Revised Universal Soil Loss Equation (RUSLE)

The Revised Universal Soil Loss Equation (RUSLE) in "*Managing Urban Stormwater – Soil & Construction Landcom (2004) and DECC (2008")* (Also called Blue Book) is used to predict the long term, average soil loss and the soil loss class from sheet and rill flow over the development site.

The RUSLE formula is: A = R x K x LS x P x C (Tonnes /ha/year), where

A = computed soil loss
R = rainfall erosivity factor
K = soil erodibility factor
LS = slope length/gradient factor
P = erosion control practice factor
C = ground cover and management factor

Rainfall erosivity provides R-factor = 2330 for that area. For the whole site where the slope is or less than about 5% and based on "*Figure 4.6 – assessment of potential erosion hazards*" (blue Book), we have low erosion hazard.

Hence, the following input parameters are used:

- Rainfall erosivity factor (R) = 2330
- Soil erodibility factor (K) = 0.038 (Bannerman and Hazelton, 1990)
- Slope length/gradient factor (LS);
  - 0.78 for the haul road and the composting area (assuming an average slope gradient of 3.5% and a slope length of 80m)
  - 0.78 for the stockpiling area (assuming an average slope gradient of 3.5% and a slope length of 80m)
- Erosion control practice factor (P) = 1.3
- Ground cover and management factor (C) = 0.5

The average soil loss for the site is estimated as follows:

i. For the haul road:
A = 2330 x 0.038 x 0.78 x 1.3 x 0.5 = 44.9 Tonnes/ha/year

For the Haul Road = 44.9 tonnes/hectare/year (very low erosion hazard)
= 44.9 x 0.3 = 13.5 tonnes/year in total

For this material the specific density is likely to be about1.4 tonnes/m^3. Hence, the volume of sediments is 13.5/1.4 = 9.64 m^3/year therefore for the required capacity to be included in the sizing of the sedimentation pond, only volume of sediments for 2 months is required and this will be 9.64/6 = 1.6 m^3/ 2 months which will be added to the size of the sedimentation pond 1 as shown below.

ii. For the composting area (2.1 ha):
A = 2330 x 0.038 x 0.78 x 1.3 x 0.5 = 44.9 Tonnes /ha/year

Composting area = 44.9 tonnes/hectare/year (very low erosion hazard)

= 44.9 x 2.1 = 94.3 tonnes/year in total

For this material the specific density is likely to be about1.4 tonnes/m^3. Hence, the volume of sediments is 94.3/1.4 = 67.4 m^3/year therefore for the required capacity to be included in the sizing of the sedimentation pond, only volume of sediments for 2 months is required and this will be 67.4/6 = 11.2 m^3/ 2 months which will be added to the size of the sedimentation pond 2 as shown below.

iii. For the proposed stockpiling area (5.4 ha):
A = 2330 x 0.038 x 0.78 x 1.3 x 0.5 = 44.9 Tonnes /ha/year
= 44.9 tonnes/hectare/year (low erosion hazard)
= 44.9 x 5.4 = 242.5 tonnes/year in total

For this material the specific density is likely to be about1.4 tonnes/m^3. Hence, the volume of sediments is 242.5/1.4 = 173.2 m^3/year therefore for the required capacity to be included in the sizing of the sedimentation pond, only volume of sediments for 2 months is required and this will be 173.2/6 = 28.9 m^3/ 2 months which will be added to the size of the sedimentation pond as shown below.

The proposed sediment ponds (4&5) storage volumes were sized according to the Blue Book to have sufficient capacity to contain the 5-day, 90th percentile rainfall event using rainfall data for Wallacia (48.4 mm) which is considered to be the closest location to the site as included in the Blue Book. In this case, the volumetric runoff coefficient (C_v) was considered to be 0.70 (Blue Book) as a conservative approach.

In addition to containing this volume of water, ponds were designed to also retain 2 months of anticipated soil loss. This volume (called sediment storage volume) is calculated by considering the average soil loss, determined by RUSLE in Section 2. The minimum sedimentation pond storage volumes for the four sedimentation ponds should be as outlined below.

Sediment pond 4 (composting area)
This sediment pond serves only the composting area which is approximately 2.1 ha
Hence for sediment pond 4 we have:
The Settling Zone Volume is 48.4 x 2.1 x 0.70 x 10 = 711.5 m^3
Total required size of sediment pond 4 = 711.5 + 11.2 = 722.7 m^3 (or 0.723 ML)

Sediment pond 5 (stockpiling area)
Despite the fact that there are two (2) relatively small sediment ponds within the boundaries of this site, it was considered appropriate to size this sediment pond (No5) to include sediment and surface water runoff from the whole site as a conservative approach.. Hence for sediment pond 5 we have:
The Settling Zone Volume is 48.4 x 5.4 x 0.70 x 10 = 1829.5 m^3
Total required size of sediment pond 5 = 1829.5 + 28.9 = 1858.4 m^3 (or 1.858 ML)

The five (5) sediment ponds and the pit sump will provide the storage volume capturing all stormwater runoff from the whole site (and relevant sections of the proposed stockpiling site) during rainfall events. The sediment pond locations are shown on the drawing **NICS162001_FIG001 Rev01** and will mainly be used as storage/diversion ponds for irrigation and dust suppression purposes except for sediment pond 4 as detailed in Section AA.

However, they could also be used as sediment ponds for flocculation during circumstances where they are near full and, requiring excess water to be treated and emptied into the existing watercourse. Excess water from the sediment ponds can also be pumped between each other when emptying the sediment ponds is required. (Note: Water does not require flocculation or treatment when used for irrigation or dust suppression purposes or if it is pumped from one sedimentation pond back into the other).

The existing sediment ponds were constructed according to Standard Drawing SD 6-4 and the details outlined below. Similarly, the proposed sediment ponds will be constructed according to Standard Drawing SD 6-4 and the details outlined below. During last year's refurbishment of these ponds, Epic ensured that management and industry best practices were implemented in their construction.

- The sediment ponds were built to incorporate a primary outlet (weir overflow) sized to have a capacity to pass the 100 year peak flow. This is 3 m in base width by 1m in depth with side slopes of 1:4.
- Internal batters are graded to a maximum of 6:1.
- A 'Full of Sediment' marker is placed in the sediment ponds to show the design capacity depth of the sediment storage volume, and hence to determine when sediment removal is required. The sediment storage volume equates to approximately 1.6% of the total pond volume, therefore under normal circumstances the 'Full of Sediment' marker is to be placed at a level within the sedimentation pond to indicate the bottom 1.6% of the volume. Due to the very low percentage, we consider it to be unnecessary to mark the sedimentponds.

Note that any water released into the creek (whether from the sediment ponds (except No4) or from a water cart) will require flocculation to achieve adequate settling of dispersible fine material – i.e. 50 mg/L of suspended solids (sediment).

The pit internal storage area will provide the storage volume, primarily capturing all stormwater runoff from the quarry area during rainfall events. Sediment pond 1 will be the existing dam and will mainly be used as a storage/diversion pond for irrigation and dust suppression purposes. However it will be used as a sediment pond for flocculation during circumstances where the pit internal storage area needs to be emptied and the sediment pond is full, requiring excess water to be treated and emptied into the existing watercourse. Excess water from sediment pond 1 can also be pumped back into the pit internal storage area when emptying of the sediment pond is required. (Note: Water does not require flocculation or treatment when used for irrigation or dust suppression purposes, or if it is pumped from the sedimentation pond back into the pit internal storage area.