Appendix C Geological Inspection Report

Douglas Partners
Geotechnics / Environment / Groundwater

Report on
Geological Inspection
Orange Drought Relief Connection
Orange, NSW

Prepared for
MWH Australia Pty Ltd

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Integrated Practical Solutions

Douglas Partners

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Report on Geological Inspection of Orange Drought Relief Connection Corridors Orange, NSW

1. Introduction

This report presents the results of a geological inspection and associated desk study by Douglas Partners Pty Ltd (DP) of the two investigated pipeline corridors from the Macquarie River to the City of Orange, NSW (refer to Section 3 of the main report for more information on the investigated corridors). The proposed Orange Drought Relief Connection will include the construction of an approximately 40 km long, 375 mm pipeline, with associated new pumping stations, from the Macquarie River to the existing Suma Park Dam Pumping Station with a provision for connection to Suma Park Dam reservoir. The work was commissioned by MWH Australia Pty Ltd (MWH) and was undertaken in liaison with Orange City Council (OCC) and in accordance with DP's proposal dated 12 November 2010.

Information supplied by MWH and OCC indicates that the Orange Drought Relief Connection will comprise one of two investigated corridors with proposed river off-take points of MR4, MR5a, MR5b and MR6. The eastern corridor (Corridor 2), from the confluence of the Macquarie and Turon River, is common with Corridor 1 only over a short section adjacent to the Suma Park Dam Pumping Station.

The aim of this study is to provide a preliminary assessment of regional and engineering geology, with particular emphasis on:

- rock types and strengths and the probability of intersection of the rock profile by pipeline trenches up to 3 m in depth;
- soil characteristics including susceptibility to erosion;
- influence of previous mining; and
- potential constructability issues.

2. Site Description

The project area lies within the Central Tablelands area of NSW where plateaux areas crest at approximately RL 900 relative to Australian Height Datum (AHD). The plateaux have been entrenched by the meandering, northwesterly-trending course of the Macquarie River and its associated northward-trending drainage systems, particularly those of Summer Hill Creek, Oaky Creek, Lewis Pond Creek, Emu Swamp Creek and Coolumbala Creek. Site levels at the proposed Macquarie River pumping station sites range between approximately RL 400 and RL 450.

It is anticipated that the corridor selected for construction will lie mostly within existing road easements and will deviate into adjacent property where surface conditions (e.g. vegetation, excessive slopes) or access from roads to the Macquarie River is required. The roads along the investigated corridors are mostly unsealed with the exception of the southern sections of Ophir Road and Lewis Creek Road. Properties adjacent to the roads are mostly used for grazing purposes or are part of public reserves.

Details of topography, drainage systems and land use are included in Maps 1 – 9 (Drawings 2 -10 in Appendix A) which include extracts of 1:25 000 topographic mapping sheets.

The project area lies within Climatic Zone 10A described by Edwards (in Soil Landscapes of the Bathurst 1:250 000 Sheet). The warm temperate climate of the Orange area has an average rainfall of approximately 810 mm; rainfall is at a maximum between June and August (monthly average of approximately 70 mm to 80 mm) and February and March are the driest (monthly average of approximately 40 mm).

3. Regional Geology and Soils

The study area lies within the Hill End Trough Geological Zone of the Central and Southern Highlands Fold Belt of NSW. The fold belt is characterised by north-trending bands of folded and faulted, metamorphosed strata of Ordovician, Silurian and Devonian ages which have been locally intruded by granitic rocks of Carboniferous age. These rocks are locally mantled by basalt and gravel deposits of Tertiary age and by recent alluvium along the creek and gully lines.

The distribution of lithological units (after the Orange 1:100 000 Geological Series Sheet), within an approximately 2 km wide corridor centred on the investigated corridors, are shown on Maps 1 – 9. A summary of lithologies and lithological unit identifiers of the various units shown in Maps 1 – 9 are given in Table 1 (refer following page).

The Soils Landscapes of the Bathurst 1:250 000 Sheet indicates that the bedrock geology is the major factor controlling the distribution of soils within the mapped area. The Silurian and Devonian rocks of the Hill End Trough are characterised by the development of yellow solodic soils, red podzolic soils and shallow soils which are grouped into the Mookerawa (mk), Mullion Creek (mu) and Burrendong (bd) Soil Landscapes. The Ordovician rocks within or adjacent to the proposed pipeline corridors are included within the North Orange (no) Soil Landscape. The soils developed on the Tertiary basalts overlying the older rocks are grouped in the Panorama (pa) Soil Landscape.

Two soil groups, the Macquarie (mq) Soil Landscape and the Lachlan (lh) Soil Landscape, are also locally developed on alluvium associated with Summer Hill Creek and Emu Swamp Creek. It is noted that additional alluvial deposits have also been observed along streams during the current study.

