Geotechnical Assessment of Outer Metropolitan Ring (OMR) Transport Corridor

Network and Asset Planning

Outer Metropolitan Ring Transport Corridor

Report No: MW 91-01-08-02

20/05/2009

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EXECUTIVE SUMMARY

Key Points

1. This study provides a geotechnical assessment in support of the planning study for the proposed Outer Metropolitan Ring transport corridor

2. The task has comprised principally of a desktop study of available information and brief kerbside site inspections.

3. Three primary geological units are present within the OMR transport corridor,

- **Quaternary age River Alluvium (soils derived from adjacent rock)**
- **Quaternary age Newer Volcanics (Basalt)**
- **Silurian/Ordovician age Sediments (Mudstone, siltstone and sandstone)**

4. High to extremely high strength, “non rippable” basalt is exposed at natural surface level in many areas of the proposed OMR transport corridor.

5. The costs associated with rock excavation may be partially offset with re-processing and reuse of excavated materials for lesser quality pavement materials.

6. A substantial area of landfill underlies the proposed OMR transport corridor on the northern side of Bulla-Sunbury Road. Further detailed examination would be required to fully establish construction costs associated with the area.

7. Cut excavations in Silurian/Ordovician sediments should be generally rippable, except where the rock is metamorphosed to hornfels.

8. Suitable Type A/B fill sources should be available in close proximity from local quarries in close proximity to the proposed OMR transport corridor.

9. Major bridge structures sites at Werribee River, Kororoit Creek, Jacksons Creek and Deep Creek occur in deeply incised valleys with possible poor foundation conditions, other proposed structure sites should generally intersect suitable foundation conditions.

10. Brief site inspections have indicated that some soils within the transport corridor are of low to moderate dispersion potential and may be prone to rilling and sheet erosion.

11. Cut batter slope design will be largely dependent on the site geology and the road alignment geometry. However standard batter slopes 2(H):1(V) should be generally suitable.

12. From a geotechnical perspective, no major impediments exist apart from the presence of possible challenging foundation conditions at some major structure sites and the presence of high to extremely high strength “non rippable” basalt.

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1. INTRODUCTION

At the request of VicRoads Network and Asset Planning (Ms Joan Gilmer), a study has been undertaken to identify and review the geotechnical aspects which may impact the alignment of the proposed Outer Metropolitan Ring (OMR) transport corridor between Princes Freeway West near Werribee and the Hume Freeway near Beveridge.

The Outer Metropolitan Ring transport corridor commences at the Princes Freeway between the Little River and Werribee townships and travels in a northerly direction for much of its length before ultimately connecting with the Hume Freeway at Donovans Lane just to the south of the Beveridge township. The proposed transport corridor is intended to be a "dual facility" incorporating both a new freeway and railway facility. The incorporation of the railway facility in the transport corridor dictates that a maximum gradient of 1% is required in all areas.

Along its length, the Outer Metropolitan Ring intersects a number of major freeways and arterial roads including Ballan Rd, Hopkins Road, Western Freeway, Melton Highway, Calder Freeway, Bulla Road and Mickleham Road. The proposed corridor also crosses the main railway lines from Melbourne to the Geelong, Ballarat and Bendigo regional centres. A locality plan showing the proposed OMR transport corridor is shown in Appendix A.

The southern section of the corridor to the Calder Freeway is characterised by mainly flat lying to gently undulating terrain. To the north of the Calder Freeway, the terrain is "undulating to quite hilly" in character. Changes in topographic relief can often reflect significant changes in the rock and soil types and the structural geological features.

The southern section of the OMR Transport Corridor traverses principally cleared farm and grazing land, however intensive urbanisation is adjacent in a number of areas e.g. Little River, Werribee, Melton and Sunbury. The northern section is less urbanised and contains a number of small areas with remnant vegetation remaining relatively intact.

The objective of the study was to provide background information regarding the geology and geomorphology of the proposed transport corridor and to identify any significant constraints and their potential effect on the Outer Metropolitan Ring.

The geotechnical assessment has been mainly a desktop study consisting of:

- review of existing borehole data from databases ("GeoVic" from the Department of Primary Industries) and the Victorian Water Resources Data Warehouse and the Sinclair Knight Merz database
- review of VicRoads and EPA's priority sites registers for contaminated sites
- review of aerial photographs from 1966 and 1984 and of recent satellite images (i.e. Google Earth) to identify potential contaminated sites such as landfills (refer Appendices F1 and F2 for aerial photographs)
- discussions with councils
- discussions with operating quarries in close proximity to the proposed alignment.
- brief site visits along the proposed alignment were conducted where access was possible from public roads (refer Appendix C for site photos).

