coffey geotechnics
SPECIALISTS MANAGING THE EARTH

ENGINEERING GEOLOGY & GEOTECHNICAL MODELS

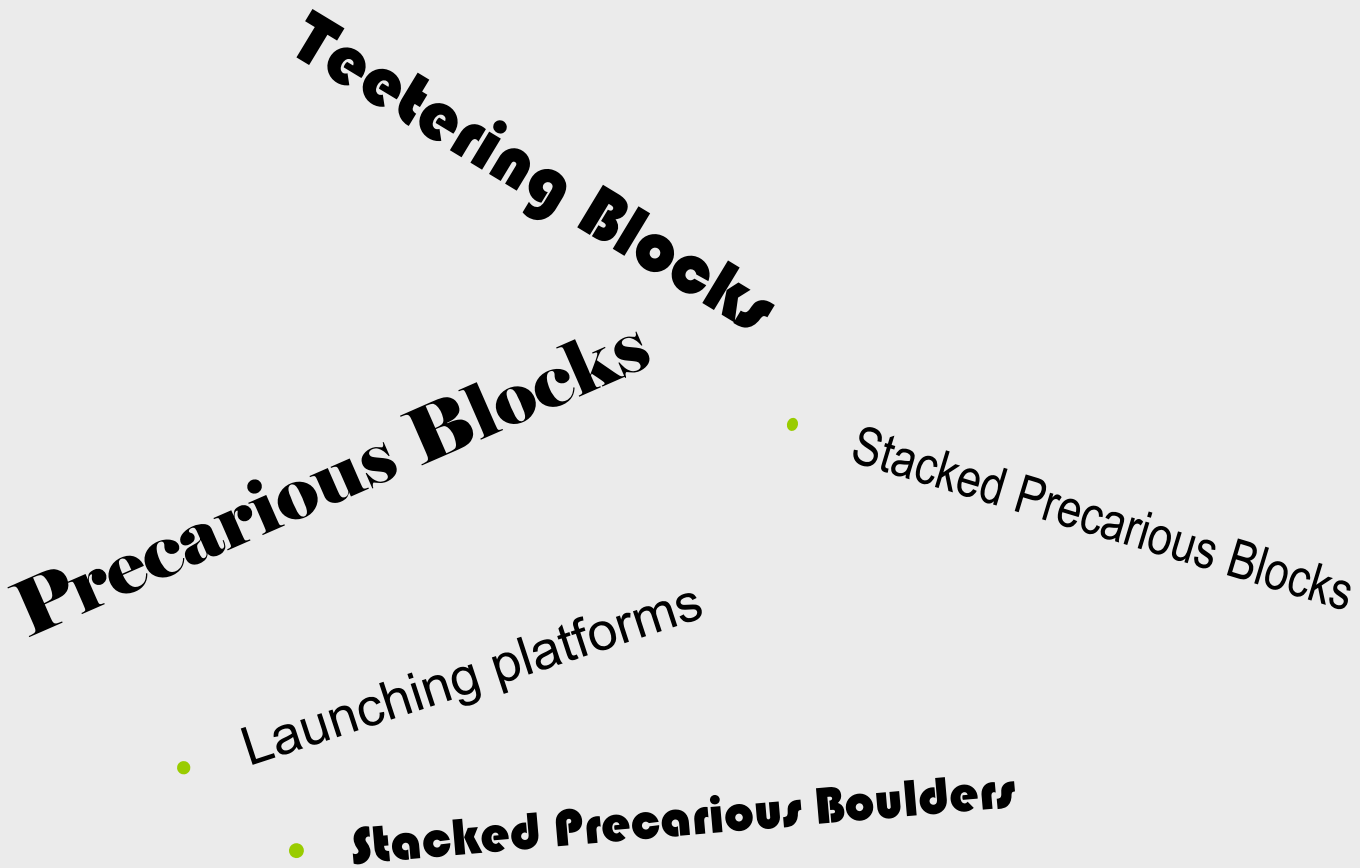
Lake George – Federal Highway Slope Stability

SH3 - FEDERAL HIGHWAY.
ROCKFALL INCIDENT ON 20 JUNE 2005.

