Report DRAFT

Marda East Drainage Investigation

Company	Southern Cross Goldfields Limited (SXG)
Site	Marda East
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- regulatory and policy changes

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1 Introduction

1.1 Report Preparation

This report is prepared by Jerome Arunakumaren, Principal Hydrological Modelling Engineer, of Resource Environment Numerical Consulting Pty Ltd, ABN 38 158 706 935 (REN Consulting) on behalf of Palaris Limited.

1.2 Background and Scope

Southern Cross Goldfields Ltd (SXG) is proposing a new greenfields gold operation at its Marda Gold Project. SXG is now looking to progress approvals for the ore deposits located north-east of the Marda Central project area, known as the Marda East Project (MEP), which includes the Red Legs and Fiddleback. These areas are approximately 12ha and 33ha in size, respectively, and are located within a project survey area of approximately 245ha.

The objectives of the report as follows:

- Description of the sites drainage by defining sub-catchment boundaries, flow directions and drainage lines
- Determination of mine runoff and potential impacts (if any) to conservation areas;
- Drafting of associated maps
- Preparation of a brief report detailing the above for manipulation and inclusion into referral documentation

1.3 Digital Elevation Model (DEM)

Watersheds are natural hydrologic entities where water flows in a definite path. DEMs provide good terrain representations and are applied routinely in watershed modelling. DEMs can be used to derive flow networks and then automatically generate watershed boundaries for given outlet points using GIS technology. Therefore, an essential component to watershed delineation is a hydrologically sound DEM of the land area of interest.

The NASA Shuttle Radar Topographic Mission (SRTM) provides DEMs for over 80% of the globe at 3 arc second resolution. MEP provides 2m vertical resolution contours for the project area (22.65km x 18.60km). Figure 1 indicates the DEM developed for the study area with the MEP 2m contours and SRTM data.

2 Site Drainage and Watershed Delineation

A watershed is a topographically delineated area that is drained by a stream system. Watershed delineation and natural drainage network for the study area were generated from the DEM using the MapWindow software. MapWindow supports manipulation, analysis, and viewing of geospatial data and associated attribute data in several standard GIS data formats. MapWindow provides the "Watershed delineation" plugin to delineate watersheds. Figure 2 provides the delineated watershed sub-catchments based on the DEM developed using the MEP 2m contours. The SRTM data has been used to delineate the sub-catchments outside of the MEP-2m contour coverage. Figure 3 provides the sub-catchments delineated with the MEP and SRTM DEMs. Figure 4 indicates the flow directions within the sub-catchments. As indicated in Figure 3 and 4, there is a natural watershed is present between the mine outline and the proposed Class "A" Nature Reserve adjacent to the mine. The runoff from the sub-catchments flow north-east direction into Lake Giles through the Mt Manning Conservation Park.

The following conclusions can be made from the major drainage lines identified in deriving the sub-catchment boundaries:

- the drainage from the proposed mine area is within the Salt Lake River Basin
- runoff from the area around the proposed mine will flow into Lake Giles which is a salt lake
- the proposed mine areas will not drain into the Proposed Class A Nature Reserve

3 Design Peak Floods

Design flood peaks have been estimated at two locations within the proposed mine lease areas. Figure 5 provides locations and their catchment boundaries.

Location A - This location (119.3877518° E, 29.91759548° S) is within the proposed Red Legs mine lease area. The catchment also is within the mine area, and is approximately 14.6 ha in area.

Location B - This location (119.4153293° E, -29.95433759° S) is within the proposed Fiddleback mine lease area. The catchment lies partly within and partly outside of the proposed mine lease area. The catchment area is approximately 121.2 ha.

The peak discharges at these locations have been estimated using the Rational Method for Western Australia as described in "Australian Rainfall and Runoff – A Guide to Flood Estimation"(ARR), published by the Institution of Engineers Australia May 2003. The proposed mine leases fall within the Arid Zone of Western Australia. As there is virtually no flow record available for the Arid Zone, ARR recommends use of the rational method for the Wheatbelt Area, which has been applied.

Table 1.1 provides relevant information as well as the estimates of the 10 year average recurrence interval (ARI) and 50 year ARI peak discharges at these two locations. The estimated peak flow estimates in Table 1.1 are for the undisturbed (existing) state of development. Development of the mine will alter the drainage therefore the catchment areas and peak discharge estimates may change. The 100 year ARI coefficients for the rational method have not been provided in ARR, so the peak Q100 was not estimated.

