APPENDIX I

SOUTH WESTERN AREA

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I1. INTRODUCTION

The south western part of the site currently comprises substantial filling that has been dumped by the quarry operators on the slopes between Old Man's Creek and the crusher. Drawing PSM1059-3 shows the extent of Part 4.

The area had been partly cleared since the 1930's with a track running along the eastern side of the creek from Old Man's Valley to the current site of the West Hornsby Sewage Treatment Plant.

The area was cleared further between 1975 and 1978 and a number of low buildings removed. Filling also appears to have commenced in this period (based on aerial photographs). Filling was substantially completed by the mid to late 1980's with minor activity continuing in the area until the late 1990's.

The quarry operator appears to have constructed a steep armoured slope of large boulders along the eastern edge of the creek. The armoured slope forms the edge of the filled zone and is up to 10m to 12m high. The full extent of the armoured wall is not known.

The area is now partly clear mostly on the flatter fill areas with a cover of low scrub and some mature eucalypt and other trees across the slopes and in the area between the creek and the toe of the fill batters.

The slope between the existing access road at the west side of the crusher and the dumped fill area is covered with between 0m and 5m of fill associated with construction of the access road.

Figure I1 shows the current contours of the SW area.

I2. INVESTIGATIONS AND MATERIALS

Four test pits were dug in the fills at south western area, namely TP4, TP5, TP6 and TP7. Appendix A includes the complete logs of these test pits and their locations in plan. One borehole, BH HQ1 was drilled in the south western part of the site (complete log also given in Appendix A).

