# Independent Environmental Audit on Sydney Metro City & Southwest – TSE Works

# Final Report

**8th November 2018**

**Contract works: Tunnel, Stations & Excavation Works (TSE)**

**Scope: Planning Approval compliance relating to Construction Heritage Management**

**Reference: SM18.19-067-CSW-TSE-ENV**

| | | | |
|---|---|---|---|
| **Audit Organisation:** | QEM Consulting | **Audit Date:** | 4th October 2018 |

# 1. Executive Summary

## 1.1 Introduction

The purpose of this Independent Environmental Audit was to assess Principal Contractor John Holland CPB Ghella's Joint Venture (JHCPBG's) compliance with relevant Planning & Assessment Approvals associated with Construction Heritage Management for the City & Southwest Tunnel, Stations and Excavation (TSE) works.

## 1.2 Background

Planning Approvals issued by the Department of Planning & Environment require Sydney Metro (formerly Transport for NSW) to develop an Environmental Audit Program for independent annual environmental auditing against the terms of the City & Southwest projects Critical State Significant Infrastructure (CSSI) Approval .

QEM Consulting Pty Ltd have been engaged by Sydney Metro Delivery Office (SMDO) Safety, Sustainability & Environment (SSE) to deliver a program of Independent Environmental Audits. As required by Planning Approval CSSI 15_7400 Ministers Condition of Approval (MCoA) A39 and the associated Environmental Audit Program, an Independent Environmental Audit was undertaken to assess JHCPBG compliance with relevant Planning Approvals associated with Construction Heritage Management in their delivery of Tunnel, Stations and Excavation (TSE) infrastructure construction works.

As background, Sydney Metro is delivering the Sydney Metro City & Southwest (C&SW) TSE works on behalf of the NSW Government, and have engaged JHCPBG JV to Design and Construct this phase of the Project.

## 1.3 Objective and Scope

The objective of the audit was to assess the implementation of the JHCPBG Construction Heritage Management Plan* (CHMP) in achieving compliance with associated Planning Approvals including MCoA C3 g) plus relevant Revised Environmental Mitigation Measures. Audit criteria also included implementation of relevant requirements and obligations documented in the C&SW Construction Noise & Vibration Strategy* (required by MCoA E32) and the C&SW Construction Environmental Management Framework* (CEMF). The audit scope included the following focus areas:

- Waterloo and Barangaroo project worksites;
- Management, protection and control of vibration and excavation impacts on heritage structures;
- Construction Heritage Management Plan implementation;
- Approval & regulatory compliance records.

** Assessed versions of documents current at the time of audit are indicated in Appendix 1.*

## 1.4 Summary of Findings

The table below provides a summary of key findings noted in this audit and the priority assigned to these findings.

| Ref | Description | Priority* |
|---|---|---|
| Obs | Engineering, instrumentation, monitoring, review and additional mitigation measures for management of ground settlement issues that had caused cosmetic damage to the local heritage-listed circa 1860 Waterloo Congregational Church's Annex was observed as a positive. | Observation |
| 1. | Identified heritage structures generally specified as requiring vibration monitoring by the Construction Heritage Management Plan needed clarification, given that referenced Construction Noise & Vibration Impact Statements did not provide much guidance further. | OFI |

** Priority Definition enclosed as Appendix 2*

## 1.5 Overall Assessment

This section summarises the outcomes of an independent environment audit of JHCPBG's implementation of the Construction Heritage Management Plan (CHMP) in achieving compliance with relevant Planning Approvals and Revised Environmental Mitigation Measures. Conducted on 4th October 2018 the audit comprised a Waterloo and Barangaroo site inspection, followed by a project review, including brief assessment of the management of construction vibratory impacts on identified heritage structures.

Based on documentation and information sampled, implementation of the CHMP was assessed as compliant with Minister's Conditions of Approval MCoA C3 (g). The audit built on an internal JHCPBG Construction Heritage Management audit earlier in the year and focussed on subsequent heritage related activities including archaeological excavations, most of which were nearing completion. To this end, several Archaeological Method Statements (AMSs) required by MCoA E17 were published on the project website, these reflecting consultation with the Heritage Council of NSW. Inspection of the remaining Barangaroo archaeological excavation site noted a near-intact wooden boat hull circa 1850 discovered the week prior. This find had been notified to Office of Environment & Heritage and ensuing discussions were underway around recording and salvaging processes, the expectation being that preliminary advice documented by attending Heritage Consultants would inform an Archaeological Relics Management Plan required by MCoA E20.