Water erosion is a natural process whereby soil particles are detached from the soil surface and transported by the movement of water. The three dominant processes of water erosion are classified as 'hillslope', 'gully' and 'stream bank'. The MEP 2m contours indicate that runoff at Location A would be sheet flow in nature and at Location B, it appears to be drainage present. In order to determine the erosion potential, topographic influences such as peak flow velocity and vegetation cover, and soil erodibility should be considered. The resolution of the MEP 2m contours is inadequate to define the cross-sectional areas at locations A and B, in order to calculate the peak velocities.

Table 3.1 Peak Discharge Estimates – Pre-Development

Description	Unit	Location A	Location B
Catchment Area	km^2	0.1468	1.212
Mainstream Length	km	0.59	2.017
10 year ARI Runoff Coefficient C_{10}		0.43	0.26
Time of concentration Tc	min	22	49.1
10 year ARI rainfall intensity for duration = T_c	mm/hr	45.3	28.7

Description	Unit	Location A	Location B
50 year ARI rainfall intensity for duration = T_c	mm/hr	70.9	44.6
Estimated 10 year ARI Peak Discharge	**m^3/s**	**0.79**	**2.51**
Estimated 50 year ARI Peak Discharge	**m^3/s**	**2.73**	**8.59**

4 Conclusion

This study confirms that a natural watershed is present between the proposed Marda East mine outline and the proposed Class “A” Nature Reserve adjacent to the mine. The runoff from the sub-catchments flow north-east direction into Lake Giles through the Mt Manning Conservation Park. The proposed mine areas will not drain into the Proposed Class “A” Nature Reserve and impacts to the Mt Manning Conservation Park areas are expected to be minimal.