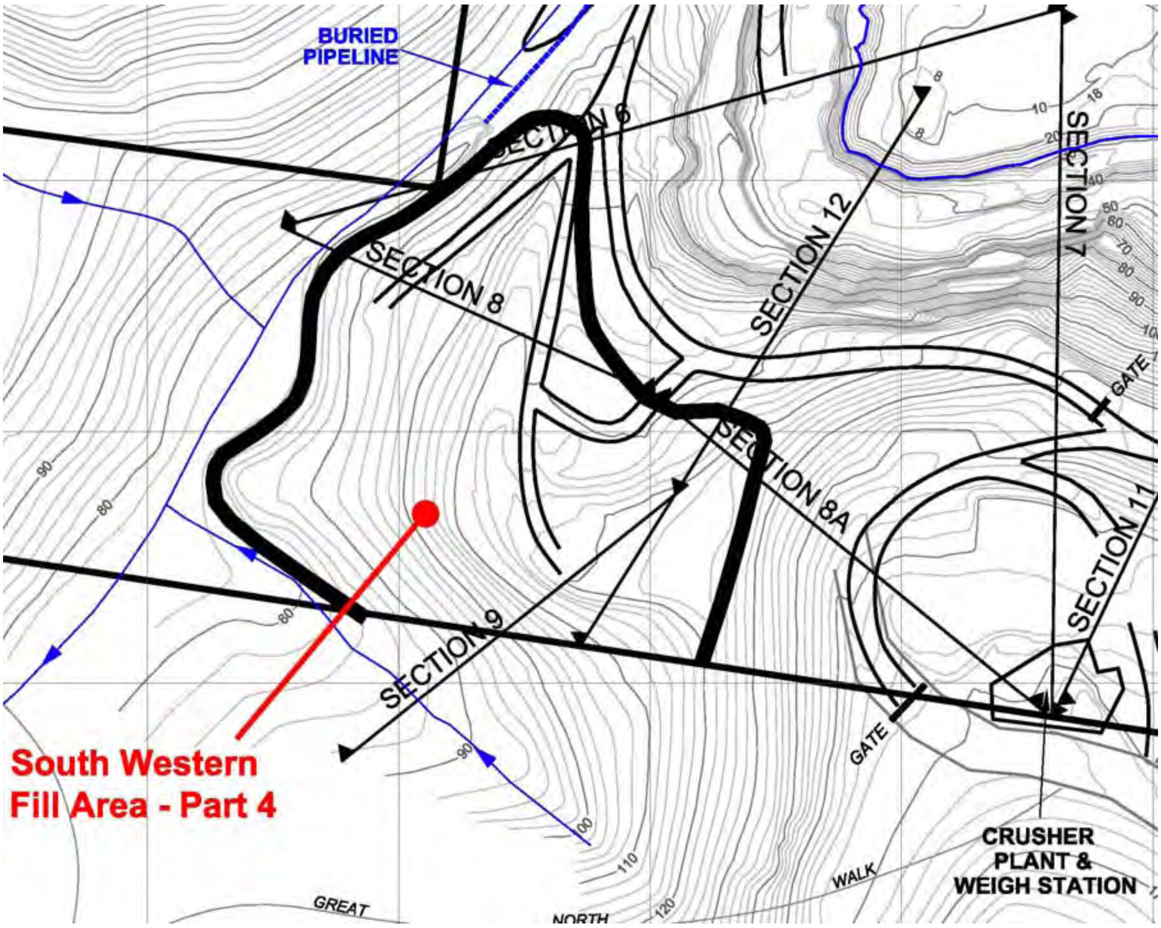

Figure I1: Location of South western area with contours and sections shown

Test pits TP4 and TP5 were dug into the upper parts of the dumped fill while test pits TP6 and TP7 were excavated adjacent to the crest of the armoured slopes above Old Man's Creek.

Filling comprised a variety of materials derived from the quarry operations. The materials encountered in the test pits were all well drained, dry and in a loose to medium dense condition and comprised the following:

A. <u>MAIN BODY OF FILL</u> (TP4 and TP5)

SANDY GRAVELS - Subrounded and angular dolerite and breccia gravels with some cobbles and boulders up to at least 1000mm size. Sand fraction also contained some clay material. Some deleterious materials (steel cables) were also encountered in the filling.

B. LOWER FILL AREA (TP6 and TP7)

CLAYEY GRAVELLY SAND

- Sandy soil with subrounded to angular gravels and some cobbles and boulders up to at least 500mm size. A range of deleterious materials including a car seat, cans, timber and an air conditioner were also encountered – most likely from the original site occupation and use.

  Below about 1.5m depth (TP7) the size and number of boulders was found to increase with boulders of at least 750mm size.

Testing results indicate the fine fraction of these fills to have a pH in the range of 7.7 to 8.2, i.e. slightly alkaline and sulphate content of up to 160mg/kg.

I3. INTERPRETED GEOTECHNICAL MODEL

Three cross sections have been developed for the south western area of the site.

Sections 8 and 8A	Drawing PSM1059-13
Section 9	Drawing PSM1059-14

Figure I2 shows the Sections 8/8A.

