Memorandum

Subject	OB32 Stage 2 Technical Support		
Date	25/11/2024		
To	Nicole Romanczuk (BHP)	**From**	Stefan Berger (Worley)
CC	Rebecca D'Agostino (BHP) Iain Rea (BHP)	Camila Mercado (Worley) Kelly Lavell (BHP)	
Project No	311012-00724	Doc No	311012-00724-HY-MEM-00001
Project	OB32 Surplus Water		

Background

BHP has requested additional technical input to support the submission of regulatory approvals documentation for the management of surplus water associated with the development of Ore Body 32 (OB32). The creek discharge modelling that was conducted as part of the OB32 Surplus Water Definition Phase Study (DPS) required refining to provide higher resolution model outputs.

Details pertaining to the TUFLOW model setup and parameterisation can be found in the DPS creek discharge modelling report (PREP-040-G-1217/0).

Scope

The TUFLOW model built during the DPS was run with a cell size of 25 m. As part of this additional technical support scope, the model was re-run with a finer cell size resolution of 6 m to provide a more accurate representation of the Homestead Creek channel within the model domain.

The following scenarios were selected to be re-run:

- Scenario 1 – Continuous discharge of 60 ML/day from the proposed Homestead Creek discharge location for a duration of six years (52,560 hours), and
- Scenario 2 – Continuous discharge of 60 ML/day from the proposed Homestead Creek discharge location plus Rio Tinto's discharge to Kalgan Creek (27 ML/day) and three months of discharge from Ophthalmia Dam (120 ML/day) for a duration of one year (8,760 hours)

Cross-sections were then taken at several points of interest along the predicted flow path for the wetting front associated with each modelled scenario. Figure 1 presents the location of the cross-sections.

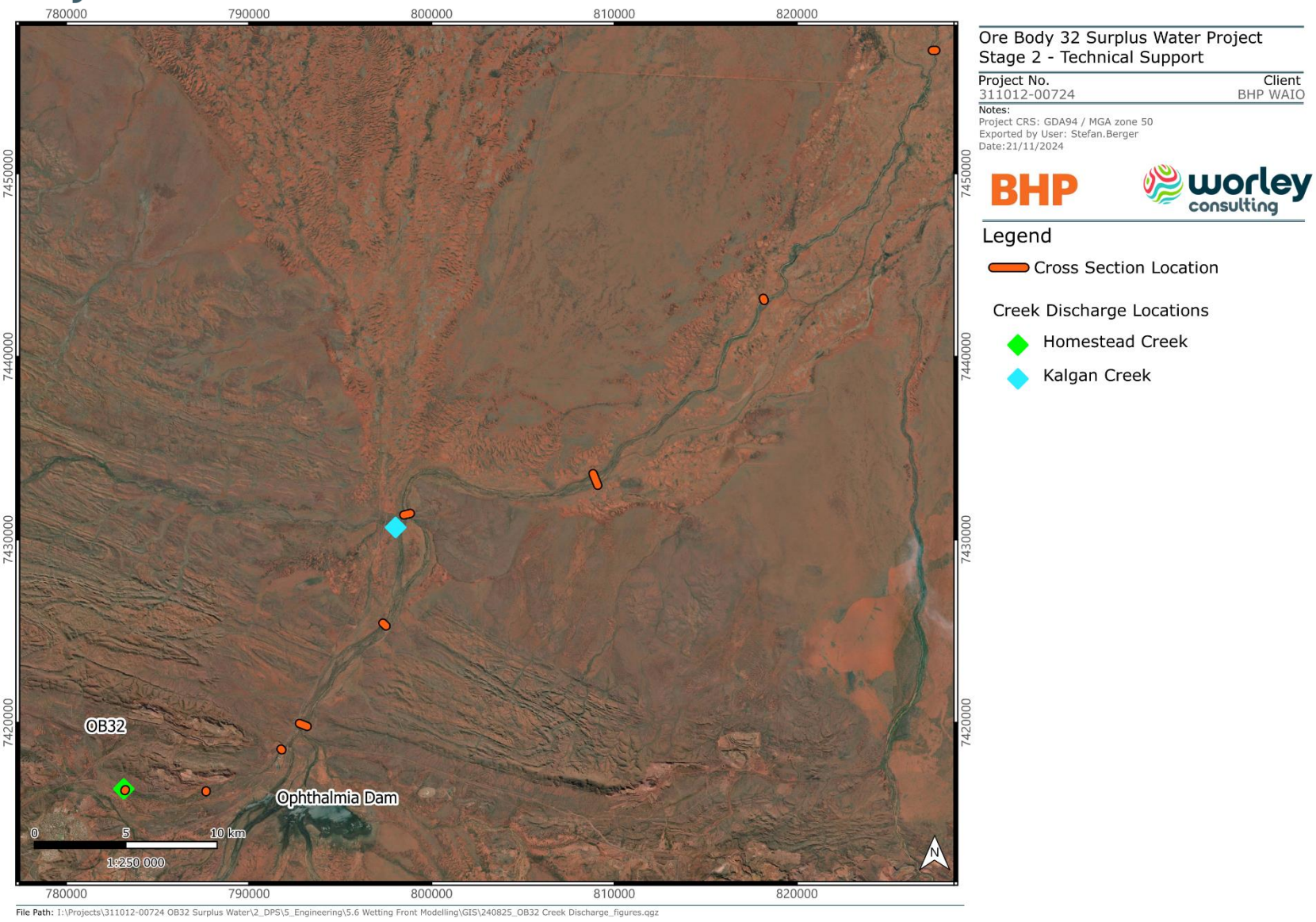


Figure 1: Cross-section locations.

Approach

The cross-section locations were selected and agreed with BHP in accordance with the following areas of interest:

- Immediately downstream of the discharge location on Homestead Creek,
- Several locations along Homestead Creek capturing different channel geometries and reach types,
- Confluence of Homestead Creek and Fortescue River,
- Confluence of Fortescue River and Kalgan Creek, and
- Several locations along Fortescue River, capturing different channel geometries and reach types.

Model outputs of maximum water level for each scenario were plotted with the available topographic data (originally supplied by BHP as part of the OB32 Surplus Water DPS).

Results & Discussion

The following figures present the modelled maximum water level associated with each creek discharge scenario (labeled "Indicative Low Flow Channel"). Cross-sections 1, 2 and 3 are the same for both modelled scenarios as they are situated upstream of the Ophthalmia Dam discharge location. There are two cross-sections (4 & 7) which intersected pools; it should be noted that the presence of these pools may have influenced the predicted wetting front depth and width.

A discussion of each cross-section is presented below:

- Cross-section 1 – immediately downstream of the modelled discharge location. Predicted wetting front width in the order of 6 m for Scenarios 1 & 2 (see Figure 2).
- Cross-section 2 – Homestead Creek incised main channel. Predicted wetting front width in the order of 13 m for Scenarios 1 & 2 (see Figure 3).
- Cross-section 3 – Homestead Creek anabranching channel. Predicted wetting front width in the order of 5 m for Scenario 1 & 2 (see Figure 4).
- Cross-section 4 – confluence of Homestead Creek and Fortescue River. Predicted wetting front widths in the order of 40 m for Scenario 1 (see Figure 5) and 45 m for Scenario 2 (see Figure 6).
- Cross-section 5 – Fortescue River wide anabranching channel upstream of Kalgan Creek confluence. Predicted wetting front widths in the order of 21 m for Scenario 1 (see Figure 7) and 23 m for Scenario 2 (see Figure 8).

- Cross-section 6 – confluence of Kalgan Creek and Fortescue River. Predicted wetting front widths in the order of 37 m for Scenario 1 (see Figure 9) and 43 m for Scenario 2 (see Figure 10).
- Cross-section 7 – Fortescue River wide anabranching reach. Predicted wetting front widths in the order of 19 m for Scenario 1 (see Figure 11) and 21 m for Scenario 2 (see Figure 12).
- Cross-section 8 – Fortescue River incised reach on bend. Predicted wetting front widths in the order of 18 m for Scenario 1 (see Figure 13) and 22 m for Scenario 2 (see Figure 14).
- Cross-section 9 – Fortescue River incised reach upstream of Jigalong Road. Predicted wetting front in the order of 21 m for Scenario 1 (see Figure 15). The wetting front for Scenario 2 did not reach this far as the model was run for one year only. The wetting front for Scenario 1 reached ~1 km downstream of Cross-section 9 after six years of model runtime.