Appendix A Figures

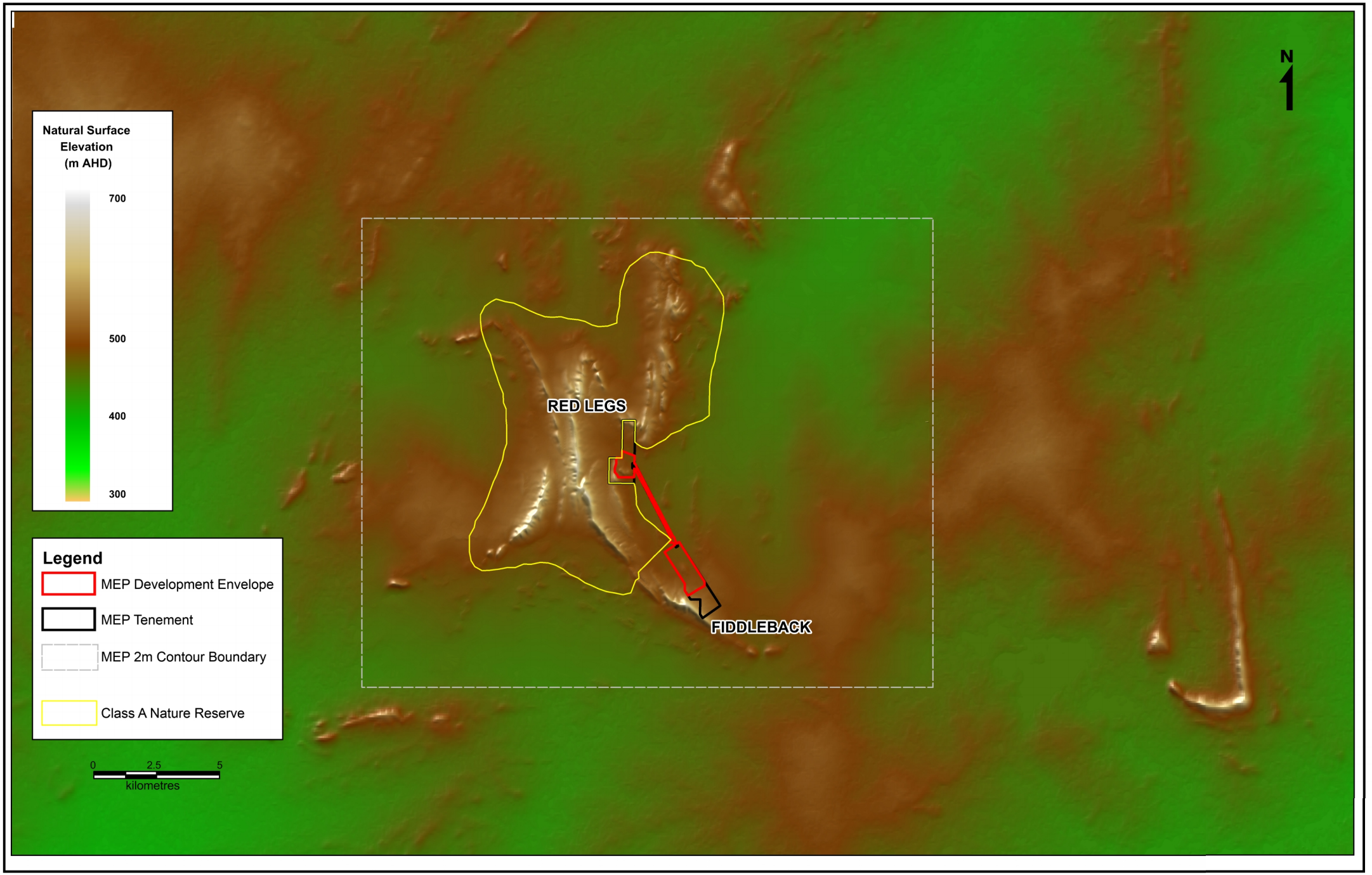

Figure 1
COMBINED DIGITAL ELEVATION MODEL