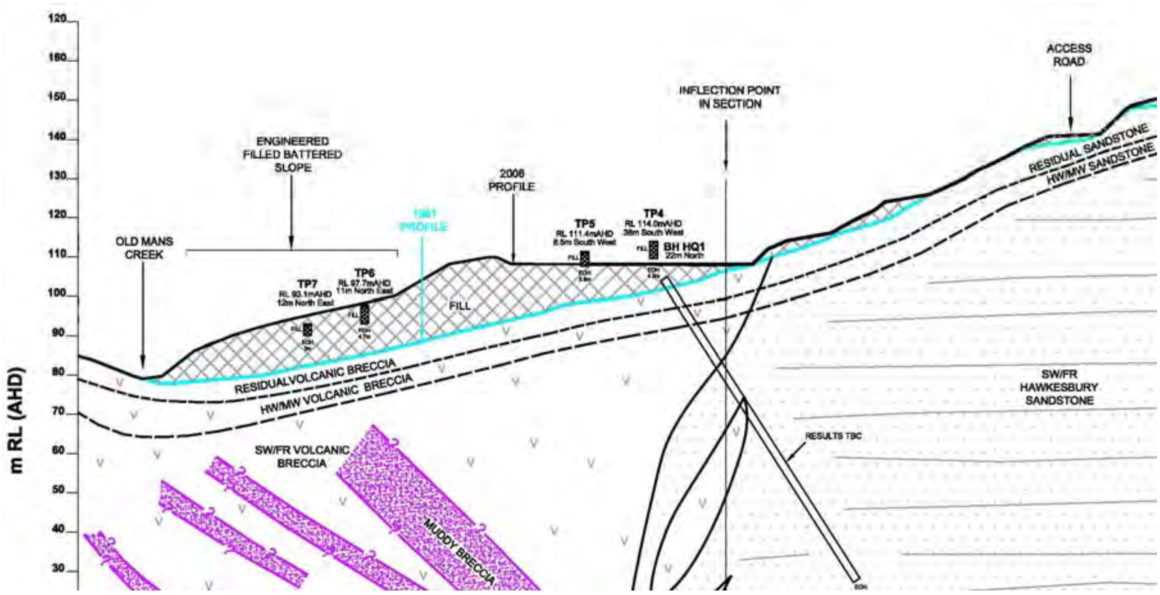

Figure I2: Cross Sections 8/8A

The models indicate fill depths of up to about 19m depth all overlying natural residual soils and rocks. The extent and depth of filling was assessed by comparison of contours developed from aerial photographs from 1961 and from 2006 supplemented through test pit investigations and observations from stereo pairs. The natural profile below the fill is volcanic breccia at the western side of the area and Hawkesbury Sandstone at the eastern and southern side of the area.

Residual soils and extremely weathered (EW) rocks are typically between 5m and about 8m thick with generally 5m of highly weathered (HW) and moderately weathered (MW) rock below this. Rock typically present below this comprise slightly weathered (SW) and fresh (FR) rock.

Section 8A (Drawing PSM1059-13) shows the interpreted fill profiles between the access road and the main area of dumped fill, and indicates scattered sections of fill across the slope with residual sandstone materials present elsewhere.

Approximate contours of fill thicknesses for the SW fill area (Part 4) have been prepared by comparing the 1961 and 2006 contour plans (as discussed above). The results are shown on Drawing PSM1059-20 and in Figure I3 below.