- *The preliminary site inspection commenced at 12:00 hours on the 20 June 2005. The rockfall incident occurred near and prior to 4 am and involved a loaded semi-trailer and 2 passenger vehicles. The semi-trailer was still on site, however, the rocks had been pushed from the road and the 2 vehicles, one of which had rolled and caught fire, had been taken away. It is understood that the rocks were already on the carriageway before the vehicles arrived. There were no skid marks visible at the site, although sight distance is good. The site was wet following recent rainfalls and water was ponding at many locations.*

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

- The largest rock which reached the roadway was 0.75m^3 (1.5 x 1 x 0.5m) which along with other rocks bounced over the boundary fence (approx. 1m high). The rock impacted at several locations which were clearly visible as it crossed the northbound carriageway and came to rest in the middle of the southbound carriageway. This rock was not involved in any incident or vehicle damage.
- The rocks pushed from the northbound carriageway which may have been involved in the accident comprises a total volume of approximately 0.65 m3. The size of any original boulder is unknown, however, the maximum dimension of the largest remnant block is 0.95m with a minimum dimension of 0.3m. As the rocks would most likely lie on their minimum dimension, the maximum height of all the remnant boulders is 0.4m.



coffey geotechnics
SPECIALISTS MANAGING THE EARTH

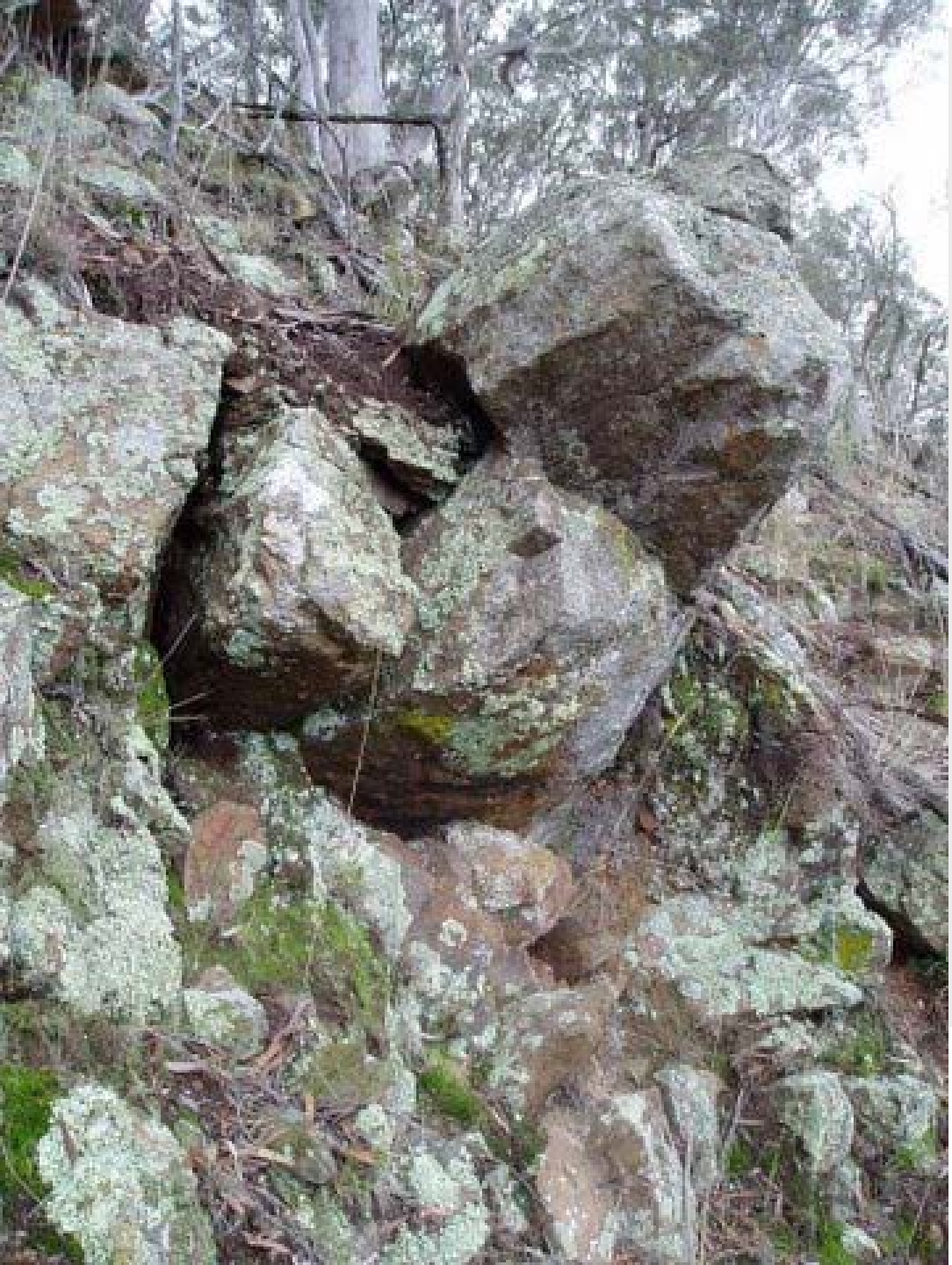
Federal Highway – Lake George NSW

- The site of the rockfall release and surrounding slope condition on 27 June 2005.
- The release area was found to be just above the upper cliff line from where it is estimated at least 2-3m^3 of rock was destabilised.
- It is likely that the impact of these rocks dislodged other unstable rocks on the slope surface adding to the over all quantity of the rock fall.

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

- Generally the slope was found to contain numerous potential rock release areas of varying sizes
- Several of the boulder sites could be easily triggered by heavy rain, erosion, progressive weathering, falling trees, bushfire, animal movement and or an earthquake.
- An inspection of the boundary fence also revealed the presence of rocks from recent falls along its length, indicating that the frequency of rock release is relatively high with falls generally contained on the slope or behind the fence.

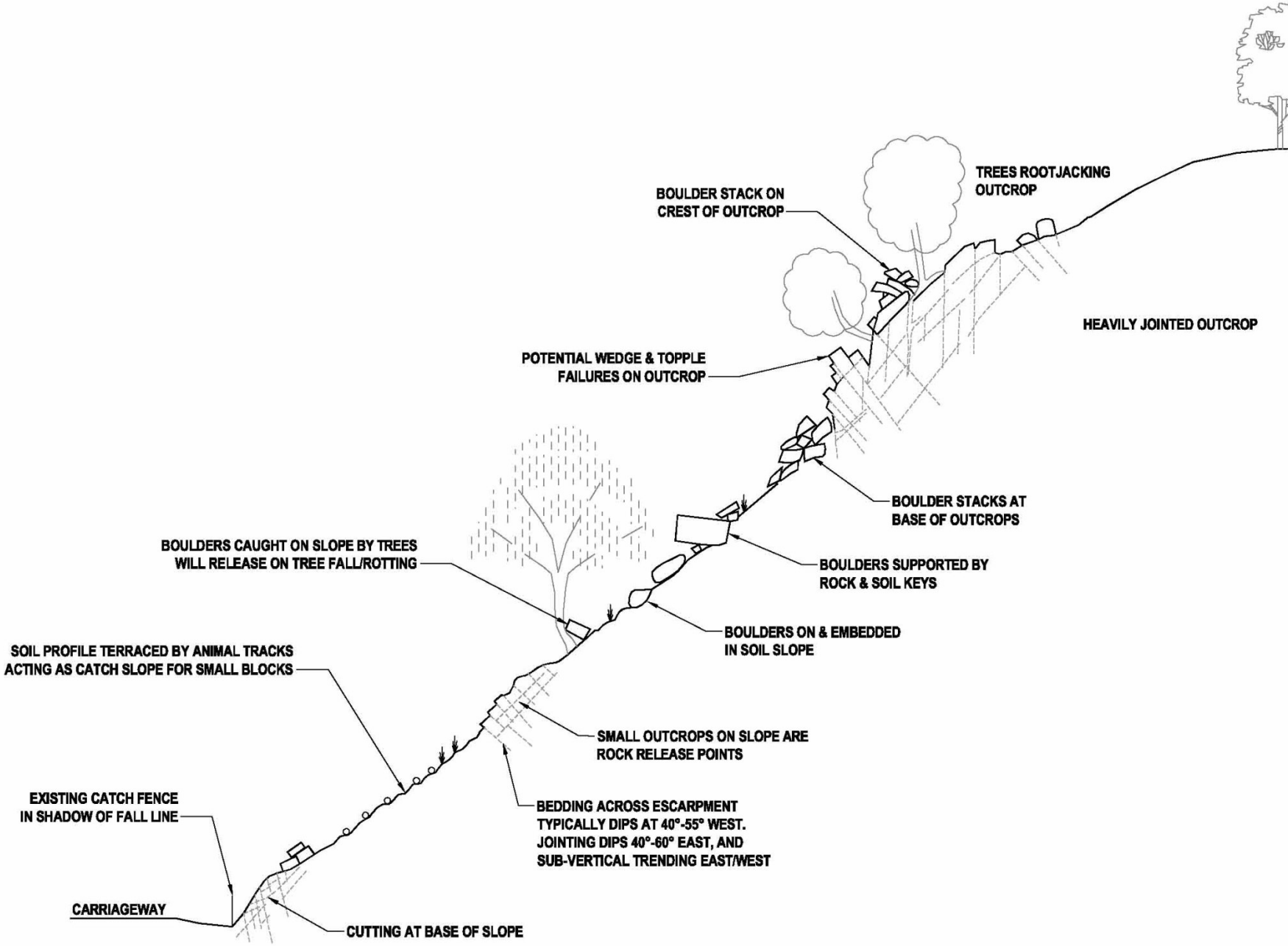
coffey geotechnics
SPECIALISTS MANAGING THE EARTH