The audit also assessed engineering controls around monitoring and protection of listed heritage structures, including vibration monitoring data. Ground settlement issues at the Waterloo Congregational Church causing cosmetic damage were noted, this matter receiving considerable attention with technical investigations, enhanced monitoring and remedial action being well documented. A documented JHCPBG Monitoring & Protection Plan was available and, although predominantly focused on excavation / tunnelling impacts and related monitoring equipment and surveillance requirements, implementation thereof had been adapted to increase monitoring of the Church. Enhanced monitoring and mitigation measures were supplemented by geotechnical data, with vibratory exceedances triggering real-time alerts to key stakeholders. Depending on exceedance levels, the Monitoring & Protection Plan then mandated commensurate Management Action Team or MAT response. A Permit-to-Tunnel (or Excavate) process was also observed, this being a hold point requiring assessment, review and approval by a multidisciplinary team that considered potential risks and monitoring data.

The lack of guidance on vibration monitoring requirements for nominated historical heritage structures adjacent to worksite surrounds (impact predicted to be of low risk, but nonetheless requiring confirmation) resulted in an Improvement Opportunity being raised as an Audit Finding.

In conclusion, the audit determined that formal processes were established to identify, manage, protect and conserve historic and aboriginal heritage, with considerable effort being undertaken to minimise vibratory impacts on structures, some of which were extremely close to construction works.

**Report Author (& Auditor)**:

*L J Weiss*
**Larry Weiss**

# 2. Detailed Findings and Agreed Action Plan

## 2.1 Audit Findings & Action Plan

This section of the report provides details of audit findings and the agreed action plan, including allocation of responsibility and timeframes.

| Ref | Audit Finding | Risk or Impact | Classification (and Priority) | Action Plan |
|---|---|---|---|---|
| | *Positive observations / strengths:* | | | |
| Obs | Engineering, instrumentation, monitoring, review and mitigation measures applied to settlement issues and mitigation of further cosmetic damage to the annex of the local heritage listed circa 1860 Waterloo Congregational Church were of note. | None | Observation | N/A |
| | *Audit findings requiring action:* | | | |
| 1. | Vibration monitoring requirements for numerous Items listed in Table 6 of the Construction Heritage Management Plan simply refer to relevant Construction Noise & Vibration Impact Statements (CNVIS), but in most instances CNVISs did not provided any further specific guidance such as frequency and/or applicable construction activity or stage.<br><br>*The absence of CHMP guidance mostly relates to "Adjacent Historic Heritage Items" and where in some instances heritage impacts were stated as being "indirect", vibration monitoring was still implied, by implication precautionary.* | | OFI | **Action to be taken by JHCPBG:**<br>a) Update the Construction Heritage Management Plan to detail specific monitoring requirements for all specified heritage structures.<br>b) Collate project compliance records demonstrating required vibration monitoring, especially of "adjacent" Historic Heritage Items.<br><br>**Responsible person:**<br>Environment, Approvals, Sustainability & Interface Manager<br><br>**Due date:** 30 January 2019 |

** Priority Definition enclosed as Appendix 2*

## 2.2 Assessment Details

*The following section of this report provides narrative of plans, methodologies, procedures, systems, processes and activities assessed to determine compliance (or otherwise) with required project obligations and outcomes. Specific documentation, information and records are captured in Appendix 1 further.*

**Worksite heritage protection arrangements (Waterloo)**

Heritage protection requirements were well known to JHCPB personnel, including that of the heritage listed Congregational Church, plus archaeological aspects pertaining to site and Station Box excavation. Administratively, these requirements were communicated through a pictorial Site Environment Plan (SEP) and a heritage risk component of site inductions, the latter emphasising the Waterloo Congregational Church. Physical protection measures were observed around the church including fencing, hoarding and bollards addressing REMM NAH 19, as was a freestanding precautionary steelwork support / prop (shown in Appendix 1B) to mitigate any potential future settlement of the Church Annex towards the open-cut Station Box excavation works. Vibration, settlement and other related sensors were observed on the church, with vibratory vector sum data for the preceding days and prior month sighted as compliant with BS 7385 this required by the Construction Noise & Vibration Management Plan (CNVMP) specification goal of peak component particle philosophy for cosmetic damage of 7.5 mm/s. Records were available of a real-time monitoring (MCoA C11) exceedance of 17/9/2018, the alert investigation of which had triggered a stop work, subsequently deemed to be an isolated event.

**Worksite heritage management arrangements (Barangaroo)**

Administrative components of the Construction Heritage Management Plan (CHMP) were similarly implemented as per Waterloo above, with some remaining supervised archaeological excavation work underway, although the majority of other areas such as the “Shark Fin” Area R & T was completed, with Clearance Certificates issued. Just prior to this audit, an important historical find had been made being an intact pre-1850 wooden boat hull, with archival photogrammetry recording and pre-salvage work being undertaken by JHCPB’s appointed Archaeological Excavation Director and specialist Marine Archaeologist at the time. This European / NAH find had been reported as a S146 notification to OEH Heritage Division and a preliminary advice memo was sighted, JHCPBG indicating that this document would inform an Archaeological Relics Management Plan required by MCoA E20.