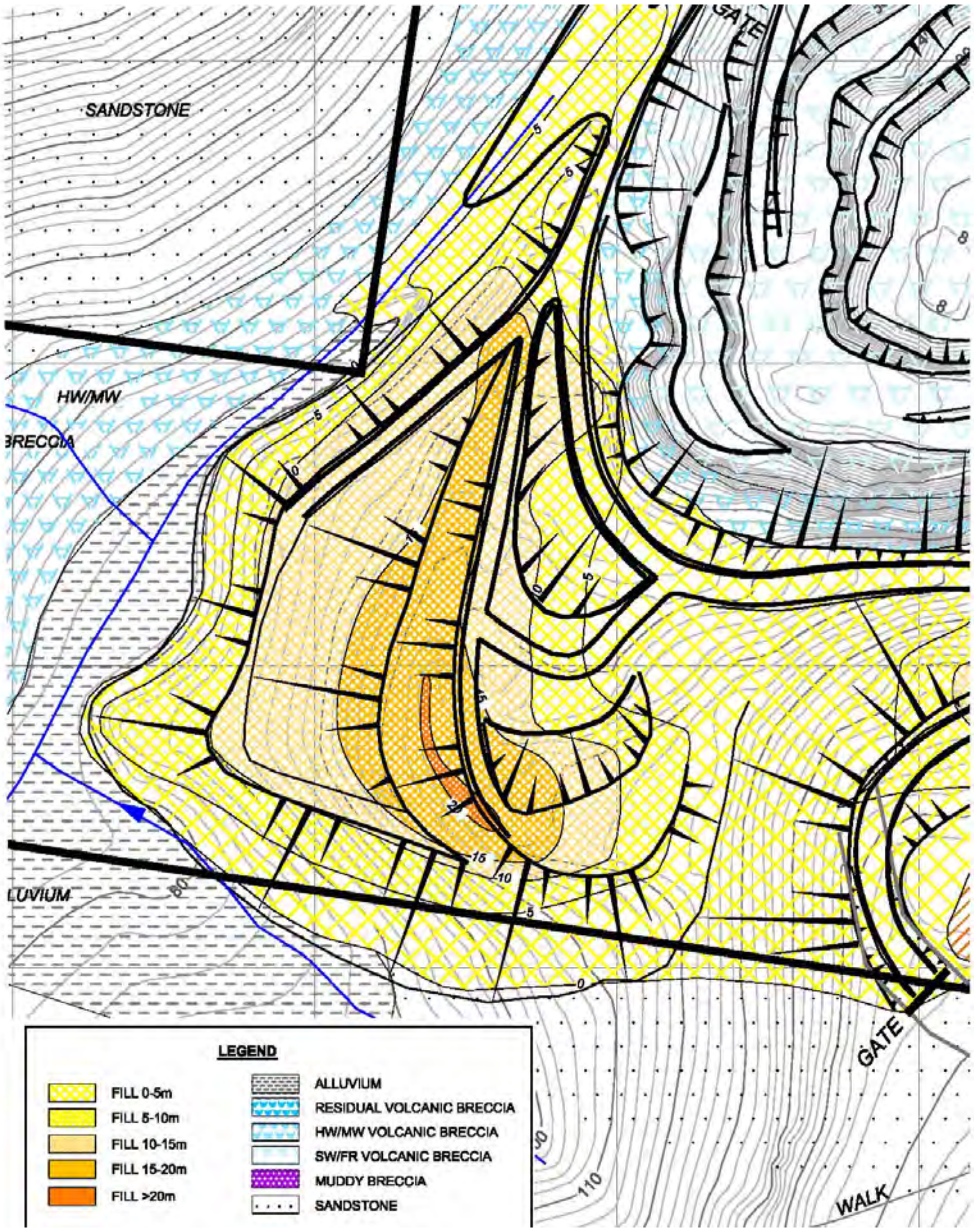

Figure I3: Isopachs of fill thickness.

The total estimated fill volume is 300,000m^3.

Fill Batters

Batters of the main fill deposit vary from 15° (to the horizontal) up to a maximum measured of about 45°. The steeper faces of between 30° and 45° are typically associated with the first batter below the uppermost, flatter part of the main body of the fill.

Groundwater

The borehole drilled along the access road around the quarry indicates a piezometric surface to be present at about 26m depth. No indication of a perched water table in the fill or residual soils was noted during the drilling.

Notwithstanding this, it is expected that infiltration from rainfall and surface water runoff from higher up the site would create a transient water table in the fill.

I4. MATERIAL PARAMETERS

Material parameters adopted for the stability assessment of this area are summarised in Table B1 of Appendix B.

The prime parameters are those of the fill materials which are:

Cohesion	10kPa
Friction Angle	30°
Unit Weight	20kN/m^3

I5. STABILITY ANALYSIS

Stability analysis of the south western fill area was undertaken using the computer program Slide.

The most severe section in terms of steepness of fill batters was taken from Section 9. Models 9-1 and 9-2 were analysed to take into account a low and high water table within the fill materials. The low groundwater table represents a condition whereby surface rainfall infiltrates the fills and then runs along the base of the fills at the contact with the underlying residual soils. This scenario is considered to represent the current site conditions.

The high water table represents a "design" groundwater regime with water saturating the bulk of the fill.

Figures I4 and I5 present the results of the stability assessment and show the following:

Figure 14 – Model 9-1

- Low water table in fill.
- Minimum FOS of 1.3 for failure surface associated with steep batters at crest of main fill slope.
- Generally FOS for overall fill slope >1.5.