2. GEOLOGY AND GEOMORPHOLOGY

The Geological Survey of Victoria maps (1:250,000 Melbourne Sheet SJ55-5, Ed 2, May 1997, 1:63,360 MELBOURNE (Melbourne and Sunbury Sheets) parts of 7822 Zone 55, 1974) and the Department of Primary Industry's Geomorphological Units maps for the Port Phillip and Westernport Catchment Management region (refer Appendix B) show that the geology of the Outer Metropolitan Ring transport corridor is relatively consistent along its length. Quaternary Newer Basalt (Qvn) and associated residual soils dominate much of the length of the proposed corridor.

Outcrops of Lower and Upper Silurian sediments (Sls and Sud) are exposed in roads cuts along the proposed OMR transport corridor near the intersection of Old Sydney Road and Donnybrook Road. Small exposures of Ordovician sediments (Ou) also occur in the basal sections of Jacksons and Deep Creek, where the deeply incised creek beds have cut down through the Quaternary basalt flows.

Significant areas of Quaternary and Recent Alluvium (Qra) are present immediately around the major waterways intersected by the OMR transport corridor in particular Jacksons Creek and Deep Creek where large alluvial fans exist. These fluvial alluvium deposits consist primarily of sand, silt and clay, but may contain minor amounts of gravel. The alluvium is commonly moderately sorted and only poorly consolidated.

Several small deposits of lagoon and swamp deposits (Qrm) exist in the Little River/Werribee area along with Aeolian dune deposits (Qpd) on the ancestral floodplains of Little River and Werribee River. The lagoon and swamp deposits consist primarily of silt and clay, while the dune deposits consist of primarily of sand, clay and calcareous sand.

Fluvial deposits (Qpa) of considerable surface extent are present immediately to the north of the transport study corridor to the east of the Wallan township. These deposits overlie the basalt and commonly consist of gravel, sand and silt.

One site of State Significance (K1) and five other sites of Regional or Local Significance (Ma1, K2, Ko5, SW3 and SW4) recorded on the Department of Primary Industry's "Geological and Geomorphological Register of Significant Sites in the Western Region of Melbourne" are located within or in very close proximity to the OMR transport corridor (Refer Appendix B).

These sites are:

- K1 – Bulla Kaolinised Granite (in close proximity to study area) – abandoned quarries into the hill slope east of Deep Creek expose Bulla Granodiorite beneath Newer Volcanics lava flows. State significance as an outstanding example of deep weathering of granodiorite to produce an in situ deposit of kaolinite. Extensively used as a teaching site by schools and tertiary institutions.

- K2 – Bulla Metamorphic Aureole (in close proximity to study area) – the site illustrates thermal metamorphism of Silurian sedimentary rocks by the intrusion of the Bulla granodiorite. Regional significance as a display of the changes introduced in sedimentary rocks by contact metamorphism.

- Ko5 – Deep Creek Outcrops (within study area) – Deep Creek and Emu Creek have incised into Newer Volcanics basalt to expose underlying Bullengarook gravel resting unconformably on Silurian and Ordovician bedrock. Local significance as an illustration of the geology of Deep Creek valley.

- Ma1 – Werribee Prior Stream (in close proximity to study area) – shallow meandering section of Lollypop Creek. Regional significance as one of the last unmodified examples of the formerly extensive distributary channel system of the Werribee River.

- SW3 - Kororoit Creek Floodplain Rockbank (within study area) – the valley of Kororoit Creek upstream of Beattys Rd bridge is a wide floodplain with abandoned stream channels. Regional significance as an illustration of the influence of lava flows on drainage patterns and of the hydrological complexity of Kororoit Creek.

- SW4 – Deans Marsh Intermittent Lakes – Rockbank (within study area) – Enclosed depressions on the surface of the lava plain between Kororoit Creek and the Western Highway. Sites are marshy, indicating they are fed from groundwater springs. Water is brackish and alkaline, with sulphate concentration. Regional significance as important remnants (other similar sites have been disturbed by draining, grazing, etc.) to illustrate the formerly complex drainage and surface water distribution of the plains.