Table 1: Summary of lithological units

Lithological Unit	Unit Identifier	Lithologies
-	Qa *	Gravel, sand, silt, clay
-	Tg	Gravel
-	Tb *	Pyroxene olivine plagioclase basalt, alkali basalt, trachybasalt, trachyandesite
Bruinbun Granite	Crga	Biotite granite
Turondale and Waterbeach Formations (undifferentiated)	Dc *	Feldspathic volcanoclastics, greywacke, slate
Bay Formation	Dcb *	Feldspathic sandstone, siltstone
Cookman Formation	Dcc *	Quartz sandstone, minor siltstone, shale, silicified tuff
Merrions Formation	Dcm *	Massive quartzo-feldspathic sandstone, lithic sandstone, rhyodacite, conglomerate, siltstone
Cunningham Formation	Dn *	Slate, laminated siltstone, lithic sandstone
	Dns *	Muddy lithic sandstone, polymictic conglomerate
Anson Formation	Sma *	Carbonaceous pyritic siltstone, felsic volcanics, volcanic sandstone, limestone
	Smac *	Conglomerate, sandstone, siltstone
	Smal *	Calcareous siltstone, massive limestone
Barnby Hills Shale	Smb *	Feldspathic, micaceous and carbonaceous siltstone and shale, fine grained sandstone
Mullions Range Volcanics	Smu *	Rhyolite, tuffaceous mudstone, rhyolite breccia, volcanic conglomerate, dacite, limestone
Chesleigh Formation	Ss	Lithic sandstone, slate, tuff, mudstone
	Ssv	Dark grey, thinly interbedded crystal and vitric tuff, fine grained tuffaceous sediments
Oakdale Formation	Oco *	Mafic volcanic sandstone, basalt, siltstone, black shale, chert, breccia, conglomerate
-	Om	Monzonite, monzogabbro, quartz monzonite
-	Ou *	Ultramafic cumulates and lava

* Intersected by proposed pipeline corridors

The distributions of the mapped soil landscapes are shown in relation to the investigated pipeline corridors on Figure 1.

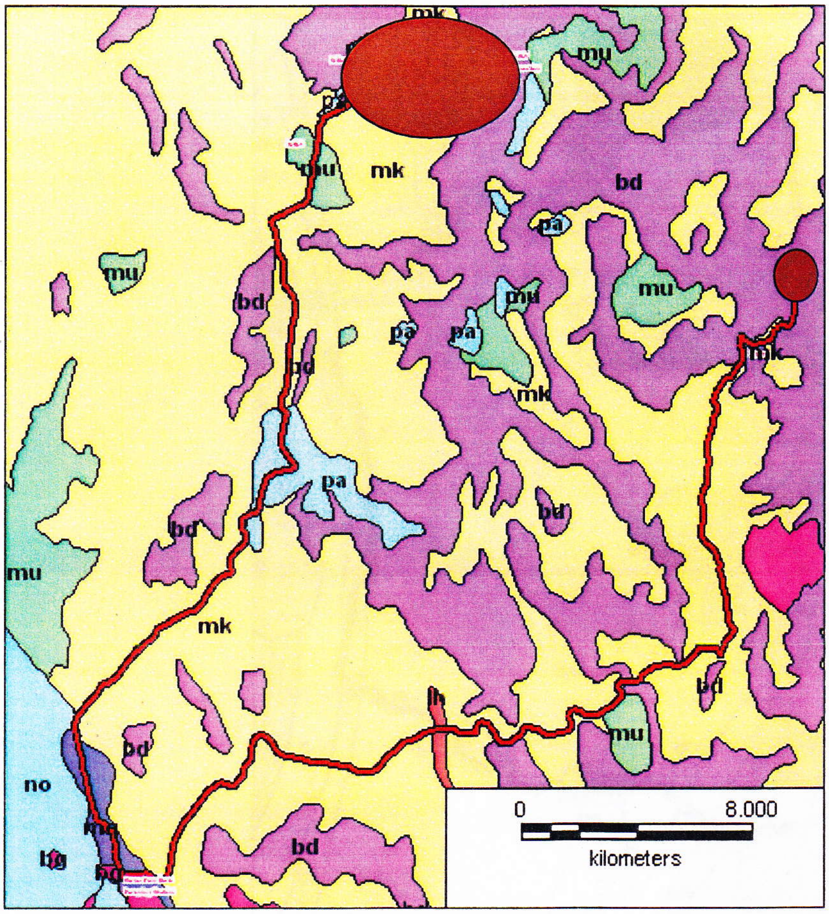


Figure 1: Distribution of mapped soil landscapes

4. Previous Mining Activity

The rocks of the Hill End Trough and alluvium derived from these include locally developed mineral deposits. Mining activity in the study area dates from the mid 1800s with underground mining of gold, silver copper, zinc and lead being carried out. Alluvial workings for gold have also been carried out within the bed of the Macquarie River and Turon River.