The TUFLOW model results suggest significant variability in wetting front widths can be expected as a result of the proposed discharge. The wetting front widths are likely to be governed largely by channel morphology and antecedent conditions (which were not tested for as part of this additional modelling). The higher flow rate associated with Scenario 2 did not seem to result in a drastically wider wetting front, however, it is expected that the wetting front would have travelled much further than Scenario 1 if the model runtime had been increased.

An important distinction is that increasing the model resolution resulted in the predicted wetting fronts not travelling as far or as fast as the coarser resolution model. This is likely due to the fact that higher resolution model was able to capture changes in channel morphology (incl. pools) more accurately.

Limitations

The same limitations apply to this additional modelling work as outlined in the DPS report (PREP-040-G-12127/0).

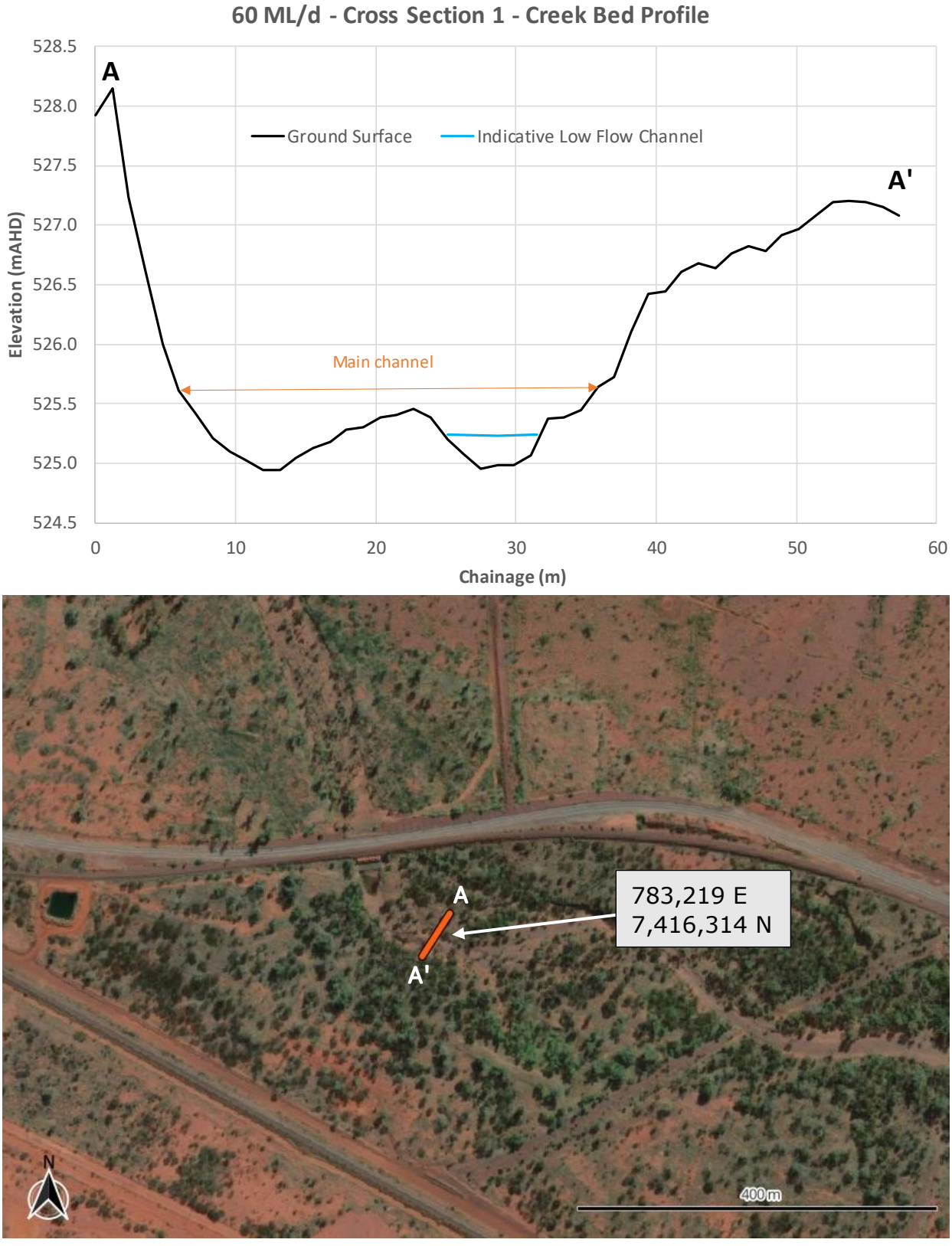


Figure 2: Cross-section 1 – immediately downstream of modelled discharge location (Scenario 1 & 2).

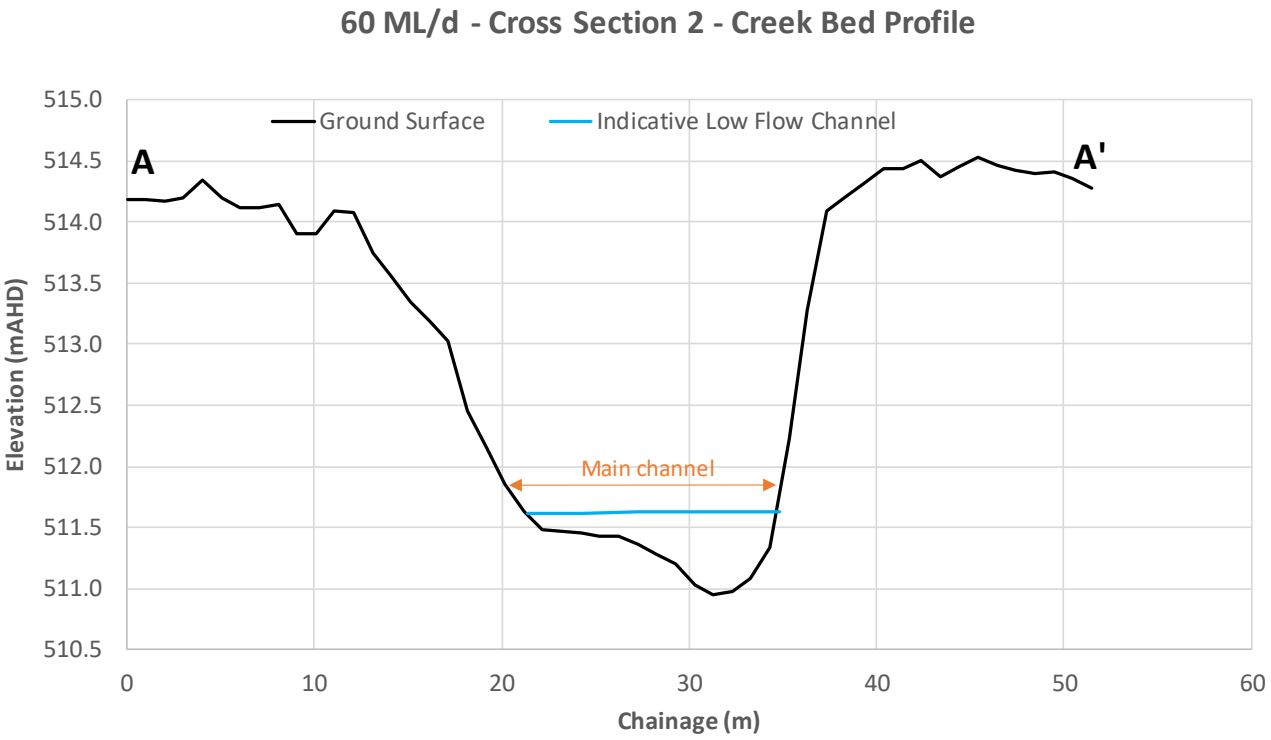


Figure 3: Cross-section 2 – Homestead Creek incised main channel (Scenario 1 & 2).