2.1 Newer Basalt and Residual Soils

The Quaternary Newer Basalt flows form part of the "Victorian Volcanic Plain" and is thought to range from 2.5 to 5 million years old. The basalt flows have emanated from numerous vents and fissures and many of the eruption points still remain as conspicuous landscape features e.g. Mt Cottrell and Mt Atkinson. The individual basalt flows range from 2m-10m thick and can be up to 100m thick in the deepest areas. The flows have largely enveloped many of the pre-existing landscape features as well as the ancestral flood plains of the Little River, Werribee River, Kororoit Creek, Jacksons Creek and Deep Creek.

The basalt rock encountered along the proposed transport corridor is typically a light grey to dark grey, coarsely to finely vesicular, strongly jointed, olivine basalt of high to extremely high strength. In some areas of the southern section of the OMR transport corridor, degradable non durable "green" basalt has been intersected in previous investigations e.g. former quarry Edgars Rd Little River. The residual soils derived from the weathering of the basalt are typically red-brown to black in colour and commonly of very low California Bearing Ratio (CBR) strength (1-2%) when wet. The basaltic clays are often highly plastic (Plasticity Indexes (PI) ranging from 35-60+) and have a high potential to shrink and swell in response to any changes in the moisture regime. This shrink/swell potential (if not appropriately managed) can cause cracking and pronounced loss of shape in road pavements.

The soils are also characterised by their propensity to waterlog in wet weather and can be difficult to traffic due to inherent poor drainage.

Along the proposed OMR transport corridor, slightly weathered to fresh basalt cobbles and boulders (in excess of 1m diameter in some areas) are often present at the surface, particularly in the more elevated areas. Stony rises (elevated remnant areas of slightly weathered (SW) to fresh, high to extremely high strength, basalt) are less common (refer Appendix C for site photos) except for the Little River area. Typically, the topsoil is a thin loamy topsoil (where present) and is underlain by a residual red-brown clay which is commonly 0.3m to 1m thick (max), except where adjacent to natural drainage lines and waterways. In the latter instance, a deeper weathering profile is evident, with up to several metres of dark grey to black basaltic clays and weathered rock.

2.2 Silurian and Ordovician Sediments

The Silurian sediments (Sls and Sud) are likely to be intersected over a small area approx 2km in the vicinity of the Old Sydney Road and Donnybrook Road intersection. The sediments where exposed in shallow cut in the vicinity of the OMR transport corridor are commonly extremely to distinctly weathered and very low to low strength. The Dargile Formation (Sud) consisting of interbedded shale, mudstone, and greywacke is the most likely geological unit which will be encountered in excavations associated with the transport corridor. However a predominant sandstone unit (Sls) known as the Springfield Sandstone may also be intersected. It consists of marine sandstone with minor thick to thin inter-beds of siltstone and conglomerate. Remnant peaks of the Silurian landform daylight through the Newer Volcanics basalt flows to the east of the OMR transport corridor in the vicinity of Oaklands Junction, Craigieburn and north of Kalkallo.

The soils derived from the weathering of the Silurian sediments are typically stiff to very stiff clays and silty clays (CBR typical values 2-4). These residual clays are likely to be of low to medium strength and of low to moderate dispersion potential. The soils will likely be prone to erosion where the gradients of drainage lines exceed 3%.

However, the Springfield Sandstone, if intersected, would likely produce sandier soils of higher strength i.e. sandy clays and clayey sands.

In the vicinity of Oaklands Road, the Silurian sediments have been metamorphosed to a hornfels; this rock is currently extracted and crushed for aggregate and crushed rock products at the Cemex Oaklands Junction quarry.

Many of the major river and creek beds in the vicinity of the OMR transport corridor are very deeply incised into the Newer Basalt landscape due to rejuvenation of streams in the past. Ordovician sediments consisting of undifferentiated sandstone, shale and mudstone have been exposed in the basal sections of Jacksons Creek and Deep Creek or covered by appreciable thicknesses of Quaternary and Recent alluvium.

3. SURFACE WATER AND GROUNDWATER

3.1 Surface Water

There are a number of significant creeks and rivers flowing in a southerly direction which intersect with the proposed transport corridor, including Little River, Lollypop Creek, Werribee River, Kororoit Creek, Jacksons Creek and Deep Creek.