The locations (shown ▲) of previous mining activities recorded on the data base provided by MWH are shown in Figure 2 (following page); an extract of the Bathurst 1:250 000 Metallogenic Map which also shows previous mining locations. The closest previous mining to a corridor (Corridor 2) is the Dead Horse Gully Mine (mine reference No. 42, Figure 2) where the 1:25 000 topographic mapping sheets (refer Map 6, Drawing 7) indicates an "abandoned mine shaft".

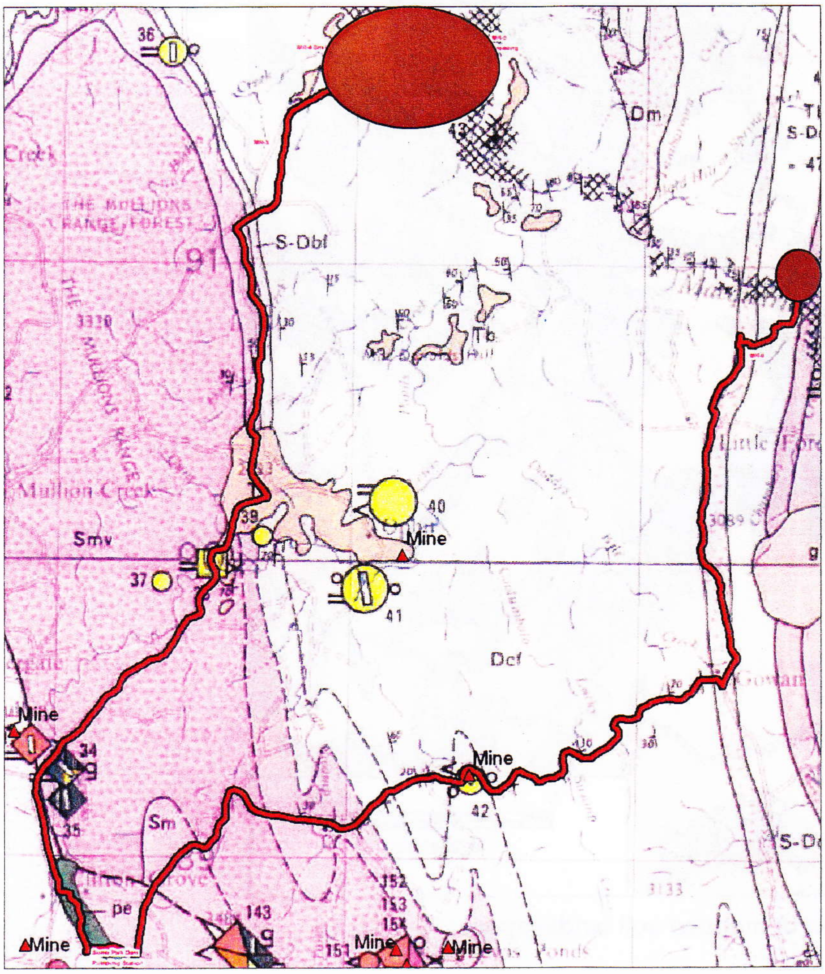


Figure 2: Mine locations (extract from Bathurst 1:250 000 Metallogenic Map

The 1:25 000 topographic mapping sheets also indicate the presence of "numerous abandoned mines" in the vicinity of Summer Hill Creek 4th Crossing (refer Maps 2 and 3, Drawings 3 and 4). These correspond to mine reference No. 38 of Figure 2. Additional "old gold digging" are also shown along Lewis Ponds Creek adjacent to MR-6 (refer Map 6, Drawing 7).

5. Field Work

The field work comprised inspection of the corridors by a Principal Engineering Geologist during November 2010. The locations of items of note were determined by either reference to features shown on 1:25 000 topographic mapping sheets or by measurement to MGA Zone 55 co-ordinates by a hand held GPS receiver.

The main items of note are described on Maps 1 – 9 and selected items are additionally shown in Photos 1 – 20 (refer Plates 1 – 6 in Appendix A). Notes describing classification methods and descriptive terms are also included in Appendix A.

5.1 Corridor 1, section around MR4 river off-take towards Long Point Road

The geological conditions of this section (Figure 3) are described below.