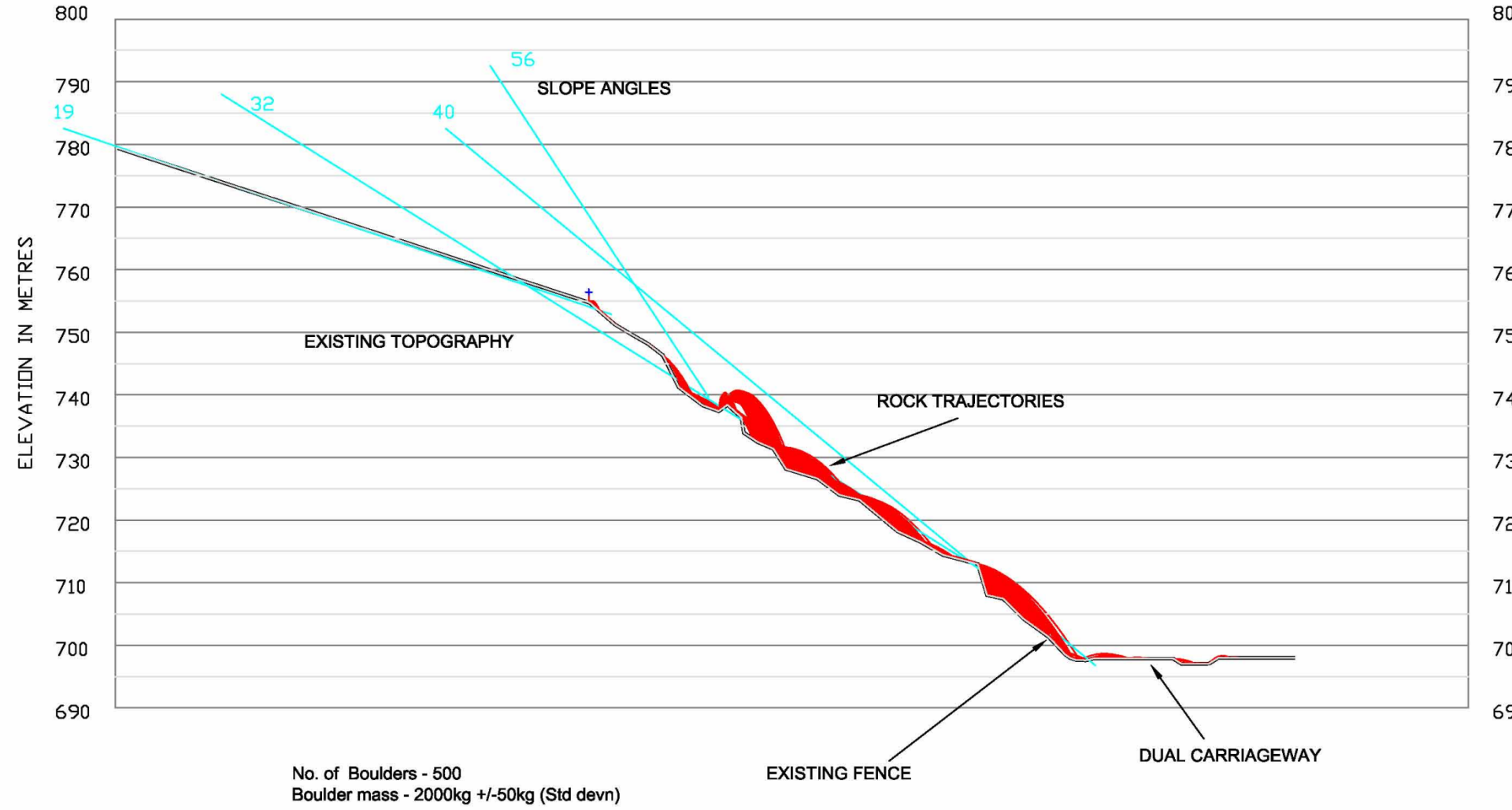


coffey geotechnics
SPECIALISTS MANAGING THE EARTH