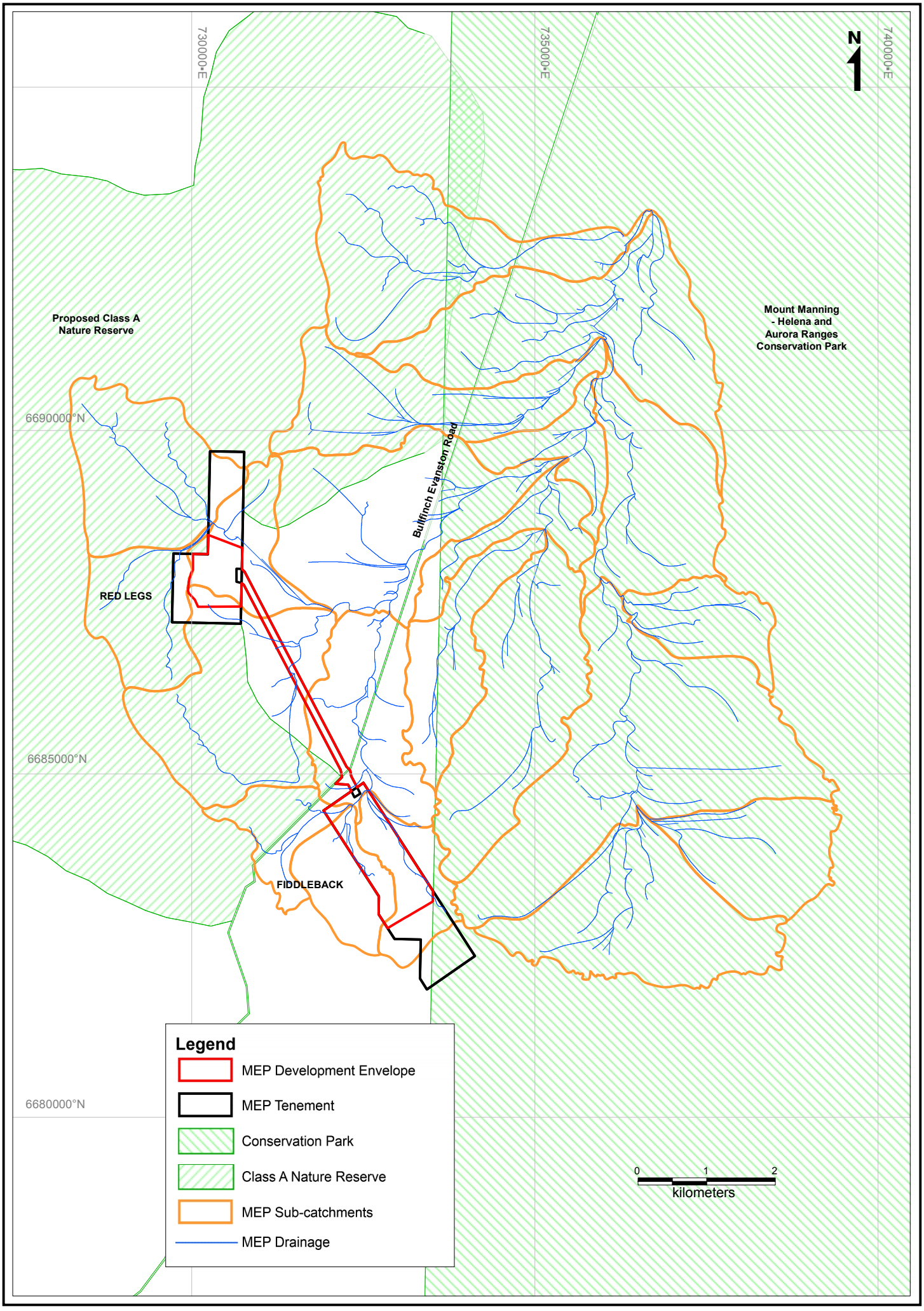

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Figure 2
SUB-CATCHMENTS (MEP 2m - CONTOURS)