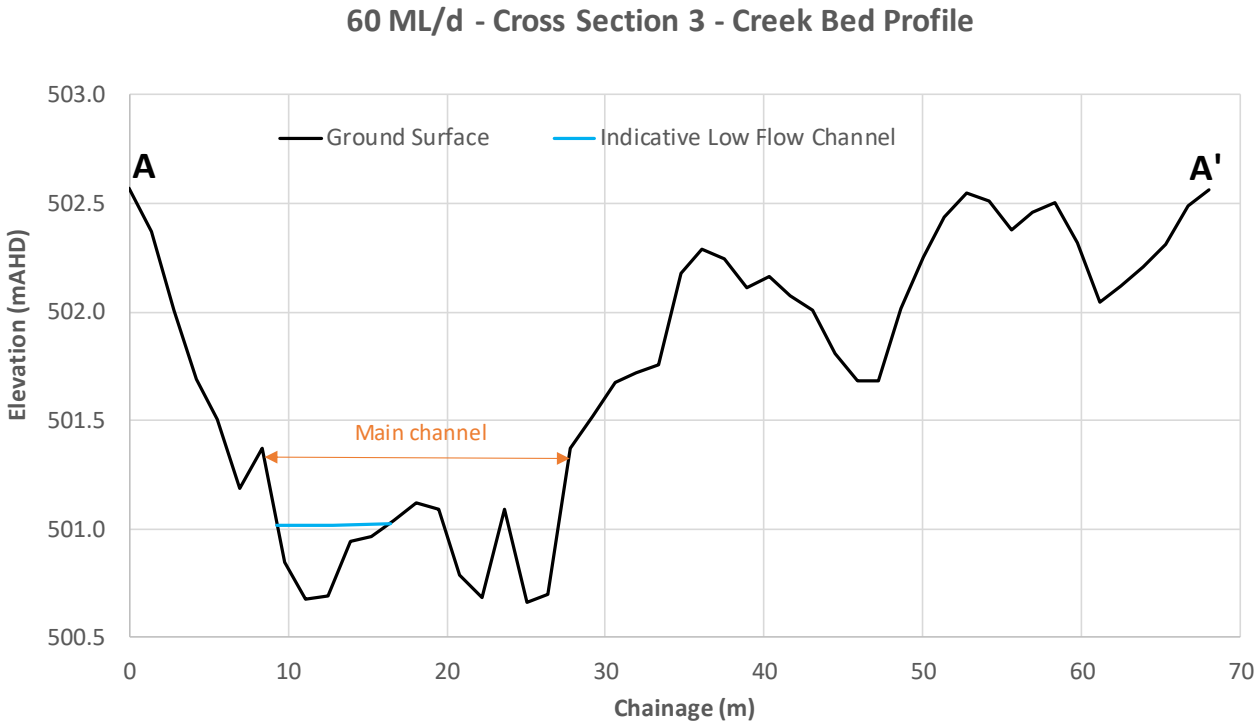


Figure 4: Cross-section 3 – Homestead Creek anabranching channel (Scenario 1 & 2).

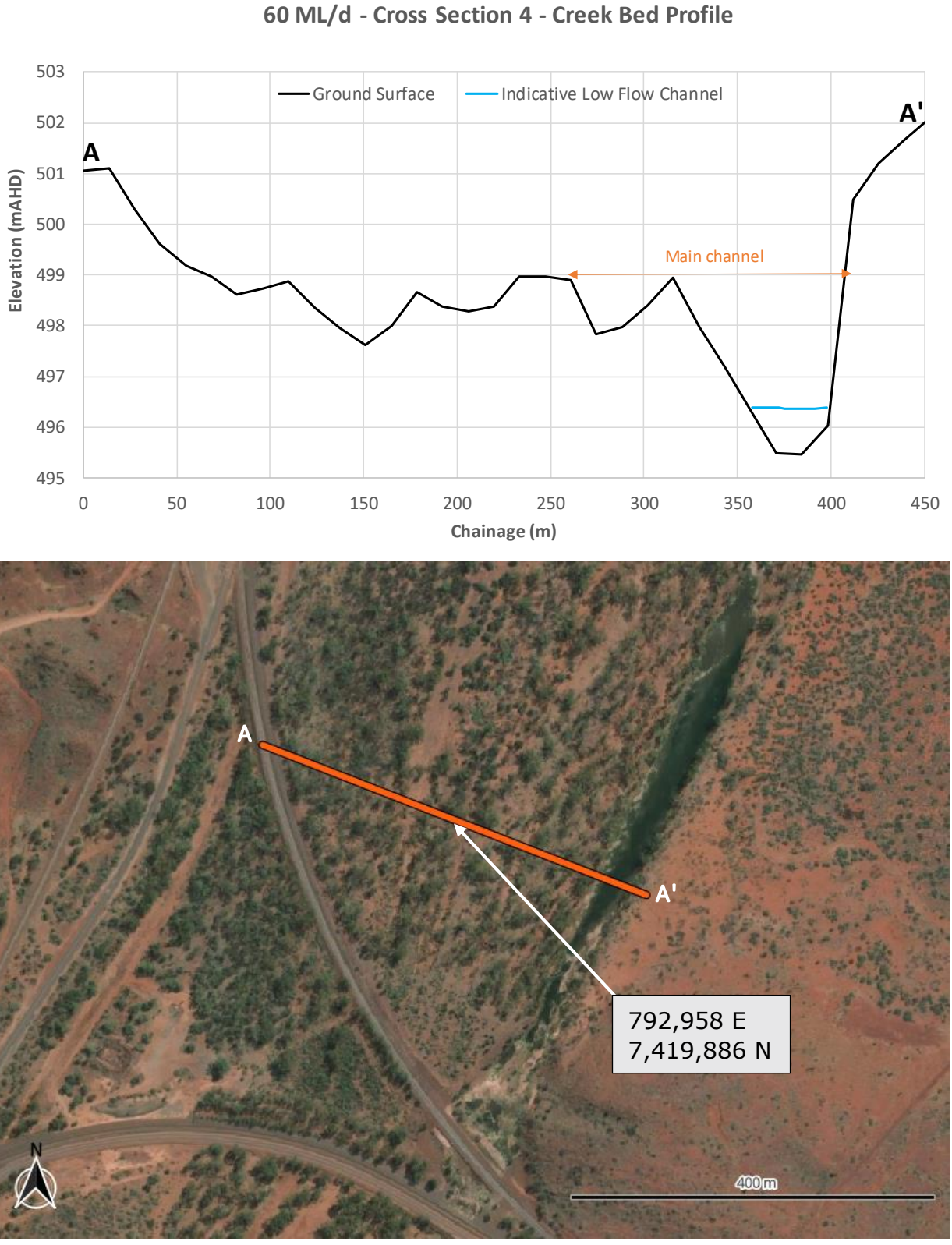
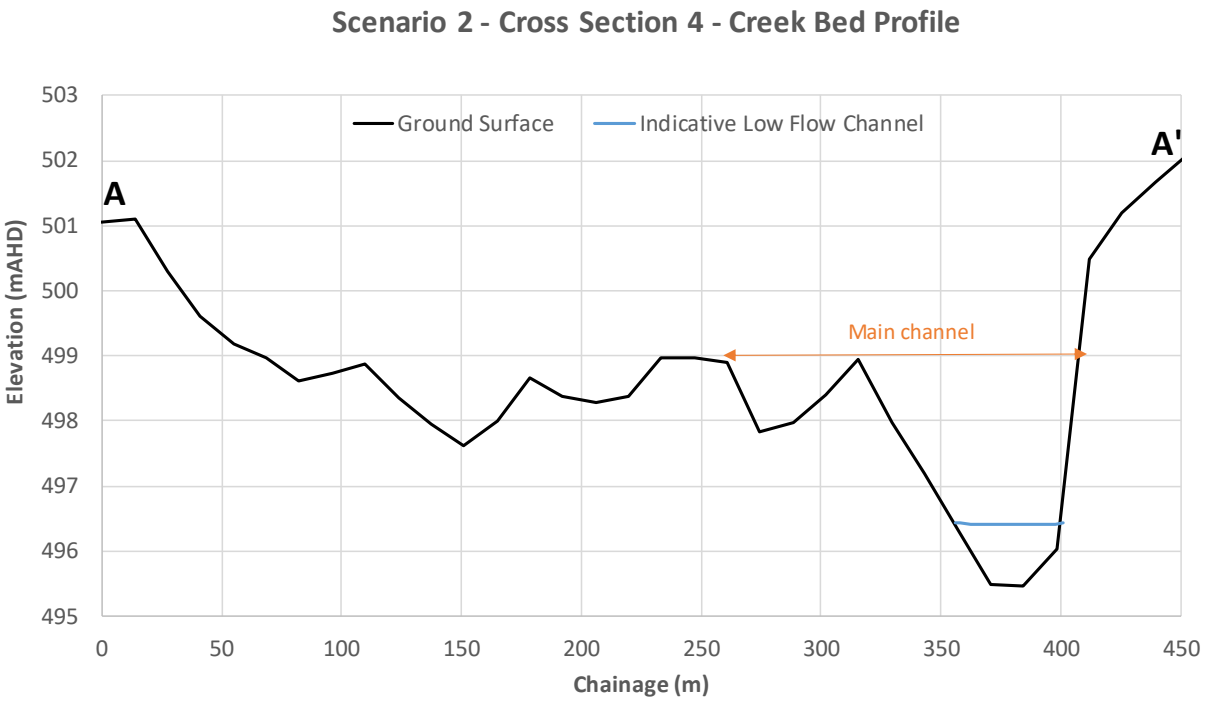


Figure 5: Cross-section 4 – confluence of Homestead Creek and Fortescue River (Scenario 1).