Each of these waterways is documented to be in relatively poor health due to a number of issues including native vegetation removal, grazing of stock in waterways, removal of vegetation cover on stream banks, erosion and sedimentation. In a number of areas, salinisation and pollution is steadily increasing as a result.

Some of the smaller streams within the transport corridor (e.g. Lollypop Creek) are prone to flooding due to impeded drainage on the basalt plain.

An appropriate level of water quality monitoring and surface runoff control should be undertaken during the construction phase to ensure that any impact on major waterways and drainage lines is minimised.

3.2 Groundwater, Springs and Groundwater Bores

The Newer Volcanics aquifer is typically a fractured rock aquifer, which is primarily recharged through the areas of basalt rock outcrop. The hydraulic conductivity of the aquifer can be highly variable and dependent on the degree of joint interconnection and development of fracture patterns. Joints/fractures have largely developed in the Newer Basalt as a part of the cooling process.

The hydraulic conductivity in a vertical direction is usually small in comparison to the horizontal conductivity associated with the interface of individual basalt flows and the interfaces with underlying sediments. As a result the groundwater regime can be quite complex.

The bore information compiled in this report was obtained through the Department of Primary Industry's "GeoVic" database (lithology) and the Sinclair Knight Merz database / Victorian Water Resources Data Warehouse (lithology, water chemistry and aquifers). Refer Appendices D and E for overview maps of the boreholes from the GeoVic website and the Victorian Water Resources Data Warehouse website.

A large number of groundwater bores are registered within the immediate vicinity of the proposed OMR transport corridor. Most of these bores are classified as being suitable for domestic and stock use with other being DSE investigation bores for groundwater quality monitoring. The standing water levels in these groundwater bores vary considerably and a summary of specific areas of the transport corridor is presented below. The bore yields range between 0.4L/sec and 16.4L/sec with the average yields typically less than 1.2L/sec.

For the section between Princes Freeway and Ballan Rd, the borehole data from the Sinclair Knight Merz database / Victorian Water Resources Data Warehouse typically show aquifers starting at a depth ranging from 4 to 50 m, with an approximate average value of 15 m.

For the section between the Ballan Rd and the Western Freeway, aquifers were encountered at depths between 11 and 65 m, with an approximate average value of 30 m.

For the section between the Western Freeway and the Calder Freeway, aquifers were encountered at depths between 15 and 47 m, with an approximate average value of 27 m.

For the section between the Calder Freeway and Sunbury Rd, aquifers were encountered at depths between 24 and 45 m, with an approximate average value of 33 m. Please note that this is based on four boreholes only.

For the section between the Sunbury Rd and the Hume Freeway, aquifers were encountered at depths between 5.5 and 90 m, with an approximate average value of 40 m.

Groundwater was not encountered at the natural surface level (0m) in any of the registered bores within the transport corridor. However, given that groundwater was encountered at the shallow level of 4m in some bores, it is quite possible that areas will exist where springs/groundwater emanate at natural surface level.

3.3 Groundwater Chemistry

The groundwater chemistry in the section of the proposed OMR corridor between Princes Freeway and Western Freeway shows high turbidity and salinity, with total suspended solids (TSS) ranging from 2500mg/L to 7200 mg/L (average 5300mg/L) and chloride levels ranging from 800mg/L to 10,000mg/L (average 2800mg/L). Electrical conductivities range from 3200µS/cm to 28000µS/cm, with an average value of 9200µS/cm.

For the section between the Western Freeway and Sunbury Rd, the chemistry shows lower turbidity and salinity, with total suspended solids (TSS) ranging from 1600 mg/L to 4400mg/L (average 4400 mg/L) and chloride levels ranging from 580 mg/L to 2400 mg/L (average 1330mg/L). Electrical conductivities range from 2500µS/cm to 8700µS/cm, with an average value of 5500µS/cm.

For the section between the Sunbury Rd and the Hume Freeway, the chemistry shows again higher turbidity and salinity, with total suspended solids (TSS) ranging from 2500mg/L to 9400mg/L (average 4200mg/L) and chloride levels ranging from 240mg/L to 5010mg/L (average 1830mg/L). Electrical conductivities range from 2900µS/cm to 14600µS/cm, with an average value of 7100µS/cm.