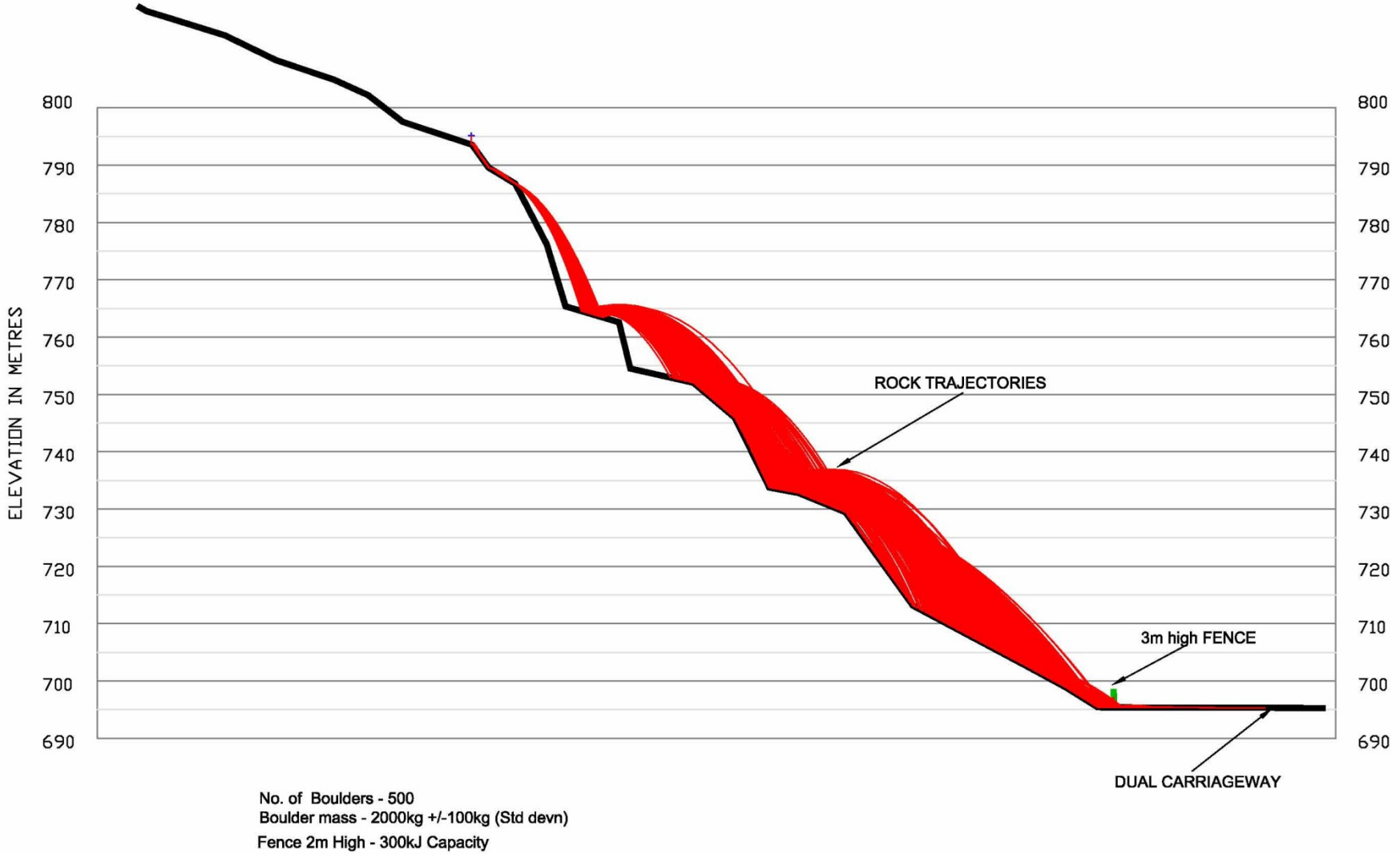
coffey geotechnics
SPECIALISTS MANAGING THE EARTH