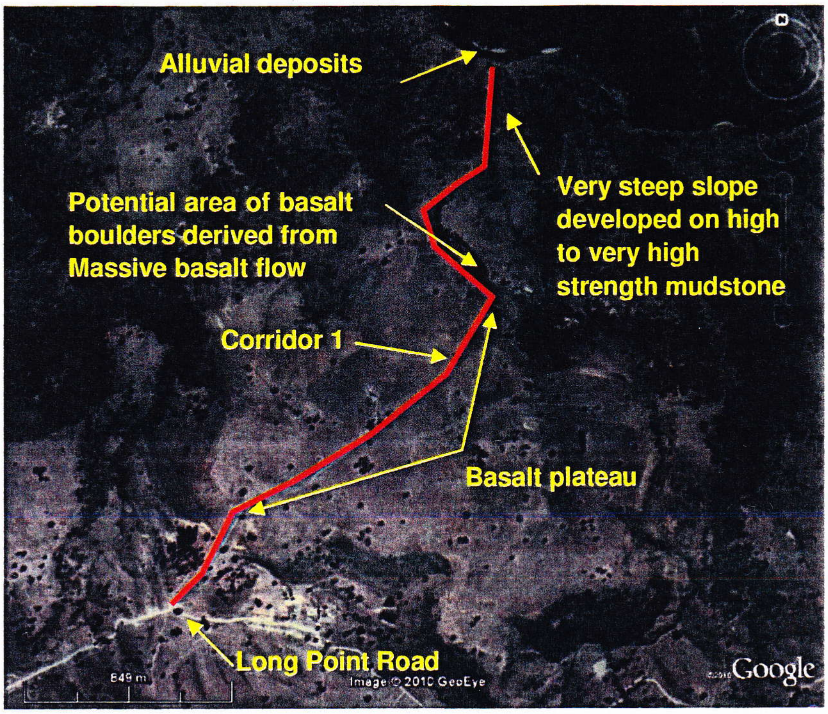


Figure 3: Inferred conditions of Corridor 1 around MR4 river off-take towards Long Point Road

It is inferred that the main geological features significant to pipeline installation in this area are:

- Potential for instability of basalt boulders from cliff lines formed about the perimeter of the basalt capped plateau.
- Probable shallow depth to High or Very high strength basalt on the plateau and in foliated mudstone, but with some interbedded sandstone, underlying steep (18° – 27°) to very steep (27° – 45°) slopes below the base of the basalt at approximately RL 600.
- Sand and gravel deposits within the base and banks of the Macquarie River.

5.2 Corridor 1, section from around MR5a river off-take towards Long Point Road

The area of Corridor 1 from around MR5a river off-take towards Long Point Road (refer Map 5, Drawing 6) is characterised by:

- Predominantly underlain at shallow depth (< 1 m) by foliated mudstone with some interbedded sandstone.
- Numerous Medium or greater strength outcrops, particularly in steep or very steep hillside sections.

- Shallow (0.5 m to 1.5 m) road cuttings exposing Extremely Low to Very Low strength mudstone with included high strength bands between areas of outcrop.
- Shallow, narrow bands of alluvium infilling the base of several minor gullies.
- A High strength rock bar within the stream bed controlling ponding within the river section (refer Photos 1 and 2, Plate 1) and apparently extending upslope (approximately 8 m above current water levels) below river alluvium (refer Photo 3, Plate 1).

5.3 Corridor 1, section from around MR5b river off-take towards Long Point Road

The conditions of this area are as described below:

- A current bed load comprising sand and gravel and high level alluvium, also including gravel bands, extending approximately 15 m to 20 m above the current water level.
- Open jointing and some fragmentation of High to Very High strength foliated mudstone at the downstream of the two possible off-take sites (refer Photo 5).
- A relatively moderate grade along the existing access track (refer Photo 6, Plate 3) which intersects, open jointed, Medium to High strength mudstone outcrops.
- Cut to fill sections of Long Point Road crossing steep side slopes (refer Photo 7, Plate 2) with spalling of 3 m high cut faces and poorly placed filling on the downslope side.
- Cleared surface conditions (refer Photo 8, Plate 2) along Long Point Road

5.4 Corridor 1, section from Long Point Road to Suma Park Dam Pumping Station

This section (refer Maps 1 – 5, Drawings 2 – 6) is characterised by:

