ELEVATION
MUCKATY STATION FLOOD STUDY**

PROJECT Muckaty FS
ENGINEER S Williams
DATE 2025-04-26
MODEL VERSION E01

**APPENDIX
A-12**