coffey geotechnics
SPECIALISTS MANAGING THE EARTH


TREES ROOTJACKING OUTCROP
BOULDER STACK ON CREST OF OUTCROP
HEAVILY JOINTED OUTCROP
POTENTIAL WEDGE & TOPPLE FAILURES ON OUTCROP
BOULDER STACKS AT BASE OF OUTCROPS
BOULDERS CAUGHT ON SLOPE BY TREES WILL RELEASE ON TREE FALL/ROTTING
BOULDERS SUPPORTED BY ROCK & SOIL KEYS
BOULDERS ON & EMBEDDED IN SOIL SLOPE
SOIL PROFILE TERRACED BY ANIMAL TRACKS ACTING AS CATCH SLOPE FOR SMALL BLOCKS
SMALL OUTCROPS ON SLOPE ARE ROCK RELEASE POINTS
EXISTING CATCH FENCE IN SHADOW OF FALL LINE
BEDDING ACROSS ESCARPMENT TYPICALLY DIPS AT 40°-55° WEST. JOINTING DIPS 40°-60° EAST, AND SUB-VERTICAL TRENDING EAST/WEST
CARRIAGEWAY
CUTTING AT BASE OF SLOPE

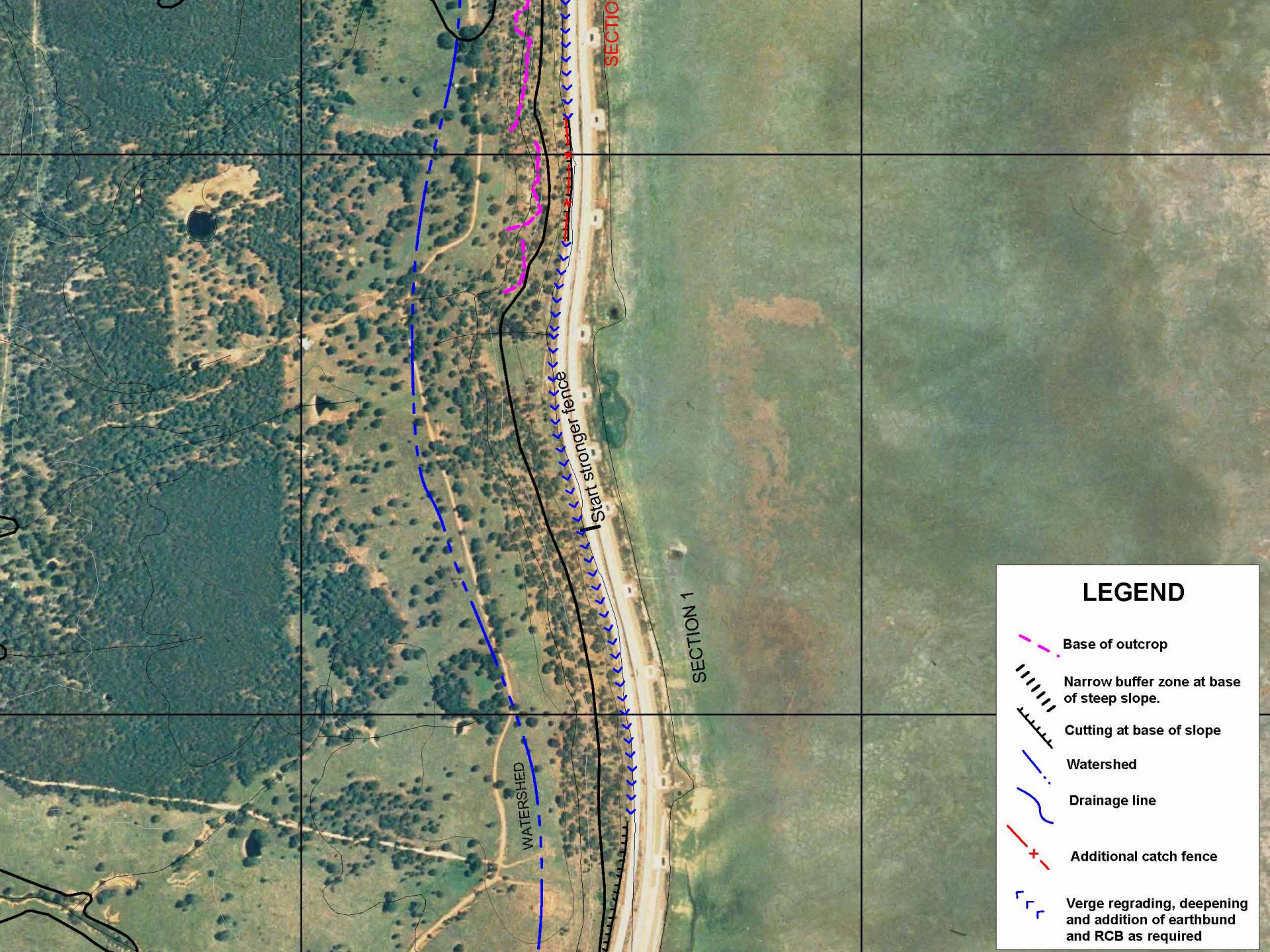


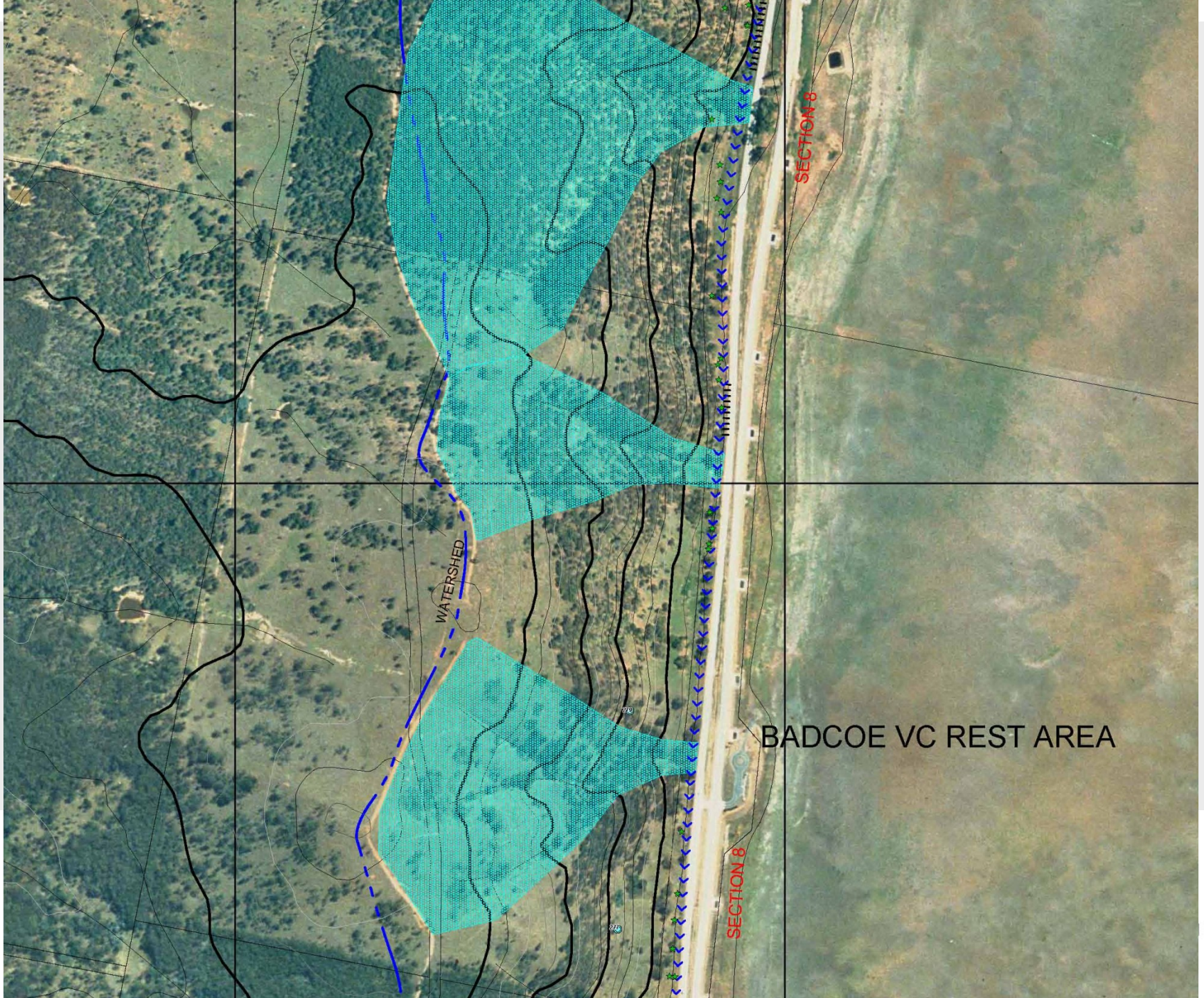
coffey geotechnics
SPECIALISTS MANAGING THE EARTH



