Appendix 9

Sediment Basin Storage Requirement Calculations

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1. SEDIMENT BASIN CALCULATIONS

1.1 BASIN TYPE

Based on the sediment type generated in the disturbed catchment, the basin should be designed as a Type D/F (Water Retention) Basin. These are also referred to as 'fill and spill' structures as they are designed to retain all in-flows to allow for settlement of sediment before the water is discharged after the total suspended solids of the water is reduced to criteria level (50mg/L).

1.2 CATCHMENT SIZE

Four catchments have been identified for the Dowe's Quarry (see **Figure A**). Runoff within the Pit Catchment is assumed to be diverted into the pit and would not be discharged. The effective catchments reporting to the remaining catchments are as follows.

- Northern Dam Catchment – 1.7ha.
- Western Dam Catchment – 1.2ha.
- Southern Dam Catchment – 0.5ha.

Capacity requirements for sediment basins for these three catchments are required.

1.3 RAINFALL DATA

Volume 2E of the Blue Book identifies that the design rainfall event to be used to determine the sediment storage and water settlement zones as either:

- 5-day 90th percentile event for standard receiving environments; or
- 5-day 95th percentile for sensitive receiving environments.

A 'sensitive' receiving environment is defined by Volume 2E of the Blue Book as "*one that has a high conservation value, or supports human uses of water that are particularly sensitive to degraded water quality*". At this stage it is assumed that the receiving environment does not fit this definition. Therefore, the design rainfall event to be used to determine storage and settlement criteria is the **5-day 90th percentile event**.

Rainfall data was extracted for the site from SILO (scientific data for landowners) database. The calculated 5-day 90th percentile event from SILO data is **35.1mm**. However, the Blue Book Table 6.3a gives the rainfall depth of a 5-day 90th percentile event for the nearest town (i.e. Tenterfield) as **47.4mm**. For sediment basin size calculation, we adopted the more conservative value given in Blue Book.

1.4 EROSION DATA

1.4.1 Rainfall Erosivity (R-Factor)

The rainfall erosivity (R-factor) of a location influences the likely soil loss (erosion). Based on the maps generated by Figure 4.9 of Landcom (2004), the site has a moderate R-Factor of 1900.

1.4.2 Erodibility (K) Factor

A conservative K-factor of **0.05** is adopted in line with the recommendations of Volume 2E of the Blue Book.

1.4.3 Length / Gradient (LS) Factor

The local topography is generally 3:1 (H:V) (~30%), with the length of slopes within each catchment generally between 60m and 80m. There is currently no plan to bench these slopes to modify the LS Factor. The following slope lengths, gradients and LS Factors have been calculated for the three catchments.

- Northern Dam Catchment gradient = 30%, length = 80m – LS Factor = 11.6
- Western Dam Catchment: gradient = 30%, length = 80m – LS Factor = 11.6
- Southern Dam Catchment: gradient = 30%, length = 60m – LS Factor = 9.23

1.5 SOIL HYDROLOGIC GROUP AND RUNOFF COEFFICIENTS

For cleared catchments, i.e. those without significant vegetation or other cover likely to slow the flow of water and reduce runoff, the runoff coefficient is largely a factor of the permeability and saturation of the soil or surface. *Appendix F* of Landcom (2004) identifies four Soil Hydrologic Groups, derived by USDA (1993) through consideration of infiltration and permeability characteristics.

- Group A: very low runoff potential. Water moves into and through these soil materials relatively quickly, when thoroughly wetted. Usually, they consist of deep (>1.0m), well-drained sandy loams, sands or gravels. They shed runoff only in extreme storm events.
- Group B: low to moderate runoff potential. Water moves into and through these soil materials at a moderate rate when thoroughly wetted. Usually, they consist of moderately deep (>0.5m), well-drained soils with medium, loamy textures or clay loams with moderate structure. They shed runoff only infrequently.
- Group C: moderate to high runoff potential. Water moves into and through these soil materials at slow to moderate rates when thoroughly wetted. Usually, they consist of soils that have:
  - moderately fine (clay loam) to fine (clay) texture;
  - weak to moderate structure; and/or
  - a layer near the surface that impedes free downward movement of water.

  They regularly shed runoff from moderate rainfall events.
- Group D: very high runoff potential. Water moves into and through these soils very slowly when thoroughly wetted. Usually, they consist of soils:
  - that are fine-textured (clay), poorly structured, surface-sealed or have high shrink/swell properties, and/or

– with a permanent high water table, and/or

– with a layer near the surface that is nearly impervious.

They shed runoff from most rainfall events.

Considering the three catchments for which sediment basins are required, the Northern and Southern Dam Catchments are considered most likely representative of Soil Hydrologic Group C given the stockpiling of clay materials within these catchments. Based on the predominantly hardstand surface of the Central Dam Catchment, this is considered most likely representative of Soil Hydrologic Group D.