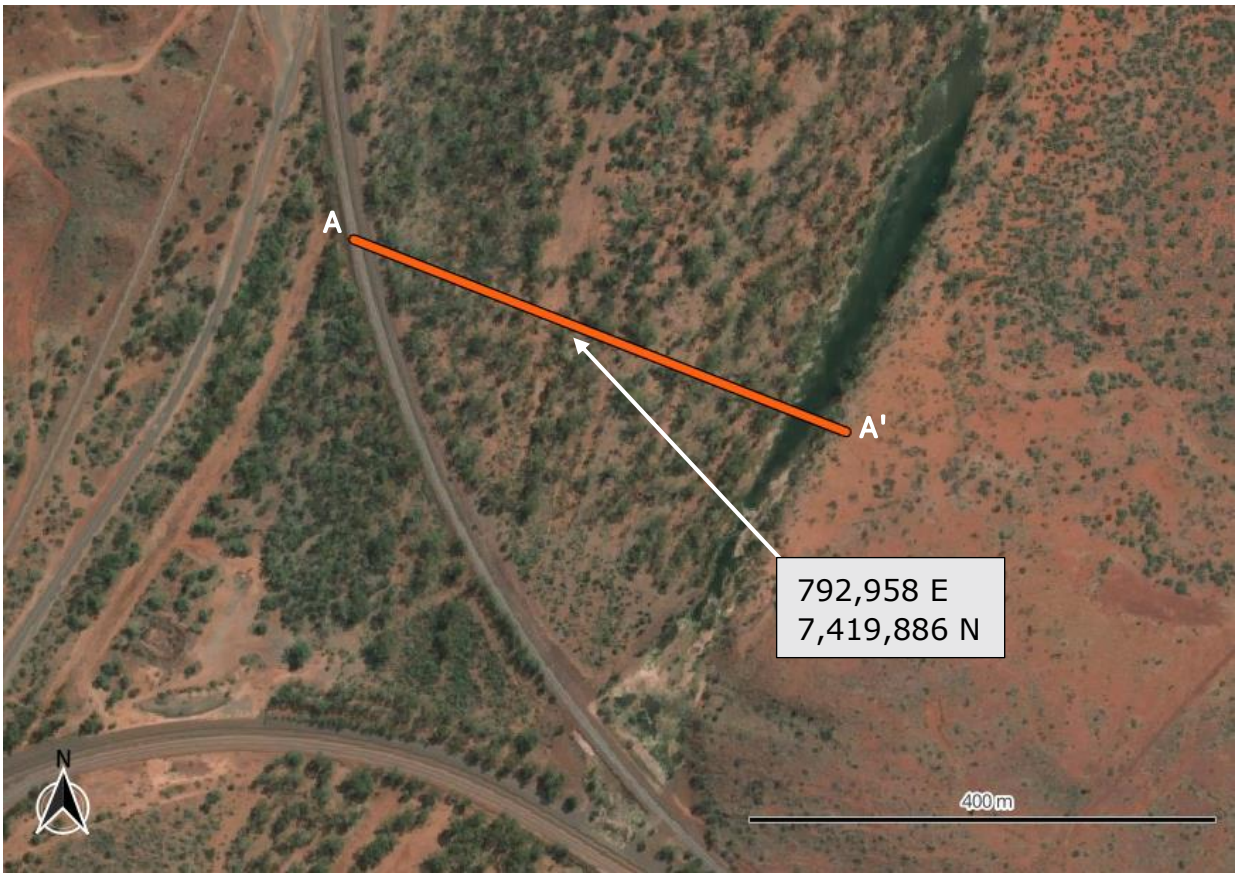


Figure 6: Cross-section 4 – confluence of Homestead Creek and Fortescue River (Scenario 2).

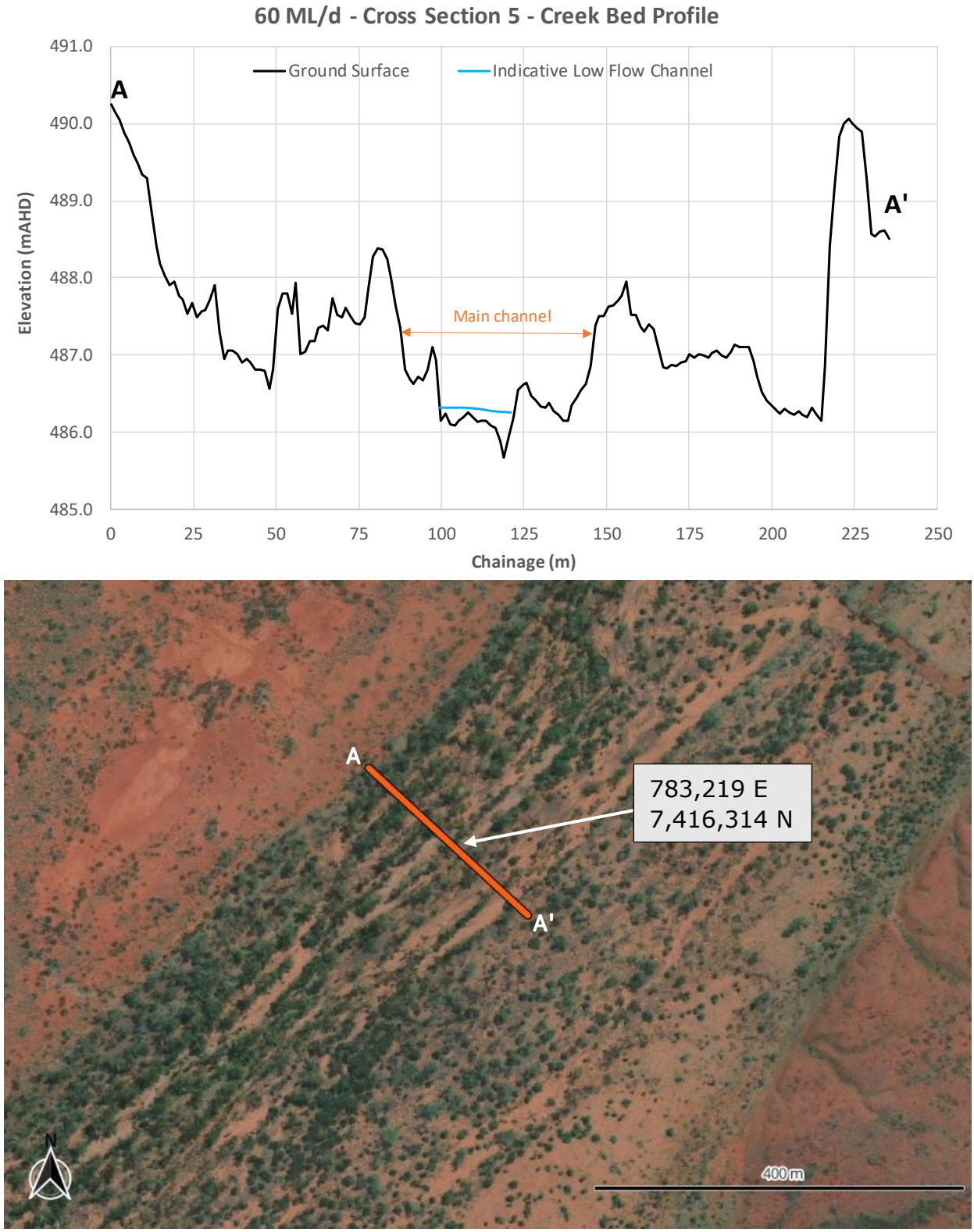


Figure 7: Cross-section 5 – Homestead Creek wide anabranching channel (Scenario 1).