3.4 Salinity

Groundwater behaviour is a reflection of geology and landform and of climate and land use practice as they influence the water balance of landscapes (Clifton 2000). Information obtained from the Department of Primary Industries (DPI) identifies a likely presence of salinity discharge lines within the northern section of the proposed transport corridor. These areas are principally confined to existing drainage lines. In addition, it is recognised that the western region of Melbourne is at moderate to high risk of developing extended saline discharge areas in the future. A regional salinity management plan for the Port Phillip area is in the process of being developed jointly by the Port Phillip and Westernport CMA, Department of Primary Industries (DPI) and Department of Sustainability and Environment (DSE) to fully address these issues in the future.

Most of the typical indicators of salt affected areas, i.e. salt resistant vegetation (spiny rush etc) or scorched areas were not visually apparent in the inspected areas of the alignment. However, in the vicinity of Beatty's Rd, Kororoit Creek has significant stands of "spiny rush" within the floodplain and along its banks indicating that this particular area has a high potential to be salt affected (refer Appendix C for site photos). It should also be noted that the prolonged dry conditions experienced in recent years within the area and many other parts of Victoria may well have masked the presence of other salt affected areas. Under normal climatic conditions, the contrast between those areas which are salt affected and those which are not would likely be more pronounced.

It would be prudent to ensure that construction works do not significantly modify the hydrological balance and/or cause enlargement of saline discharge areas or any groundwater to reappear at another location. Any salinity issues can be successfully managed by ensuring surface water is used or managed within the source area rather than allowing surface runoff to migrate to areas of impeded drainage and consequently elevating groundwater levels downstream. Increased surface runoff within the alignment will have the potential to impact significantly on erosion problems and water quality.

The protection of remnant native vegetation and dense planting of new vegetation would decrease any possible impacts in run-off prone areas. Other measures to minimise any potential groundwater impacts include:

- Maintain overland flow paths by the provision of waterway structures (culverts and bridges) at existing watercourses and drainage lines.

- Maintain subsurface flow paths by provision of appropriate subsurface drainage.

4. GEOTECHNICAL ASPECTS

While it is anticipated, that most of the earthworks along the proposed OMR transport corridor will mainly involve only low-medium cut and fill (i.e. < 1-3m), it should be noted that high to extremely high strength, slightly weathered to fresh basalt is present at the natural surface level in many areas. As such, any subsurface excavations (even shallow drainage lines) may encounter substantial quantities of “non-rippable” basalt which will require either the use of a rock breaker or blasting to affect excavation. If blasting of the basalt rock is required then appropriate design of rock blast patterns and containment would be required given the close proximity of some residential houses along the corridor. Close monitoring of ground vibrations and air blast vibrations would also be highly desirable during construction, given the close proximity of some residential houses to the proposed transport corridor. Detailed architectural inspections of affected residences would be advisable prior to the commencement of any construction activities.

Embedded floaters of slightly weathered basalt cobbles and boulders in excess of 1m diameter in many areas are a distinct possibility. From previous experience on other projects, these cobbles and boulders can be quite irregular in their distribution; thus making it largely impractical to detect their presence by normal investigation techniques. There is a common transition zone between the overlying basaltic clays and the basalt rocks composed of a mixture of clay, cobbles, boulders and extremely weathered basalt rock. Large quantities of oversize material (>1m diameter) may be generated during excavation of cuts; this oversize material will likely need to be de-sized to form a usable “rock fill” or “beaching rock” material.

Avoidance of cut and drainage excavations in these “non-rippable” basalt areas as far as practical and maintaining the alignment on low fill will considerably reduce the costs associated with the construction of the transport corridor. The probable long lengths of deep cut (e.g. Kirkbridge Rd to Black Forest Rd and Keilor-Melton Rd to Holden Rd) will likely intersect large quantities of “non rippable basalt” in such cases considerable additional excavation costs will be largely unavoidable. In order to offset this additional cost, consideration could be given to processing the substantial extracted quantities of basalt for potential use as lesser quality pavement materials (Class 3 & 4 crushed rock and railway ballast) for the transport corridor. In this way, the additional costs associated with excavation can be mitigated to a significant degree.

Care should be exercised in the design of proposed road cuts in this instance, to ensure they are well above the prevailing groundwater table at the time of excavation, otherwise additional drainage costs (e.g. provision for drainage blankets) could be inadvertently incurred.