With reference to *Table F2* of the Blue Book, the volumetric runoff coefficient (C_v) for the 5-day 90th percentile rainfall event for the three catchments will be as follows.

- Northern Dam Catchment – 0.7 (70% of rainfall accumulates as runoff).
- Western Dam Catchment – 0.7 (70% of rainfall accumulates as runoff).
- Southern Dam Catchment – 0.7 (70% of rainfall accumulates as runoff).

1.6 SETTLEMENT AND STORAGE VOLUME REQUIREMENTS

Considering the likely volume of runoff and sediment load under a 5-day 90th percentile rainfall event, **Table A** provides the minimum water settlement and sediment storage zone requirements for the two sediment basins.

Table A
Settlement and Storage Volume Requirements

Basin	Water Settlement Zone (m^3)	Sediment Storage Zone (m^3)	Total (m^3)
Northern Dam	564	312	876
Western Dam	398	220	618
Southern Dam	166	73	239

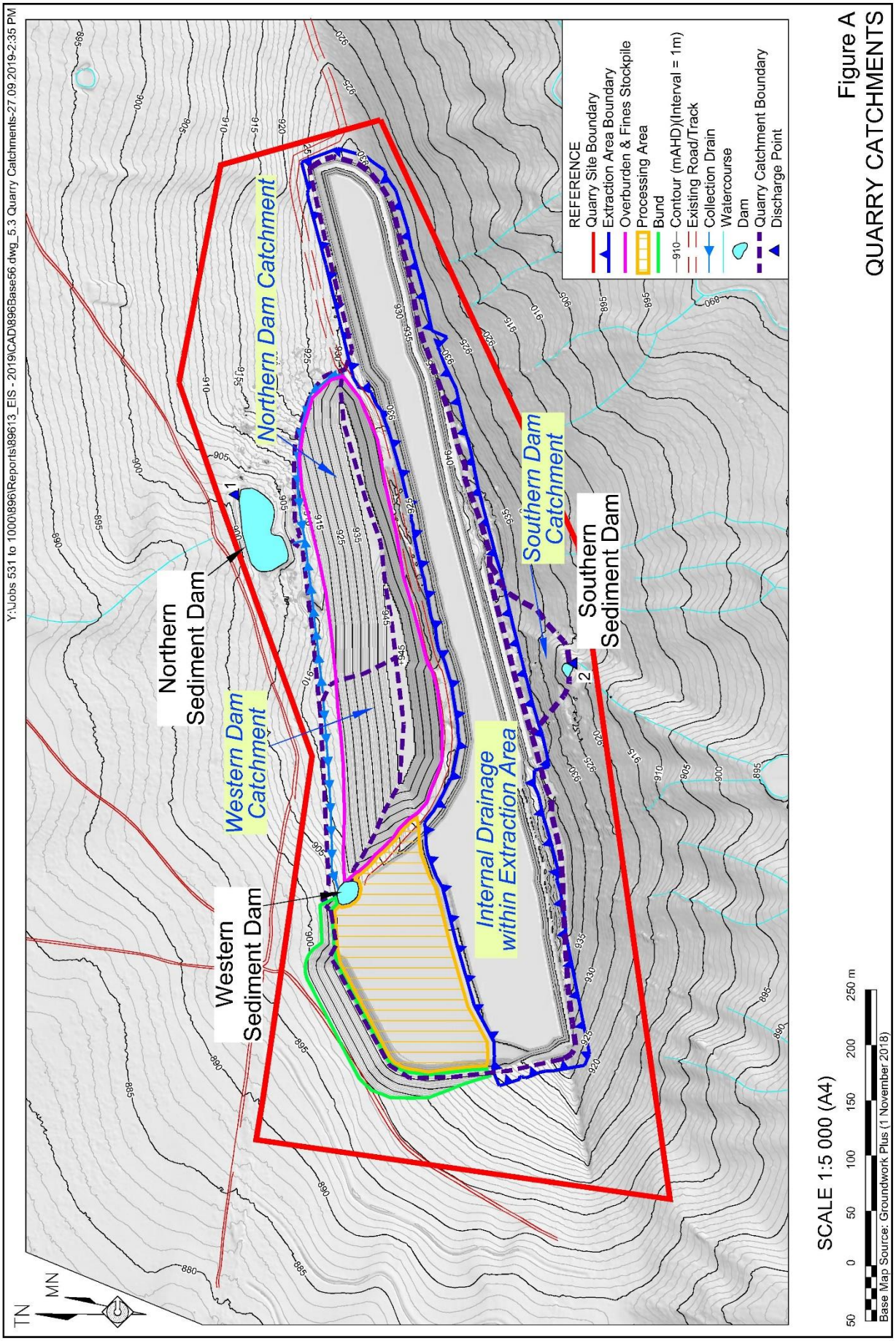
The work sheets used estimate these minimum capacities are provided as **Attachment 1**.