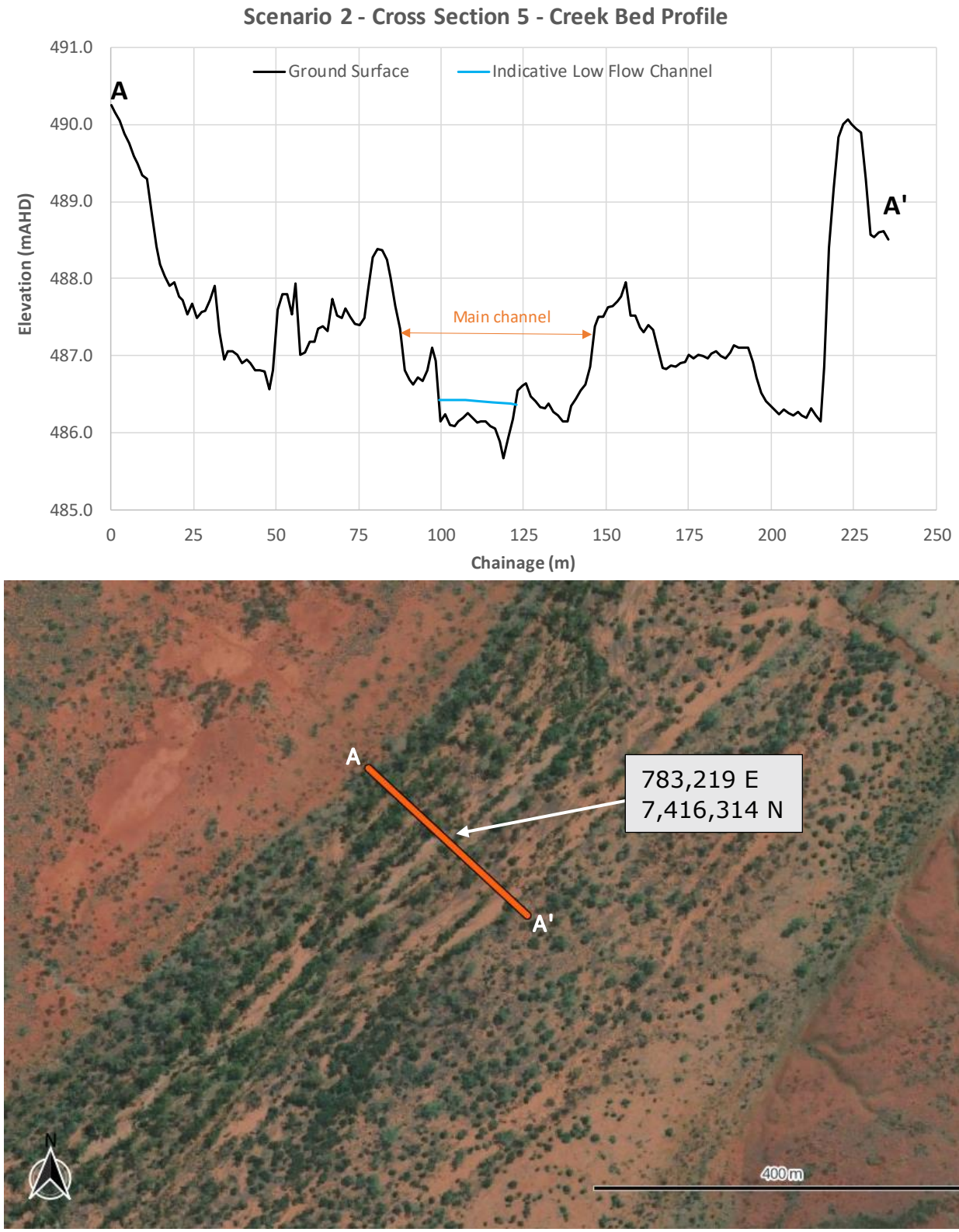


Figure 8: Cross-section 5 – Homestead Creek wide anabranching channel (Scenario 2).

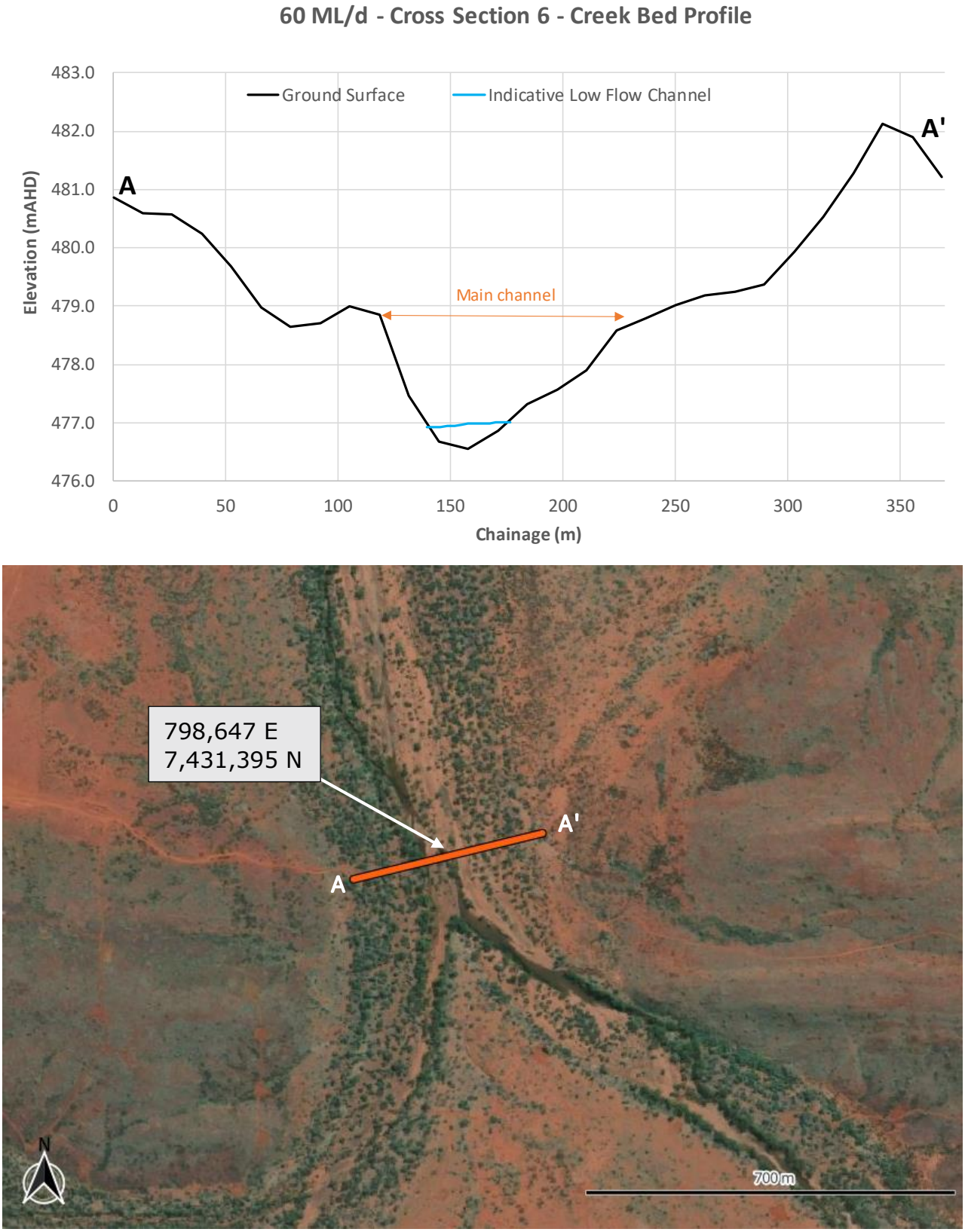


Figure 9: Cross-section 6 – confluence of Kalgan Creek and Fortescue River (Scenario 1)