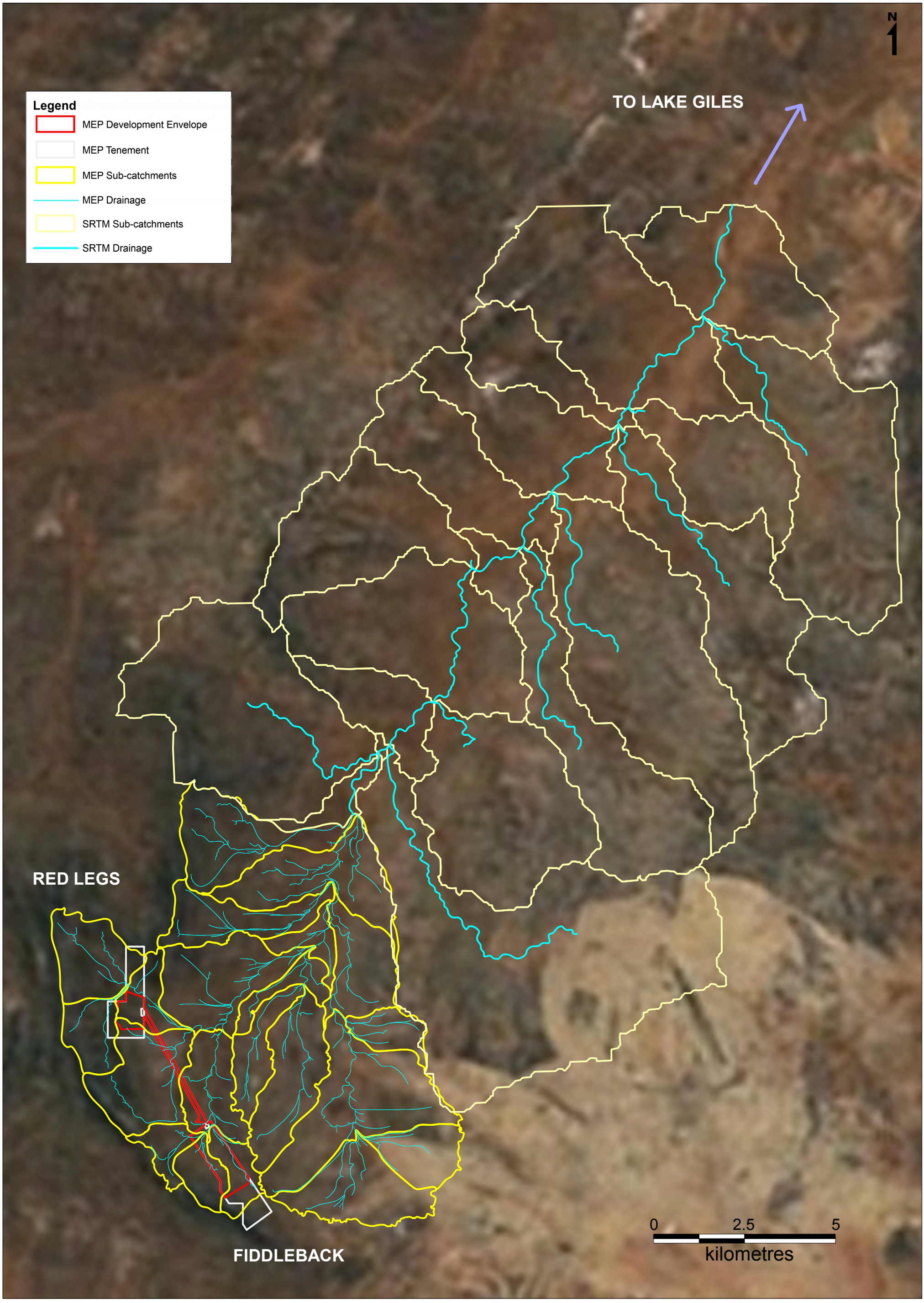

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Figure 3
DRAINAGE TOWARDS LAKE GILES