- Road cuts, ranging from approximately 0.5 m to 8 m deep, exposing profiles with soil profiles ranging from less than 0.3 m to approximately 1.5 m deep underlain by mostly foliated mudstone, siltstones and sandstone. The cuttings include many Medium or greater strength rock bands with variously tight to open jointing.
- Basaltic profiles with rounded corestones of Medium or greater strength within extremely to highly weathered matrix (refer Photo 9, Plate 3) in cuttings of Lookout Road near the intersection with Ophir Road and also in cuttings of Ophir Road (refer Maps 2 and 3, Drawings 3 and 4). A southeasterly extension of a mapped basalt-capped ridge extends to Ophir Road (refer Map 2, Drawing 3) and is also characterised by corestones (tors) to approximately 0.2 m diameter.
- High to Very High strength rock bars within the beds and banks of Summer Hill Creek 3^{rd} and 4^{th} Crossings (refer Photos 10 – 12, Plate 4).
- Alluvium infilling the bases of many gullies and creeks. The section of ~~Lookout Road~~ Oaky lane extending approximately 1 km to 6 km south of its intersection with Long Point Road is crossed by many gullies of Oaky Creek where the alluvium is subject to water logging or erosion by flood events. Recent alluvium also mantles much of the Oakdale Formation for approximately 2 km north of the Lewis Ponds Creek intersection.
- An alluvial flood plain about Summer Hill Creek (refer Photo 13, Plate 4).

- A probable cover of older, high level alluvium or colluvial soils overlying the gently sloping footslopes within the Clifton Grove subdivisional area.
- Colluvial soils including joint blocks derived from the steep hill located immediately west of the pumping station.

5.5 Corridor 2

This section (refer Maps 1, 6 - 9, Drawings 2, 7 - 10) is characterised by:

- An alluvial flood plain about Summer Hill Creek.
- A probable cover of older, high level alluvium or colluvial soils overlying the gently sloping footslopes within the Clifton Grove subdivisional area and extending approximately 2 km east of Ophir Road.
- Many alluvium infilled gullies and creek beds and extending over continuous corridor lengths of up to 1100 m. Gully erosion of the alluvium is present to depths in excess of 2 m in some locations.
- Alluvium forming a flood plain along the banks of the Macquarie River at and south of the intersection with the Turon River (refer Photo 14, Plate 5).
- Very steep hillslopes, about the course of the entrenched Macquarie River (refer Photo 14, Plate 5), with rock outcrops and joint blocks which may evidence previous slope instability.
- Road cuts of Lewis Ponds Road, Gowan Road and Root Hog Fire Trail, mostly ranging from approximately 0.5 m to 3 m deep, exposing profiles with soil profiles ranging from less than 0.5 m deep underlain by mostly foliated mudstone, siltstones and sandstone, conglomeratic in part. The cuttings and adjacent outcrops include many Medium or greater strength rock bands with variously tight to open jointing (refer Photos 15 – 17, Plates 5 and 6). A previously unmapped granite exposure (refer Photo 20, Plate 6) is also noted in a cutting of the Lewis Ponds Road adjacent to the intersection with White Hill Lane.
- The steep hillside (refer Photo 16, Plate 5), crossed by the Root Hog Fire Trail approximately 1 km to 2 km west of the Macquarie River, includes massive outcrops, tors or boulders, many of which appear to have been transported as the result of previous slope instability.
- The stream bed of Emu Swamp Creek includes rock bars both downstream and upstream of the Lewis Creek Road bridge (refer Photos 18 and 19, Plate 6).

6. Proposed Development

The concept design for the proposed Orange Drought Relief Connection includes an approximately 40 km long, 375 mm diameter pipeline, with associated new pumping stations, from the Macquarie River to the existing Suma Park Dam Pumping Station with provision to connect to Suma park Dam reservoir. Upgrading of existing roads or tracks or the construction of new roads will be required for the installation and operation of the new structures.

It is understood that OCC may have a preference for a ductile pipeline and that the depth of burial will probably range from 1 m to 3 m. Some above ground, suspended sections may be required in the initial run of rising main from the main pumping station at the river bank.

The selection of the final corridor from the currently investigated corridors (including river off-take options) will be informed by this and other engineering and environmental studies.

7. Comments

7.1 Slope Instability

Previous slope instability is noted in several natural slopes adjacent to or at the investigated pipeline corridors. Steep slopes, at the periphery of a basalt covered plateau crossed by Corridor 1 at MR4 river off-take, include scattered fallen joint blocks to in excess of 3 m greatest dimension. The eastern rising section of Corridor 2, which crosses steep to very steep slopes, is also characterised by rocky terrain including large tors and/or boulders resting on the slope. Construction of access roads or pipeline trench excavation across these areas will need to ensure that fallen blocks or open jointed exposures from which the blocks have been derived are not inadvertently disturbed as there is potential for additional slope instability.

Existing road cuttings, particularly in foliated rocks, are subject to on-going fretting and (at least) small wedge failures (e.g. in the cuttings of Long Point Road, refer Photo 7, Plate 3) controlled by foliation, jointing and often steeply inclined bedding. Construction of access roads, pumping station platforms or pipeline trench excavations will need to ensure that cut batters are selected on a site specific basis to ensure long-term amenity and construction period safety.