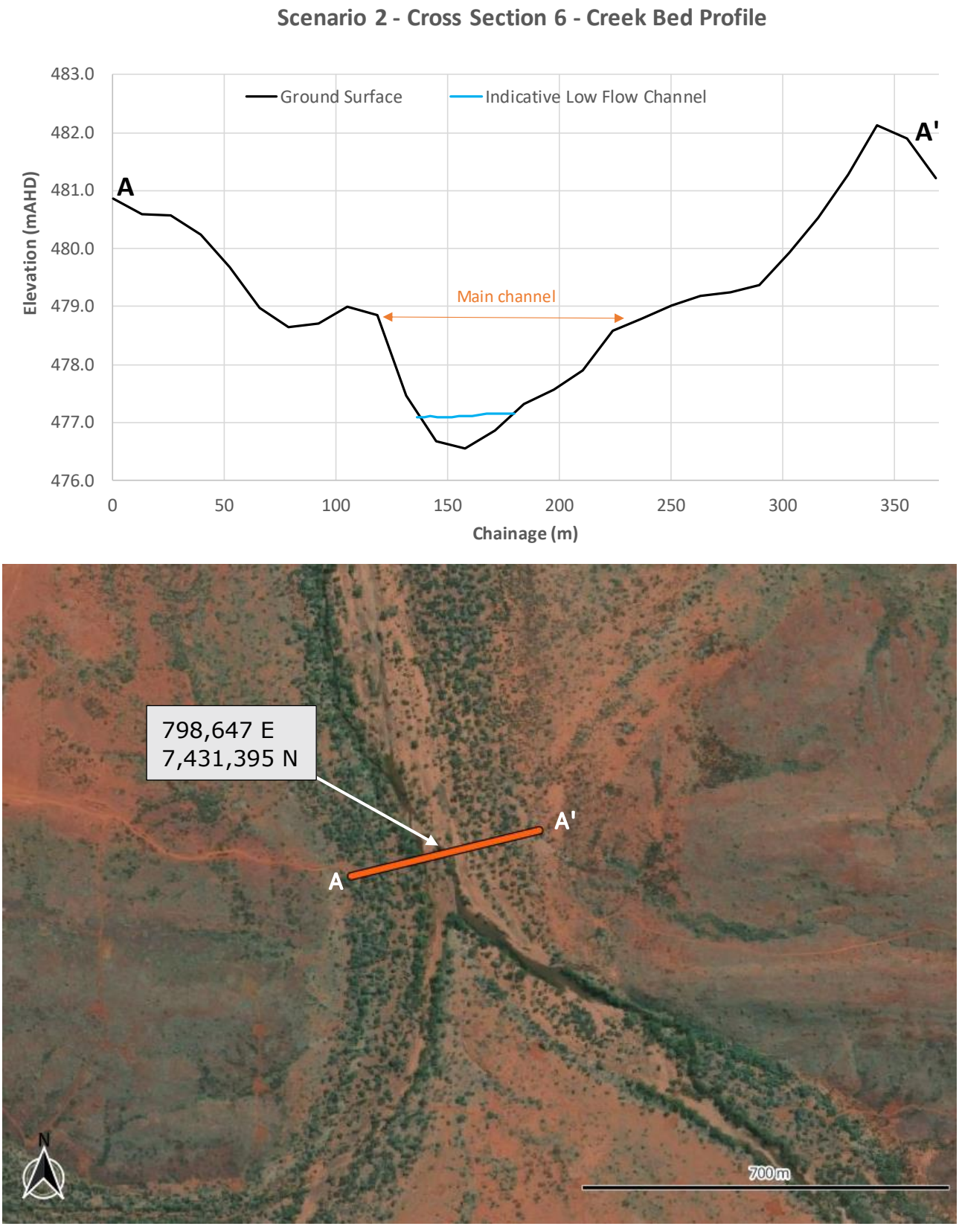


Figure 10: Cross-section 6 – confluence of Kalgan Creek and Fortescue River (Scenario 2).

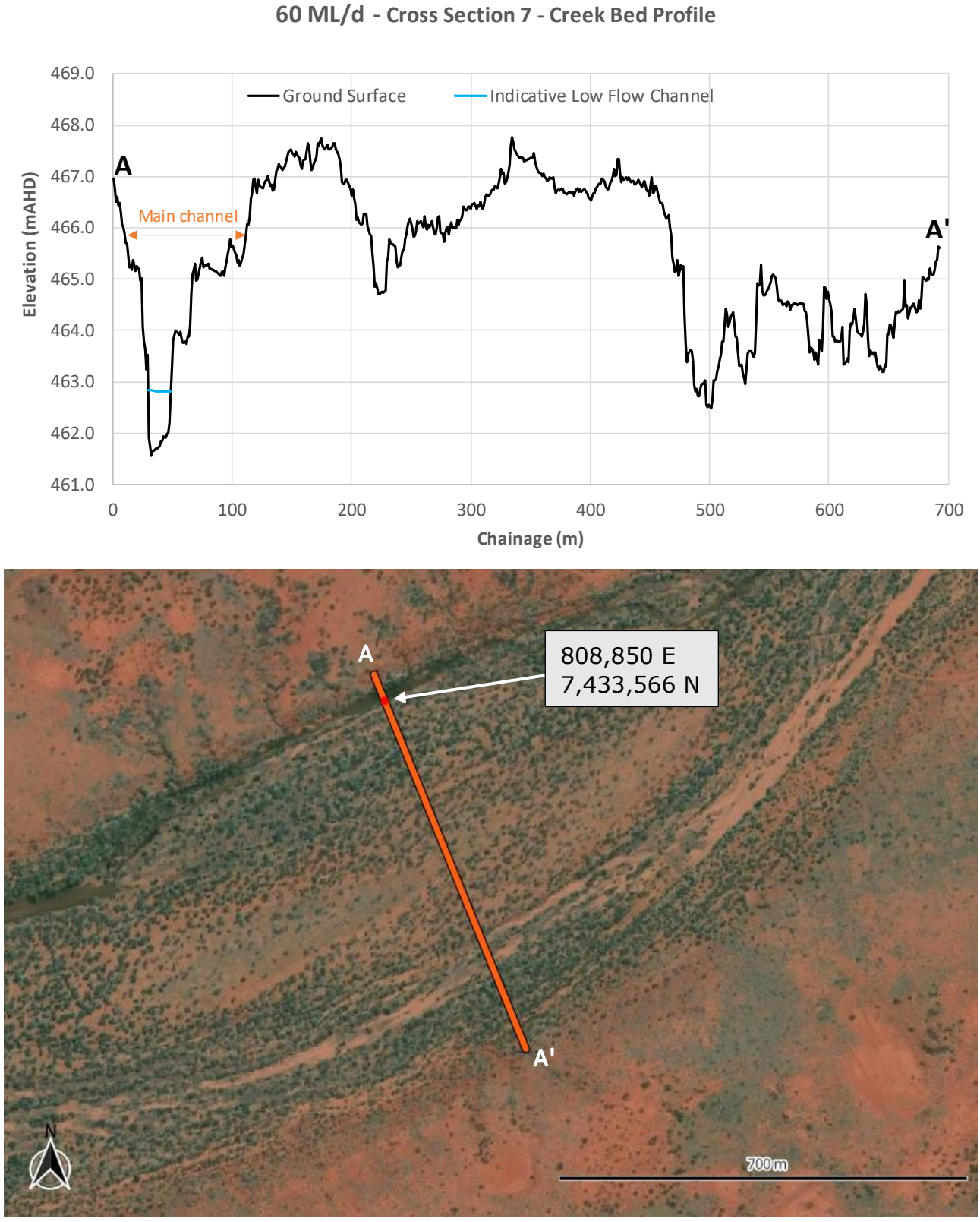


Figure 11: Cross-section 7 – Fortescue River wide anabranching reach (Scenario 1).