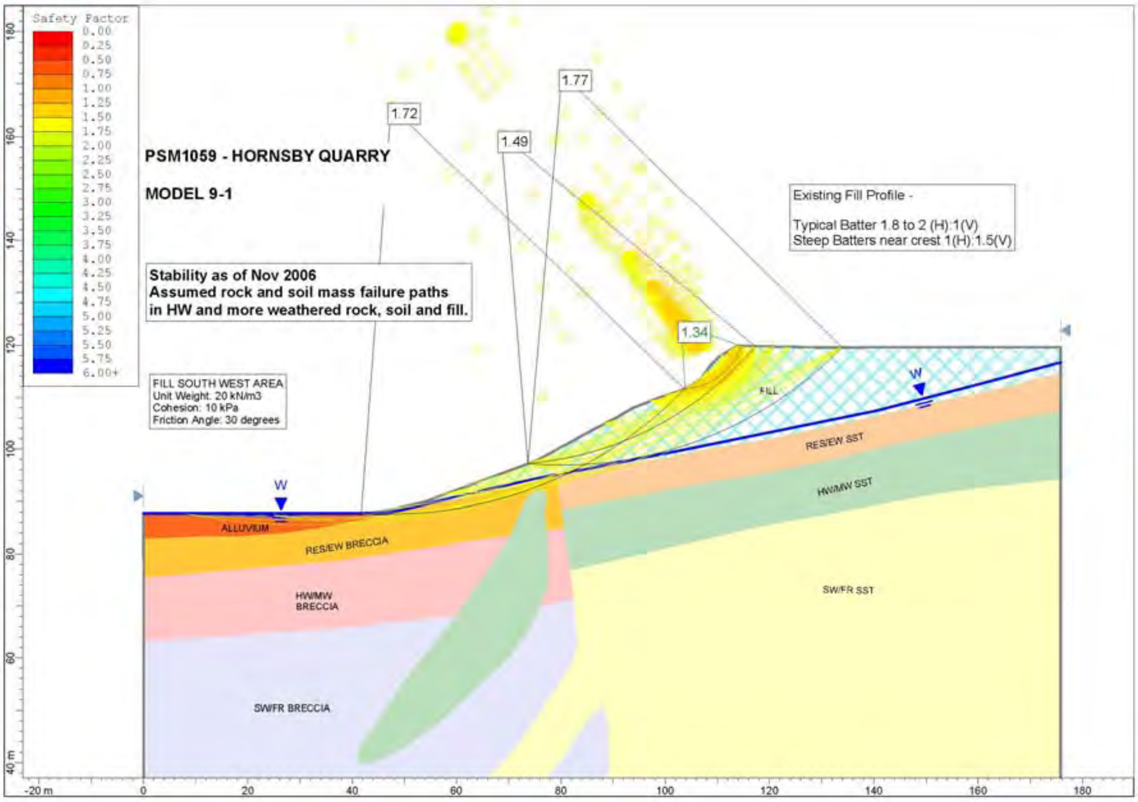

Figure I4: Stability assessment of current conditions.

Figure I5 – Model I-3

- High water table in fill.
- Minimum FOS – 0.9 – associated with a moderately deep failure extending some 50m down the main fill batter.
- Minimum FOS failure surface extends approximately 8m-10m behind main fill batter crest.
- Failure circles with FOS ≤ 1.1 extend to at least 20m behind crest of main fill batter.

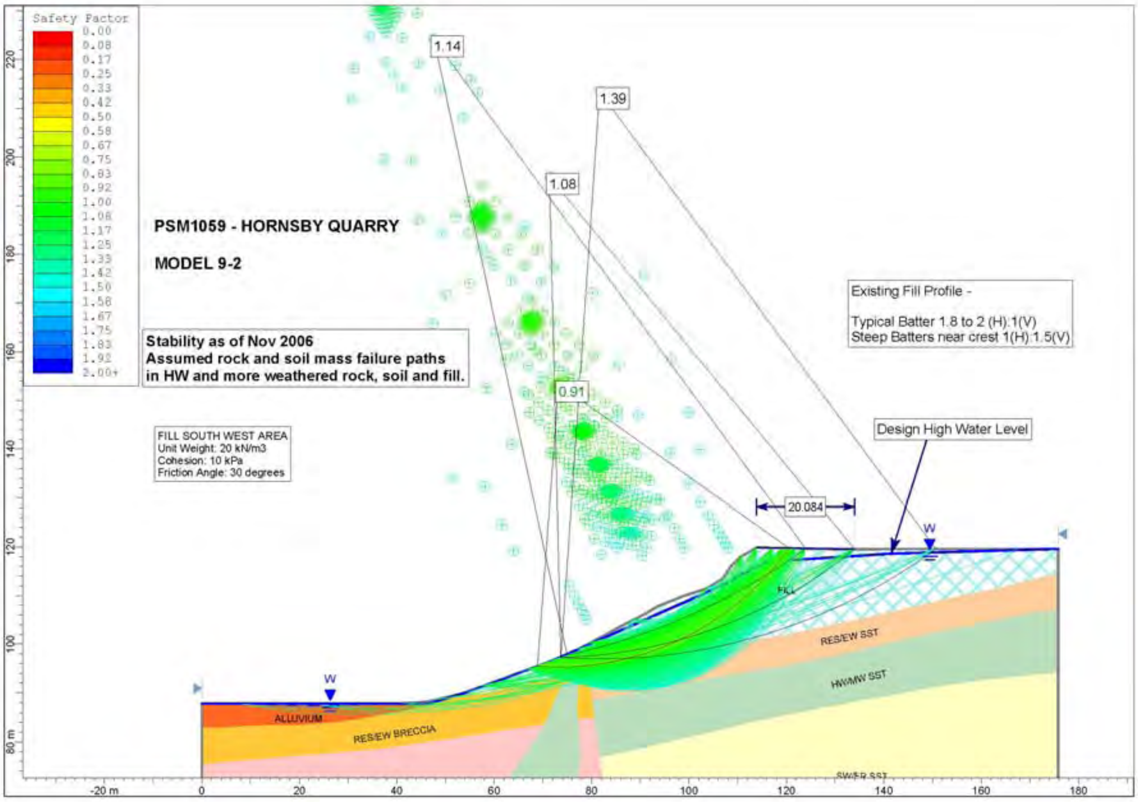

Figure I5: Stability assessment of high water table (design)

Target Factor of Safety

A minimum design FOS of 1.5 was adopted for the assessment of the slopes of the quarry and surrounding areas. The value is considered appropriate for developments where continued or frequent public access may be expected and is considered to be consistent with normal civil engineering projects.