No. of Boulders - 500
Boulder mass - 2000kg +/-100kg (Std devn)
Fence 2m High - 300kJ Capacity

coffey geotechnics
SPECIALISTS MANAGING THE EARTH


SECTION
Start stronger fence
SECTION 1
WATERSHED
LEGEND
Base of outcrop
Narrow buffer zone at base of steep slope.
Cutting at base of slope
Watershed
Drainage line
Additional catch fence
Verge regrading, deepening and addition of earthbund and RCB as required


SECTION 8
WATERSHED
BADCOE VC REST AREA
SECTION 8

12 August 2005

Waypoint	Easting	Northing	RL	Length	Width	Height	Volume	Approximate number of boulders	On Soil	Unstable outcrop	Opening joint in outcrop	Boulder stack	Slope angle	Root jacking	Held by timber	P(d)	Photograph	Suitable for rolling test
1170	716391	6117115	739	0.5	0.5	0.5	0.13	>2	X							L3	4513	
1171	716340	6117180	745	0.6	0.6	0.4	0.14		X							L3	4514	
1172	716344	6117183	748	1.5	1.5	1	2.25	2	X							L3	4515	
1173	716287	6117180	712	1.5	1.3	1	1.95	2		X		X				L2	4516	X
1174	716293	6117232	764	0.5	0.5	0.5	0.13			X						L2	4517	
1176	716292	6117337	730	1	1.5	1	1.50	8		X	X	X				L2-L3	4519	X
1177	716265	6117379	757	1.3	1	0.6	0.78			X	X					L2-L3	4520	
1178	716306	6117435	769	1.3	1.3	1	1.69	1	X							L2	4521	
1179	716329	6117489	778	1.5	1	0.8	1.20		X							L2	4522	
1180	716432	6117048		1.2	1	0.7	0.84		X						X	L2	4523	
1190	716296	6117670	728	1.2	1	0.6	0.72		X				35			L3	4528	
1192	716349	6117748	793	1.5	1.5	0.8	1.80	>10		X		X	35			L3	4531, 4532, 4533	
1193	716406	6117828	769	1.2	1	0.6	0.72	>10		X	X			X		L3	4534	
1194	716454	6117872	800	3	1.5	1	4.50									L4	4535	
1195	716450	6117880	802	1.5	1	0.5	0.75	2	X							L3	4536	
1196	716449	6117913	767	1.2	1	0.5	0.60	>3		X						L4	4537	
1197	716444	6117931	771	1	0.8	0.8	0.64		X				35			L3	4538	
1198	716465	6118107	749	1.5	1.2	1	1.80		X				35			L3	4539	
1199	716430	6114258	729	1.5	1	0.6	0.90		X				30			L4	4541	
1200	716451	6114247	733	1.2	1	0.6	0.72		X							L4	4542	
1202	716586	6118739	729	2.5	1	1.5	3.75			X	X		>35	X		L2	4546	X

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

TABLE 2: ARL SUMMARY

Section	Length of Section (m)	P_d	P_t	Estimated number of boulders on slope	Resultant Likelihood	ARL
Section 1	1460	0.001	0.0001	150	L5	ARL 3
Section 2	1190	0.01	0.001	1000	L2	ARL 1
Section 3	470	0.01	0.001	100	L3	ARL 1
Section 4	635	0.01	0.01	400	L2	ARL 1
Section 5	1090	0.01	0.01	>550	L2	ARL 1
Section 6	380	0.01	0.01	50	L3	ARL 1
Section 7	480	0.01	0.01	100	L2	ARL 1
Section 8	3050	0.001	0.0001	400	L5	ARL 3

3. ARL ASSESSMENT AND REMEDIATION MEASURES

An assessment of the ARL of the site prior to remediation works (including erection of concrete barriers) has been made using the available information. This ARL uses the hazard density information presented in our earlier report S22276/1-AF, in Table 3, coupled with the area of the hazard source to estimate the number of boulders present in each section. The likelihood of detachment (P_d) of boulders across the section has been assessed based on field data, and generally is L2 or L3, which is reflected in the hazards noted in Table 1. The travel probability (P_t) has been assessed based on the slope angles, and the base of slope conditions observed in the field. The vulnerability is based on 0.5 to 1m sized blocks on the carriageway, which equates to V2, as most blocks lee than 0.5m side dimensions should be caught with the existing catch fence.

Critical to the ARL assessment is the likelihood of the boulder reaching the carriageway which is highly dependent on the base of slope conditions.

The remediation measures outlined in report S22276/2-AF and later in S22276/2-Al are designed to reduce the ARL across the site to less than ARL 3, depending on the final design of the measures.