The design of standard cut and fill batter slopes 2(H):1(V) will be suitable for most areas containing extremely weathered to distinctly weathered basalt rock. In some areas, where competent fresh to slightly weathered basalt exists over the full depth of the cut, it may be practical to design steeper batter slopes 0.5(H):1(V) provided cut batters are pre-split. This treatment would effectively reduce the amount of “Right of Way” required. In regard to cut batters sited in materials with predominantly soil characteristics (e.g. basaltic clay and residual soils) 2(H):1(V) will be generally suitable for most areas. However, if the cut batters consist of “fissured” clays then batter slopes of 3(H):1(V) will likely be required.

In the vicinity of the intersection of Old Sydney Road and Donnybrook Road, the proposed OMR transport corridor is likely to intersect weathered Silurian sediments and associated residual soils. Observation of the existing cut exposures along Old Sydney Road indicates that any cuts in this area will be generally rippable with a large dozer (Caterpillar D10 dozer or equivalent).

The stability of cut excavations in the Silurian sediments may be a potential issue depending on the adopted cut batter height and batter orientation. A comprehensive defect and cut stability analysis should be undertaken at a later stage once the horizontal and vertical geometry of the proposed road is more fully established.

A number of current Extractive Industry Work Authorities (WA) are present within or in close proximity to the proposed OMR transport corridor. These Work Authorities are primarily used as “quarry sites” extracting hard rock, sand and gravel with some sites also used for landfill. Two current Mineral Exploration Licences EL4507 and EL5022 exist over in the southern part of the transport corridor. The reported minerals sought are coal and precious metals (gold, silver, platinum etc) respectively. The locations of the Work Authorities and Exploration Licences are contained in Appendix H.

5. ANTICIPATED FOUNDATION CONDITIONS AT STRUCTURES

Along the proposed OMR transport corridor, bridge and culvert foundation conditions vary quite considerably particularly those bridge associated with significant creeks and rivers. The deeply incised character of the river systems at Werribee River, Kororoit Creek, Jacksons Creek and Deep Creek; together with the gradient requirements for a railway facility will mean these structures will likely have considerable lengths and high elevation.

The pier foundations associated with bridge structures at Werribee River, Kororoit Creek and Jacksons Creek (structures possibly up to 300m long) are likely to encounter appreciable thicknesses of soft/loose river alluvium or possibly extremely weathered, very low strength, Ordovican sediments and residual soils in the latter two instances. The bridge abutments at these structure sites are likely to be simpler to construct due to the possible presence of shallow, very high strength, basalt, however, the deeply incised nature of the stream systems may lead to stability issues at the abutments. Overall, considering the number of pier locations likely to be required, it is judged that bridge foundations at the above locations will be difficult to construct and certainly a very significant cost item. A more detailed study of the bridge structure and foundation conditions/options is recommended.

In regard to the bridge structure across the Deep Creek Valley, the same comments with regard to foundations would apply; however, this particular bridge structure is likely to be in the order of 1.5Km long and the pier heights will be perhaps 70-80m high. The number of pier locations required and height will have a substantial impact on the creek valley and likely pose a number of major construction issues to effectively minimise the impact. It may be appropriate in the instance of Deep Creek to investigate the use of alternative types of structures (e.g. large “cable stay” bridge) rather than the normal type of bridge structure. In this way, the impact on the Deep Creek valley and the intersection of difficult pier foundations would be largely avoided. A more detailed study of the bridge structure and foundation options is recommended.

Other bridge and culvert sites are likely to be founded on the Newer Basalt and limited thicknesses of very low strength residual soils; as such it is likely that spread footings or large diameter bored piles would be the adopted foundation type for at-grade structures. In the case of elevated structures (i.e. grade separated overpasses) are more likely to adopt either pre-bored or driven piles as the preferred foundation option.

It is judged that apart from the major river/creek structures outlined above, (based on visual observation alone) that at smaller bridge and culvert structures, the foundation conditions will be generally conducive to the construction of the normally used structure types without a significant cost increase.

6. LANDFILL AND CONTAMINATED AREAS

Along the proposed OMR transport corridor, one substantial land fill area is known to exist on the north side of Bulla-Sunbury Road, the site was previously used as a quarry and formerly known as the “Boral Bulla” quarry until its close in the 1980’s. The quarry is estimated to be up to 30m deep.

While some consolidation of the landfill will have occurred over time, it is likely that the construction of a major railway/roadway across the landfill area will require significant additional design and incur appreciable additional construction costs.