7.2 Excavatability

The depths of cuttings and soil depths observed during the field work are shown on Drawings 2 – 10. At the current level of field assessment, no attempt has been made to determine the proportion of soil to rock within likely trenching depth.

Along most of the lengths of the corridors, bedrock is present at shallow depth (typically <0.3 m to 1 m) below colluvial or residual soils. Shallow deposits of often erratically distributed alluvium also mantle gully and creek floors which may have eroded down onto high or very high strength rock.

Overburden alluvial, colluvial and residual soils, Very Low, Low and Medium strength rocks may be expected to be readily excavated by heavy bulldozers (e.g. D9 class or larger) in open excavations for access roads and construction platforms. Significantly reduced (potentially uneconomic) productivity may be expected in High and Very High strength rocks and may require blasting or heavy rock breaker use. The use of these excavation techniques may result in additional fracturing of the rock mass in the batters and a consequent need for surface treatment.

In detailed excavations for the pipeline trench, footings for pumping stations and drainage/services lines, allowance should be made for use of hydraulic rock hammers for breakage of Medium or greater strength rocks. Blasting may also be required where jointing is widely spaced in the higher strength materials.

Excavations in alluvium (particularly granular material) subject to water logging have the potential for rapid caving. The use of trench boxes may be required in these areas to facilitate placement of pipes and to provide safe working conditions.

It is anticipated that the high quartz content of some of the quartz sandstones, volcanic bands and granitic materials will result in relatively high abrasion rates for the earthworks equipment.

7.3 Site Preparation

Relevant general earthworks guidelines for the cut to fill operations for access roads and pumping station platforms proposed for the project:

- unsupported cuts in soil should not exceed 1.5 m height and should be battered at no steeper than 2H:1V.
- the growth of vegetation on soil covered slopes should be encouraged and assisted by hydro-mulching where required.
- where cuts in soil are to be steeper than 2H:1V and deeper than described above, the slope should be supported by engineer-designed retaining walls.
- cuts in rock should be constructed at batters between 1.5H:1V to 0.25H:1V. The final batter slopes will depend on the strength and intensity of fracturing of the rock and should be determined by a combination of site specific investigation and excavation monitoring.
- all rock cuts should be thoroughly cleaned of loose debris prior to final inspection to determine requirements for any additional face support works (e.g. shotcrete or rock bolting) for prevention of block fall or water scour of erodible materials.
- prior to placement of filling, the subgrade should be inspected during proof rolling carried out after the removal of topsoil and any deleterious soft, loose or compressible material.
- where the ground slopes are steeper than 8H:1V, each layer should be placed and compacted horizontally in a cut and benched formation in accordance with AS3798 – 2007.

- filling materials should generally be restricted in size to less than 75 mm unless specifically selected for erosion protection or other specific purposes of limited areal extent. It should be noted that where there are open joints in the rock mass, it is likely that excavation of the high or greater strength material may result in large blocks which may not break down under compaction. These blocks should not be utilised in filling but may be used as slope protection.
- all filling materials should be approved and placed under engineering control (to Level 1 criteria in accordance with AS3798 - 2007).
- filling should be battered at no steeper that 2H:1V, unless supported by engineer-designed retaining walls. Flatter slopes and intermediate berms with drains are suggested to minimise erosion when slope lengths are in excess of 15 m.
- retaining walls should include free draining backfill over the full height for a width of at least 0.3 m behind the face to reduce the risk of water pressure build-up. Drainage should be facilitated by an ag drain at the base of the granular fill and by a lined surface drain at the crest. The collected water should be discharged to the site stormwater system.
- subsoil drainage lines should include flexible couplings and adequate inspection points for maintenance purposes.

7.4 Erodibility

Gully erosion has been noted within alluvial deposits along several minor streams. Within the confines of the Macquarie River, the gravel and sand deposits should be considered to be erodible and mobile during flood flows.

The Soils Landscapes of the Bathurst 1:250 000 Sheet provides an assessment (refer Table 2, following page) of the soil erodibility (the susceptibility of a soil to detachment and transport by water and wind) of dominant soil types of most of the soil landscapes within the study area. The Burrendong Soil Landscape is assessed as having a slight potential for sheet erosion.

7.5 Influence of Previous Mining on the Proposed Development

It is likely that previous mine working will lie adjacent to very short sections of the investigated corridors. At the current level of available detail, it is anticipated that pipeline corridors within or immediately adjacent to the existing road easements should not be affected by the previous mining activities. It will, however, be appropriate to carry out walk-over inspections of the selected corridor to confirm this assessment by searching for previously un-recorded workings.