1.7 ADDITIONAL CONSTRAINTS / COMMENTS

The sediment dam calculation worksheets identify that the potential soil loss rate (t/ha/year) within each of the three catchments is relatively high as a result of the moderate rainfall erosivity (R-factor), elevated erosivity (K-factor) and elevated length to gradient ratio (LS-factor) of the landform within each catchment.

The Soil Loss Class is subsequently elevated (Class 6) which indicates that any soil and water management plan will either require restriction on when clearing may be undertaken (refer to *Table 4.3* of Landcom, 2004) or implementation of special erosion control measures. Alternatively, the LS factor may be modified, e.g. by restricting the length of slope disturbed, benching the recreated landform, or decreasing the slope of the recreated landform, to reduce the soil loss and soil loss class.

The Soil and Water Management Plan for the Quarry should be updated to present the revised design, management and maintenance specifications for the soil and water management at the Quarry.


Y:\Jobs 531 to 1000\896\Reports\89613_EIS - 2019\CAD\896Base56.dwg_5.3 Quarry Catchments-27.09.2019-2:35 PM
REFERENCE
Quarry Site Boundary
Extraction Area Boundary
Overburden & Fines Stockpile
Processing Area
Bund
Contour (mAHD)(Interval = 1m)
Existing Road/Track
Collection Drain
Watercourse
Dam
Quarry Catchment Boundary
Discharge Point
Northern Dam Catchment
Southern Dam Catchment
Western Dam Catchment
Internal Drainage within Extraction Area
Northern Sediment Dam
Southern Sediment Dam
Western Sediment Dam
1
2
TN
MN
SCALE 1:5 000 (A4)
50 0 50 100 150 200 250 m
Base Map Source: Groundwork Plus (1 November 2018)
Figure A
QUARRY CATCHMENTS

1. Erosion Hazard and Sediment Basins

Site Name: **Dowes Quarry**

Site Location: **Mount Linsey Road, Tenterfield**

Precinct/Stage:

Other Details: **Sediment Basins**

Site area	Sub-catchment or Name of Structure						Notes
	NSD	WSD	SSD				
Total catchment area (ha)	1.7	1.2	0.5				
Disturbed catchment area (ha)	1.7	1.2	0.5				

Soil analysis (enter sediment type if known, or laboratory particle size data)

Sediment Type (C, F or D) if known:	F	F	F				From Appendix C (if known)
% sand (fraction 0.02 to 2.00 mm)							Enter the percentage of each soil fraction. E.g. enter 10 for 10%
% silt (fraction 0.002 to 0.02 mm)							
% clay (fraction finer than 0.002 mm)							
Dispersion percentage							E.g. enter 10 for dispersion of 10%
% of whole soil dispersible							See Section 6.3.3(e). Auto-calculated
Soil Texture Group	F	F	F				Automatic calculation from above

Rainfall data

Design rainfall depth (no of days)	5	5	5				See Section 6.3.4 and, particularly, Table 6.3 on pages 6-24 and 6-25.
Design rainfall depth (percentile)	90	90	90				
x-day, y-percentile rainfall event (mm)	47.4	47.4	47.4				
Rainfall R-factor (if known)	1900	1900	1900				Only need to enter one or the other here
IFD: 2-year, 6-hour storm (if known)	7.11	7.11	7.11				

RUSLE Factors

Rainfall erosivity (*R*-factor)	1900	1900	1900				Auto-filled from above
Soil erodibility (*K*-factor)	0.05	0.05	0.05				
Slope length (m)	80	80	60				
Slope gradient (%)	30	30	30				RUSLE LS factor calculated for a high rill/interrill ratio.
Length/gradient (*LS*-factor)	11.60	11.60	9.23				
Erosion control practice (*P*-factor)	1.3	1.3	1.3	1.3	1.3	1.3	
Ground cover (*C*-factor)	1	1	1	1	1	1	

Sediment Basin Design Criteria (for Type D/F basins only. Leave blank for Type C basins)

Storage (soil) zone design (no of months)	2	2	2				Minimum is generally 2 months
Cv (Volumetric runoff coefficient)	0.7	0.7	0.7				See Table F2, page F-4 in Appendix F

Calculations and Type D/F Sediment Basin Volumes

Soil loss (t/ha/yr)	1432	1432	1140				
Soil Loss Class	6	6	6				See Table 4.2, page 4-13
Soil loss (m^3/ha/yr)	1102	1102	877				Conversion to cubic metres
Sediment basin storage (soil) volume (m^3)	312	220	73				See Sections 6.3.4(i) for calculations
Sediment basin settling (water) volume (m^3)	564	398	166				See Sections 6.3.4(i) for calculations
Sediment basin total volume (m^3)	876	618	239				

NB for sizing of Type C (coarse) sediment basins, see Worksheet 3 (if required).

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