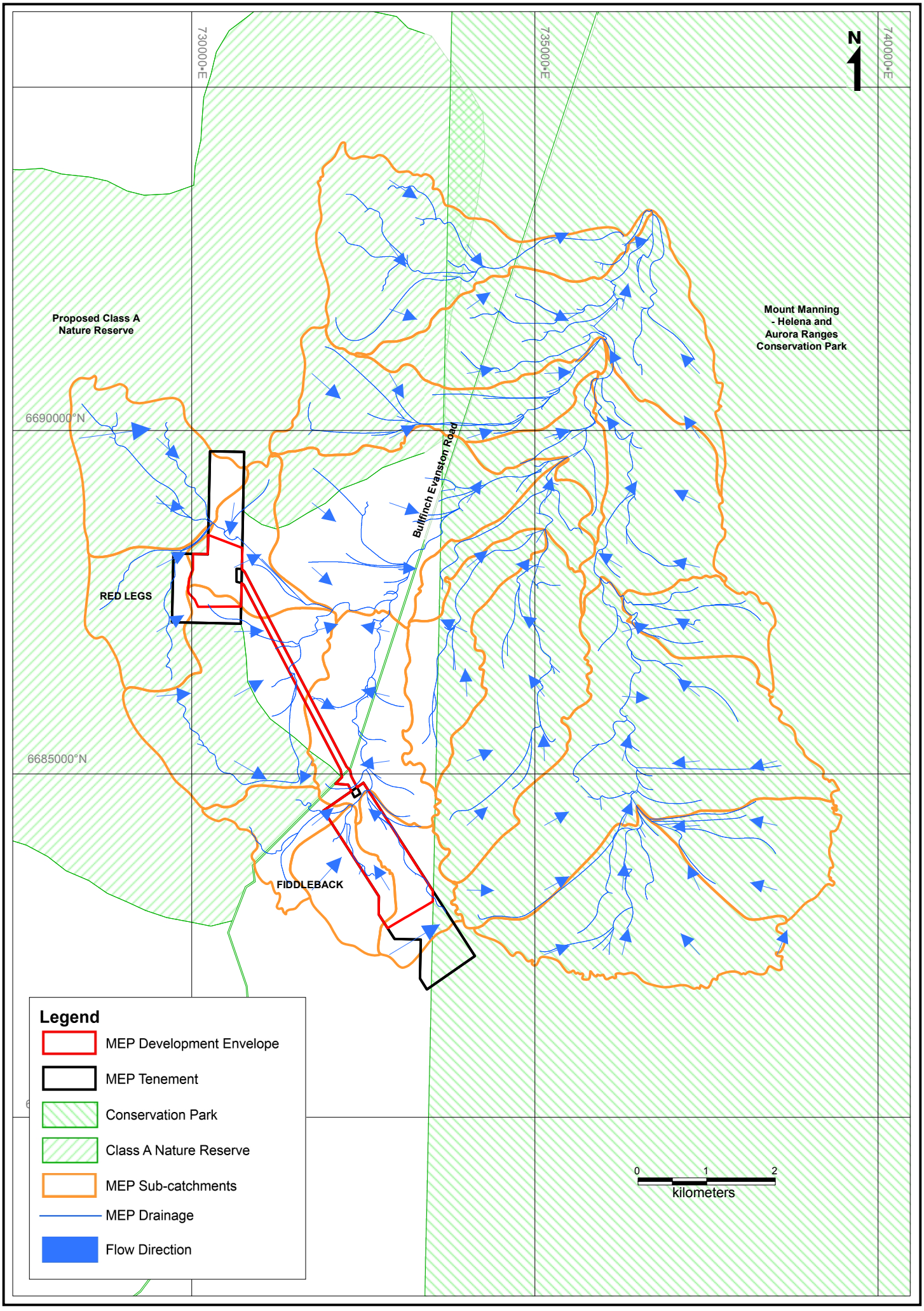

Figure 4
FLOW DIRECTIONS

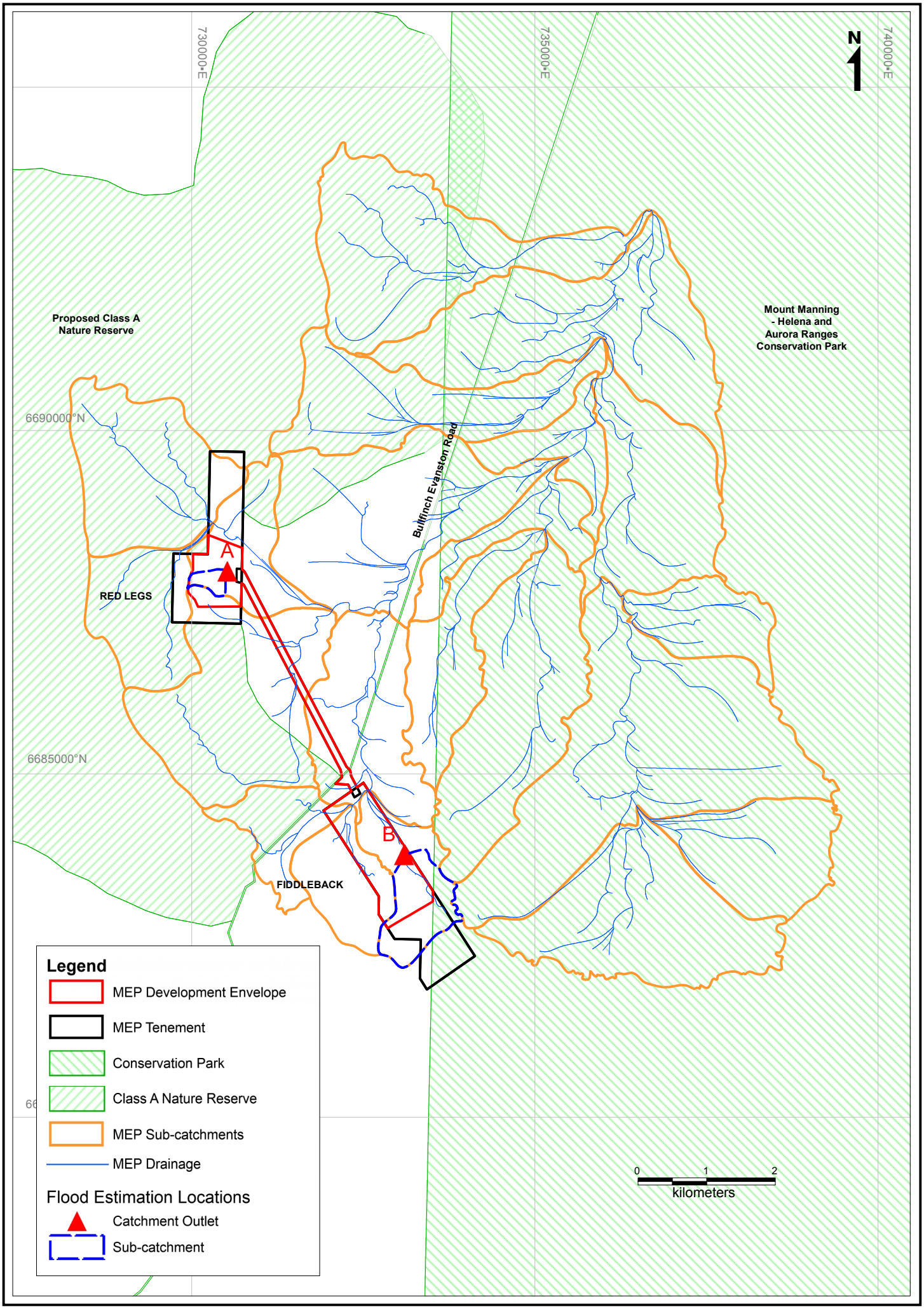

Figure 5
FLOOD ESTIMATION LOCATIONS