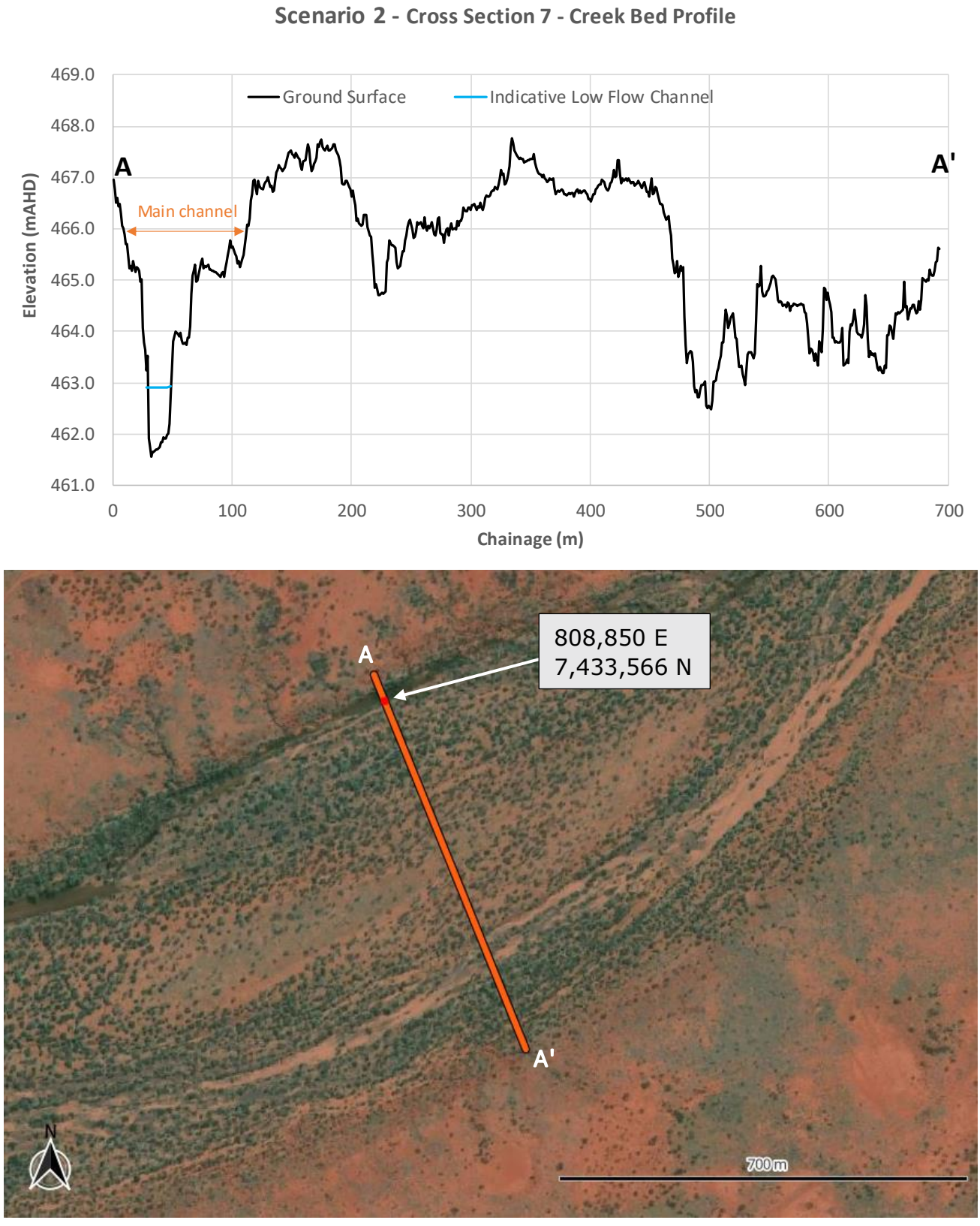


Figure 12: Cross-section 7 – Fortescue River wide anabranching reach (Scenario 2).

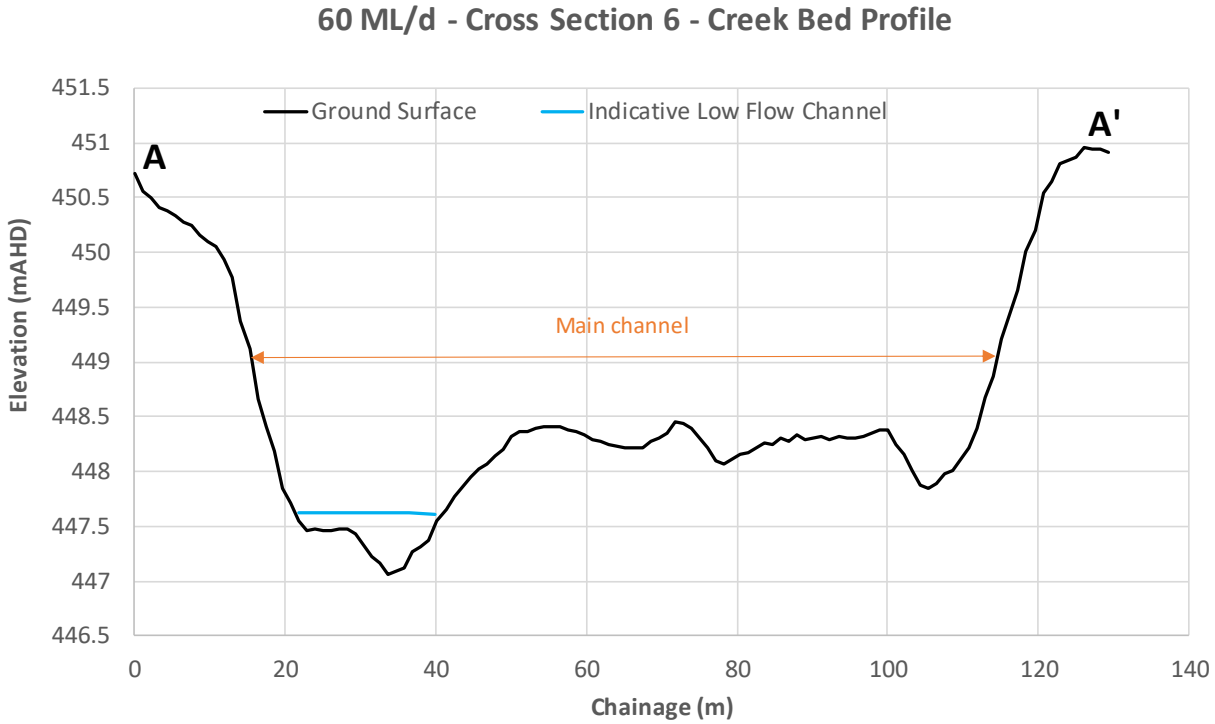


Figure 13: Cross-section 8 – Fortescue River incised reach on bend (Scenario 1).