The quality and quantity of the landfill placed is largely unknown and will need to be investigated in more detail in the near future, so that the impact and costs of the construction of the transport corridor across this area is more fully understood.

In two other areas, extensive landfill sites are currently operating in very close proximity to the Outer Metropolitan Ring transport corridor; these quarry operations and subsequent landfills will potentially encroach on to the corridor in the future. These sites are:

- CEMEX Werribee quarry (NE corner)
- Boral Deer Park quarry (NW corner)

In close proximity to the transport corridor, off Bulban Rd Werribee, the local municipality formerly operated a refuse incinerator. While the actual incinerator facility is not on the proposed transport corridor, it is possible that emissions may have generated some contamination of the immediate surrounding area. The extent and nature of any previous emissions on the transport corridor should be examined in more detail.

Previously, the Department of Defence has operated an aircraft gunnery and artillery range within the proposed transport corridor in the vicinity of Greens Rd, Newton Rd and Edgars Rd. Undetonated shells have been located in recent excavations in this particular area. While it is considered unlikely that any of these items will be discovered on the OMR transport corridor; it is recommended that this aspect be investigated in the future to ensure that the finally adopted route is thoroughly clear of any remnant artillery shells.

7. SOURCES OF EMBANKMENT FILL AND PAVEMENT MATERIALS

With respect to potential sources of fill, the proposed OMR transport corridor will generate some quantities of (soil-like) fill materials which would be mainly suitable for use as Type B fill in the lower parts of embankments. Most of the soil fill materials available will be basaltic clays which are commonly characterised by high moisture sensitivity and very low strength (CBR values generally between 1 and 2). It should be also noted that these materials can be low to highly dispersive in some instances and may have a high degree of erodibility in constructed drainage lines where gradients are in excess of 3%.

The obvious presence of near surface, slightly weathered to fresh, very high strength basalt and basalt boulders will further impede the potential to obtain embankment fill materials in many areas of the OMR transport corridor. As such, it is likely that there will be a significant shortfall of fill materials and an earthworks balance in many areas will be difficult to achieve.

However, there are a number of well established quarries and future quarry prospects in within or very close proximity to the corridor. Full details of the current approved work authorities can be found on the Dept of Primary Industries, “GeoVic” website.

As such, it is likely that suitable overburden materials and by products from the crushing processes will provide suitable sources of fill meeting the VicRoads Type A and B fill requirements. Accordingly, it is unlikely that shortage of suitable fill materials along the proposed transport corridor will generate a significant cost increase. Those operating quarries in very close proximity to the corridor are:

- Victorian Bluestone Quarries (Beach Rd, Lara)

- Hanson Quarry - Little River (Edgars Rd, Little River)
- Cemex Quarry - Werribee (Manor Hole, Bulban Rd, Werribee)
- Cemex Quarry - Werribee (Wests Rd, Werribee)
- Mountain View Quarry – Wyndhamvale (off Ballan Rd, Wyndhamvale)
- Boral Quarry - Deer Park (Riding Boundary Road, Truganina)
- Cemex Quarry - Rockbank (Leakes Rd, Rockbank)
- High Quality - Bulla (Bulla-Sunbury Rd Bulla)
- Cemex Quarry - Oaklands Junction (Oaklands Rd, Oaklands Junction)
- Mountainview Quarry – Donnybrook (Donnybrook Rd, Donnybrook)
- Hanson Quarry – Wollert (Bridge Inn Road, Wollert)

Collectively the above quarries are also capable of providing all the necessary pavement materials (crushed rock and sealing aggregates) for flexible or bound pavement construction.

It is also likely that the outcrops of Silurian sediments in the vicinity of the intersection of Old Sydney Road and Donnybrook Road will also potentially provide large quantities of ripped soft rock suitable for both Type A and B fill materials.

8. APPENDICES

Appendix A	-	Locality Map
Appendix B	-	Geological Maps
Appendix C	-	Site Photos
Appendix D	-	Overview Maps – Borehole Locations from GeoVic Database
Appendix E	-	Overview Maps – Borehole Locations from Victorian Water Resources Data Warehouse / Sinclair Knight Merz Database
Appendix F1	-	Aerial Photographs 1984
Appendix F2	-	Aerial Photographs 1966
Appendix G	-	Overview Maps – Current Work Authorities from GeoVic Database

9. REFERENCES

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