Table 2: Summary of Ranking of Soil Erodibility

Soil Landscape	Dominant Soil	Topsoil Erodibility	Subsoil Erodibility
Lachlan	Alluvial soil (sandy)	Medium	Low
	Alluvial soil (loamy)	Low	Medium to High
	Prairie soil	Medium	Medium to High
Macquarie	Alluvial soil (sandy)	Medium	Low
	Alluvial soil (loamy)	Low	Medium to High
	Prairie soil	Medium	Medium to High
	Black Earth	Medium	Low
Panorama	Krasnozem	Medium	Medium
	Wiesenboden	Low	Medium to High
Mookerawa	Brown podzolic soil	Medium	Low
	Yellow podzolc soil	Medium	Medium
Mullion Creek	Soloth	High	High
North Orange	Red Earth	Medium	Medium
	Yellow podzolic soil	High	High
	Wiesenboden	Low	Medium to High
	Yellow Earth	Medium	High

7.6 Constructability Aspects

The site observations indicate that the main geological and geotechnical constraints related to constructability of the proposed pipeline are:

- The steep hillslope (with possible cliff line sections) crossing the margins of the basalt capped plateau on Corridor 1 around MR4 river off-take where there is potential for disturbance to trigger slope instability within massive joint blocks and boulders.
- The steep and very steep hillslope section from river terrace level to the Root Hog Fire Trail on Corridor 2 where construction plant access will be extremely limited and will probably require significant disturbance of the slope and vegetation cover. Such disturbance has the potential to trigger erosion or slope instability.
- The steep hillslope section along the Root Hog Fire Trail on Corridor 2 where there is potential for disturbance to trigger erosion or slope instability within massive joint blocks and boulders.
- The presence of numerous high to very high strength rock bars at surface or within the expected depth of pipeline trench excavation in bothl corridors. The requirement for heavy rock hammer use or blasting to excavate the trench will be governed by the intensity and intactness of jointing and the orientation of the dominant rock mass defects (typically bedding and foliation) to the trench alignment.

- The likely coarse sized, rocky nature of much of the materials excavated from pipeline trenches with potential for resulting unsuitability for use as compacted trench backfilling.
- Water logging of alluvial sections, particularly on Corridor 1 between Long Point Road and Ophir Road, with resultant potential for poor trafficability and collapse of trench excavations.
- Likely high conductivity in alluvial materials subject to long-term saturation with resulting potential for corrosive conditions in ductile materials.

7.7 Further Investigation

It is suggested that further investigation after the pegging of the preferred pipeline corridor include:

- A walk-over geological survey of the entire preferred corridor by a senior engineering geologist to assess soil and rock distribution and potential for instability or erosion.
- Selection of test pit locations for investigation of excavatability and sampling of materials for laboratory assessment of suitability for use as trench backfilling and access road construction. It is suggested that an initial phase of test pitting be carried out using a tractor mounted backhoe to enable rapid movement along the preferred corridor. A second phase of test pit excavation is suggested and would employ a larger (say 20 – 22 tonne) excavator with rock bucket and hydraulic hammer attachments to investigate areas of difficult excavation conditions assessed during the site walk-over and initial phase of test pitting.
- In situ electrical resistivity testing, using the Wenner method, within areas of potential high conductivity and corrosion potential.
- A program of laboratory testing including classification tests, compaction parameters, California bearing ratio for assessment of access roads and pavements associated with new pumping stations, together with soil aggressivity for assessment of corrosion of buried concrete and steel elements.

8. References

1. Kovac, M. and Lawrie, J.A. (1990), *Soil Landscapes of the Bathurst 1:250 000 Sheet.* Soil Conservation Serive of NSW, Sydney.
2. Raymond, O.L., Pogson, D.J., Wyborn, D., Chan, R.A., Hawley, S.P., Henderson, G.A.M., Krynen, J.P., Meakin, S., Moffitt, R.S., Morgan, E.J., Scott, M.M., Spackman, J.M., Stuart-Smith, P., Wallace, D.A., Warren, A.Y.E., Watkins, J.J., Glen, R.A., 1997, *Bathurst SI5508 (Orange 1:100 000) Digital Geology Data Package*, Australian Geological Survey Organisation, Canberra / New South Wales Department of Mineral Resources, Sydney
3. Geological Survey of NSW, Department of Mines (1979), *Bathurst Metallogenic Map Sheet SI 55-8.*
4. Standards Association of Australia, Australian Standard AS 3798-2007: *Guidelines on Earthworks for Commercial and Residential Developments.*

9. Limitations

Douglas Partners (DP) has prepared this report for MWH Australia Pty Ltd in accordance with DP's proposal dated 12 November 2010 and acceptance received from MWH Australia Pty Ltd on 17 November 2010. The report is provided for the exclusive use of MWH Australia Pty Ltd for this project only and for the purpose(s) described in the report. It should not be used for other projects or by a third party. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions only at the specific sampling or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of anthropogenic influences. Such changes may occur after DP's field testing has been completed.