I6. FINDINGS

I6.1. Stability

The existing fill cannot be considered to be an engineered fill as it was not placed in a controlled manner.

Stability assessments indicate a number of points:

1. The steep fill batters as they exist today do not provide an acceptable factor of safety in terms of a civil engineering standard.

   Steep batters will be required to be either flattened or supported by retaining walls or other suitable material.

2. Under the current 'low' groundwater regime the overall stability of the fill in the south western part of the site is acceptable. That is, large scale failure of the fill is highly unlikely while the water table remains deep within the fill.

3. If the water table within the fills is able to rise towards the surface, the overall fill slope stability will decrease to an unacceptable level.

   Use of this area will require careful attention to surface and subsurface drainage.

I6.2. Settlement and Structures

As discussed above, the filling at the south western area is not an engineered fill. As a result, settlement due to building loads and rising water table are expected to be higher than would normally be accepted for most building developments.

Settlements that need to be considered in any potential land use must include secondary, or creep as well as immediate (elastic) settlements.

The constraints on buildings and services in this part of the site are:

- Settlement of footings and roadways (rutting).
- Differential settlements between footings.
- In-ground services such as sewer, storm water, water and gas being affected due to movement at buildings relative to immediately adjacent to structures.

Following from the above, it is likely additional costs to develop this area are likely to be incurred through measures such as:

i. Piling of foundations down to highly weathered sandstone (or batter) and volcanic breccia rock. Pile lengths are likely to range up to 20m to 25m. Piling may be difficult due to the present of cobbles and large boulders in the fill.

ii. Provision of stiff, waffle raft slabs.

iii. Drainage measures to ensure surface and ground waters do not impact on the fill.

iv. Provision of flexible couplings for services may, in some instances, cope with settlements of buildings. Other methods may require provision of footings for services or treatment of the existing fill. The last point is discussed further in Section I6.3.

v. Careful siting of structures to ensure minimal total settlements by limiting the depth of fill at each location.

I6.3. Treatment of Fill

It may be possible to limit settlements through treatment of the existing fill. Possible methods are summarised in Table I1.

TABLE I1
IN-SITU FILL TREATMENT OPTIONS

OPTION	DESCRIPTION	REMARKS
1	Preloading with fill re other mass such as concrete blocks	Time consuming. May require loading period of many years depending on the desired impact and level of pre-load able to be achieved. Likely to be cheapest option and would be effective. Probably provide the greatest level of confidence in results.
2	Heavy and deep compaction with impact rollers	Most efficient in terms of time. Costs would be moderate and depend on the level of compaction and surface preparation required. Require specialist design and monitoring and be most suited to a development comprising light weight structures, inground services and lightly loaded results.
3	Deep vibro compaction/ soil mixing	Specialist equipment and expertise required from firms such as Frank:(Keller) or Menard Soltraitement. Costs not known but likely to be highest of the options listed.

I6.4. Potential Uses of Fill

The existing fills are considered suitable for the following uses:

1. As dumped fill in works to backfill the quarry void. No sorting or other treatments required.

2. Sort fill into (a) boulders and cobbles and (b) dirty gravels.

   Boulders and Cobbles could be used for construction of erosion protection measures, broken down (crushed) into gravels for general filling or as backfill to drainage lines or behind drained retaining walls.
   Dirty Gravels could be used for general filling and landscape works.

3. Crush and sort/size materials into a product suitable for use as a structural fill behind retaining walls or below light weight structure.

It is likely the most cost effective uses of the fill are:

A. Left in-situ with/without treatment depending on final land use.

B. Used as a dumped fill in backfill works to quarry.

COST SUMMARY

1. Costs are dependant on the land use(s) selected

2. Stabilise existing fills (in-situ)

a.	Flatten batters	$100-150,000
b.	Drainage measures	$150,000