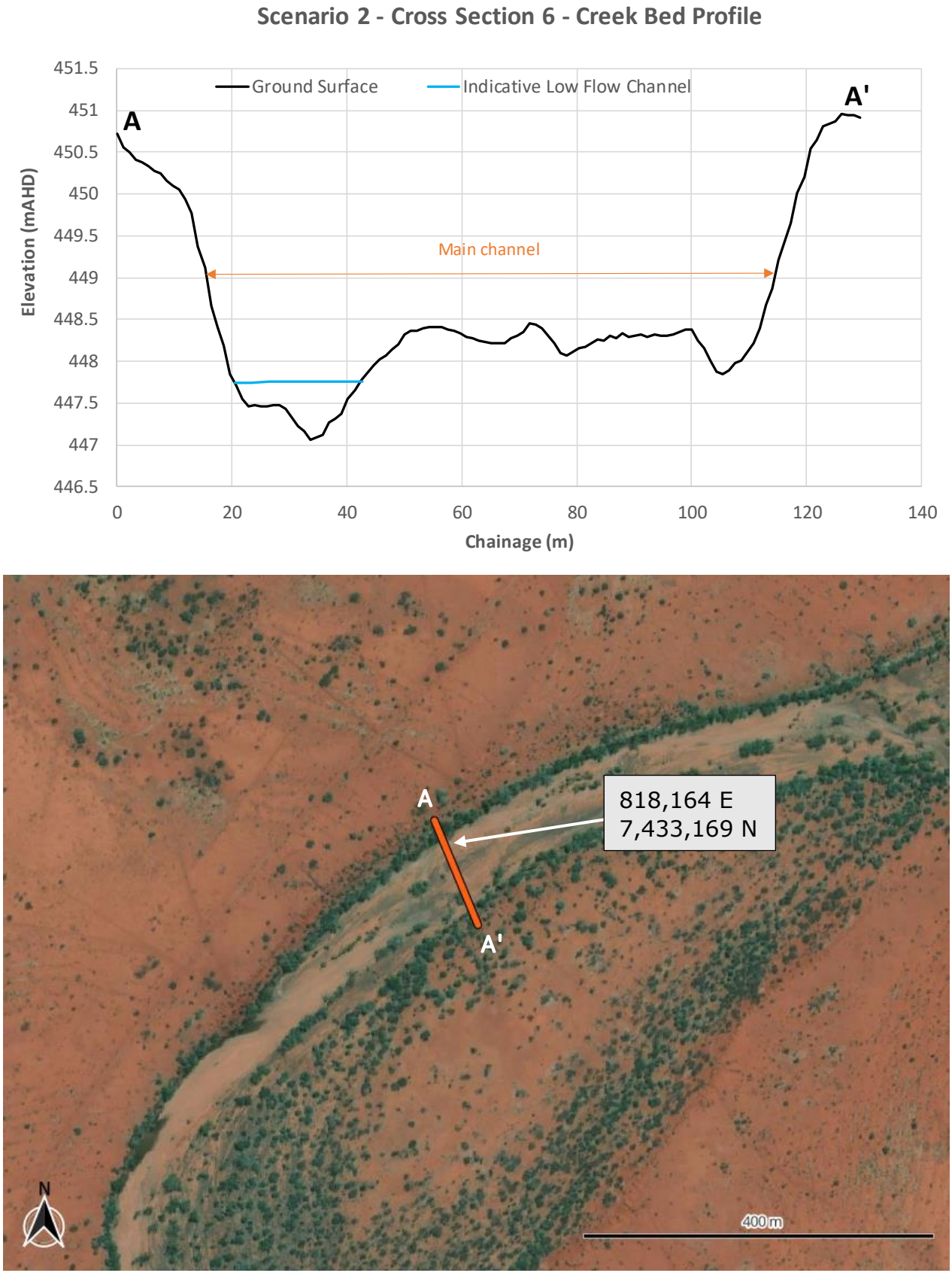
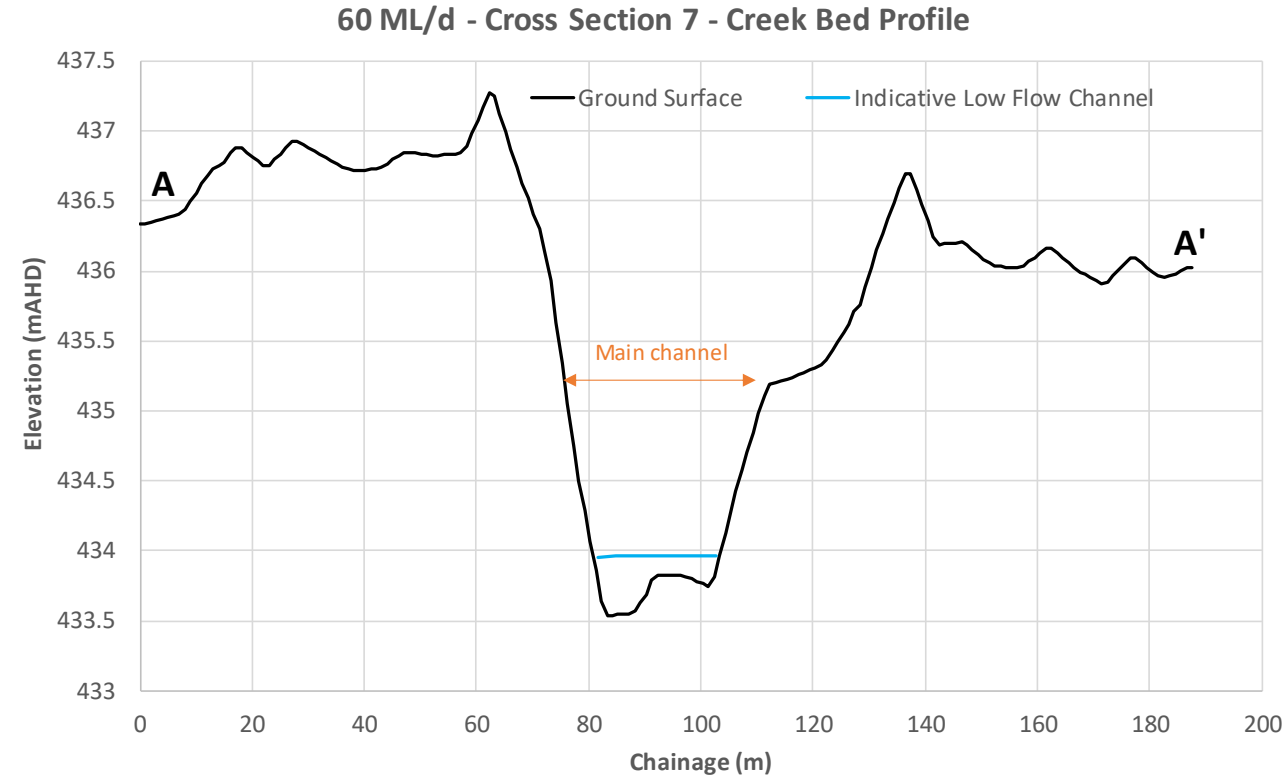


Figure 14: Cross-section 8 – Fortescue River incised reach on bend (Scenario 2).



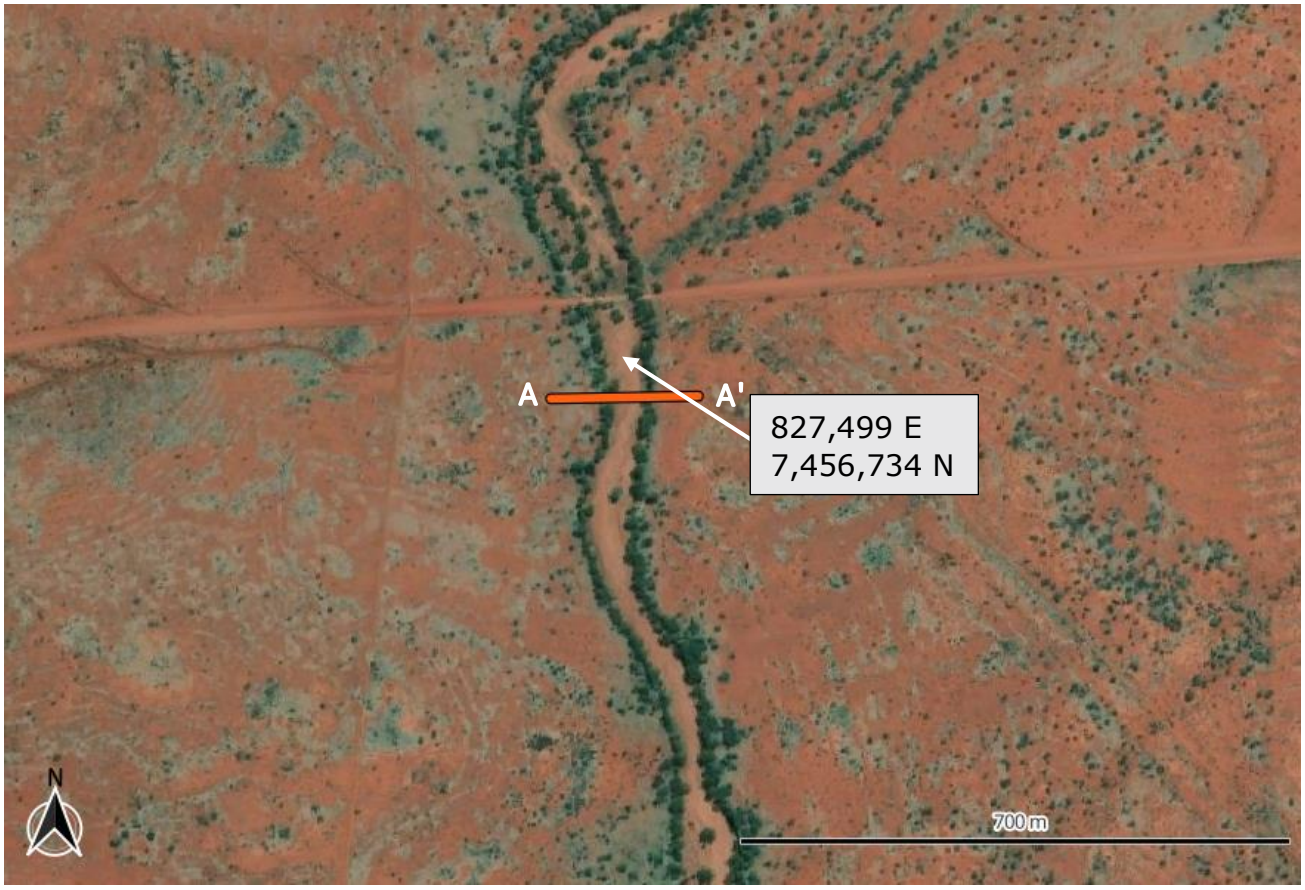


Figure 15: Cross-section 9 – Fortescue River incised reach upstream of Jigalong Road (Scenario 1).