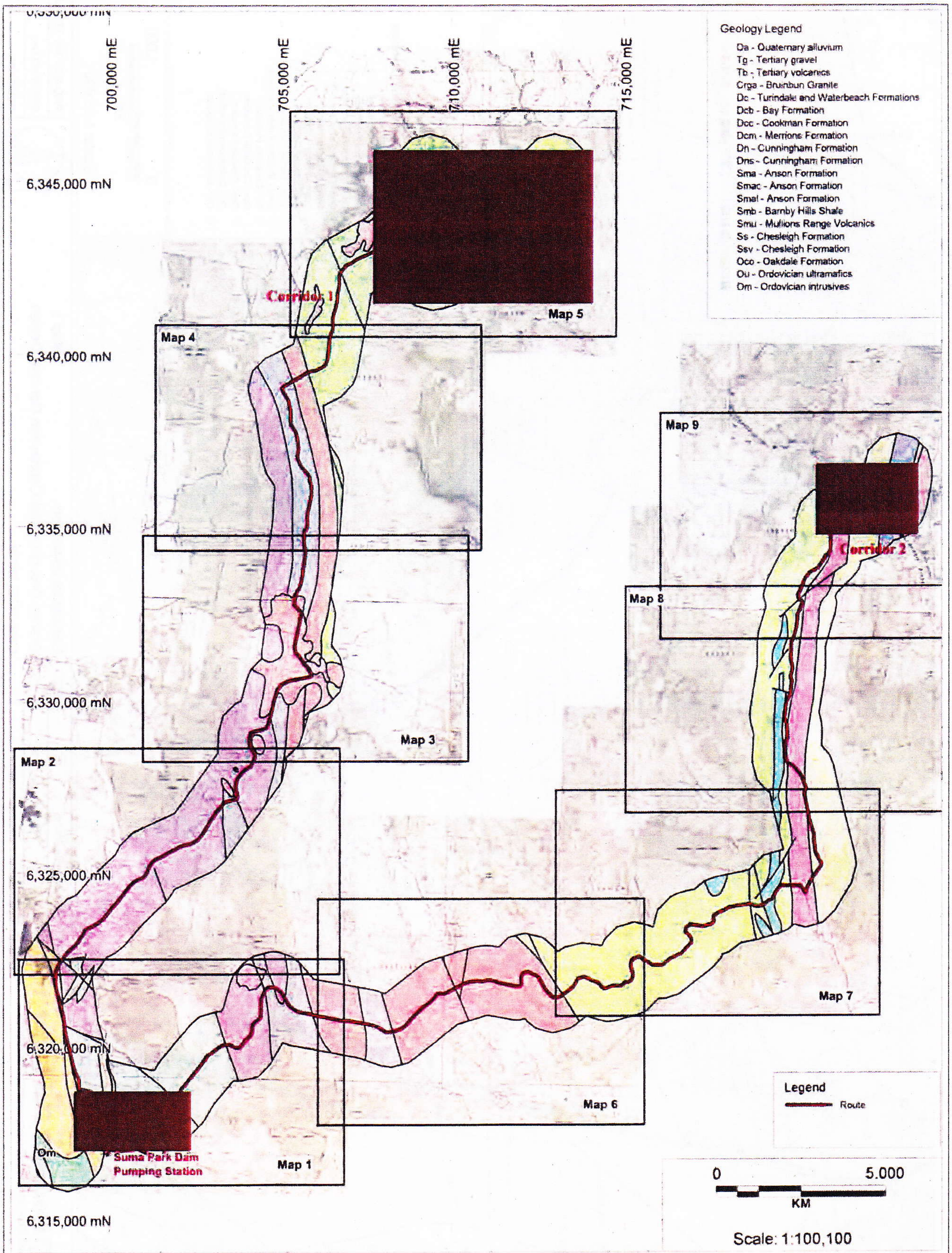
DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be limited by undetected variations in ground conditions between sampling locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.
This report must be read in conjunction with all of the attached notes and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion given in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

Douglas Partners Pty Ltd

Appendix A

About this Report
Drawings 1 – 10
Plates 1 - 6



Douglas Partners Geotechnics / Environment / Groundwater	TITLE: **Geological Inspection** **Orange Drought Relief Connection** **ORANGE, NSW**		MGA Zone 55	OFFICE: Sydney DRAWN BY: AT DATE: 25.11.2010
CLIENT: MWH Australia Pty Ltd	PROJECT No: 72151.00	DRAWING No: 1	REVISION: A	SCALE: As shown