In accordance with MCoA E10, the High Street Wall had a protective mesh and rock anchors installed, and although for predominantly safety reasons, this “modification” was under the direction of AMBS Heritage Consultants, as documented in a Technical Memo, planned for though an earlier High Street Cutting Protection Report. Lastly, sandstone blocks were observed to be stored prior to relocation, and records were available of Environmental Coordinator inspections including a heritage protection checking prompt. The latter evidencing CHMP Element 2 requirements for Inspection and Monitoring - implementation of this Management Plan being a MCoA C3 g) obligation. Weekly independent Environmental Representative (ER) inspections were sighted as also assessing compliance with Heritage Management obligations.

**Management, protection & control of vibration and excavation impacts on heritage structures**

Per MCoA C3 a) required CNVMP, s5.8 thereof defined a “conservative” vibration damage screening level of 7.5 mm/s which had been adopted and implemented by JHCPBG for the Waterloo Church and 48-50 Martin Place Building on the basis of these buildings being assessed as structurally sound. Similar objectives were repeated in site-specific Construction Noise Vibration Impact Statements (CNVISs) including Waterloo and Barangaroo.

The inspection component of this audit observed the close proximity between the rear wall of the Waterloo Church Annex and the Station Box excavation works, with construction utilising a capped pile methodology. During these works, there had been a few vibration exceedance and ground settlement issues, these assessed by JHCPBG as causing cosmetic damage, this audit noting that subsequent investigations, reports, remedial action and ongoing monitoring were well documented (refer Appendix 1A). As a result of ensuing communications and updates between JHCPBG, Sydney Metro and the Department of Planning & Environment, compliance and project outcomes were therefore not reviewed further in this independent audit. Suffice to say that data on vibration and settlement was available, a Monitoring Action Team (MAT) had been established and Permits to Tunnel (or Excavate) were observed to be comprehensive in the assessment of potential risks. Inputs to this review included vibration, settlement and geotechnical information with review and approval of said PTTs evidencing participation by a number of management and technical functions, including the Independent Certifier and Sydney Metro.

The Monitoring & Protection Plan SMCSWTSE-JCG-TPW-CM-PLN-002036.03 dated 24 May 2018 covered monitoring locations, monitoring aspects and instrumentation to be used (e.g. survey markers, groundwater bore inclinometers, crack meters & vibration sensors), as well as alert levels and triggers for the MAT, plus instrument calibration requirements, reporting and real-time data availability. Whilst technical in nature and not in the scope of this audit, the Monitoring and Protection Plan, together with the MAT, PTT and data / information evidenced demonstrated compliance with CEMF 10.2 c) iv) regarding *"records of any impacts avoided or minimised through design or construction methods"* being a contractual implementation requirement of JHCPBG.

Otherwise, monitoring included use of a formal Vibration Monitoring Field Form by site Environmental Coordinators with real-time vibration data also published on the project website in accordance with Environmental Protection Licence requirements. Some exceedances such as that at 243 Miller Street were investigated, with improvements noted and post-event heritage building reassessment reflected in a System Improvement Note.

**Construction Heritage Management Plan implementation**

Further to the above, compliance information required by the CHMP (MCoA C3 g) was evidenced through implementation of processes for the management of listed historic heritage items, section 5.0; historical archaeological investigations, 6.0; and aboriginal heritage investigations 7.0.

Heritage Consultants had been appointed to the project by JHCPBG with Photographic & Archival reports progressing beyond those initially undertaken for the entire Chatswood to Sydenham project and the McMahons Point Seawall, and more recently including that of 37-51 Martin Place. Regarding archaeology, Excavation Directors had been appointed as per Planning Approvals, with their physical presence observed on site, and associated Site Clearance certificates sighted as maintained on TSE file. Also, per MCoA E17 numerous Archaeological Method Statements had been prepared and communicated to the Heritage Council of OEH. Preliminary (40 day) Archaeological Findings Reports were also progressing, these available per REMM NAH 8 to potentially inform the Heritage Interpretation Plan.

**Approval & regulatory compliance records**

In addition to the above, records demonstrating compliance with the MCoA C3 g) required CHMP and associated REMMs were available on request including but not limited to MCoA E31 regarding the solicitation of advice from heritage specialists on methods and locations for installing equipment used for vibration monitoring of heritage-listed structures. Inputs and specific arrangements such as that with Macquarie Bank (Martin Place) were noted as covered through a formal Deed.

## Appendix 1A: Audit information

The following indicates key systems, documents, reports, information and records that were reviewed, accessed or sighted during the audit process:

| Documentation | Information / Records |
|---|---|
| **0. Sydney Metro Planning Approval related documentation** | |
| Sydney Metro City & Southwest Construction Environmental Management Framework (CEMF) v3.1 dated 15/08/2016 | |
| | |
| **1. Worksite heritage protection arrangements** | |
| Casey & Lowe Technical Memo dated 2/10/2018 as preliminary advice re required Barangaroo Archaeological Relics Management Plan | Vibration Monitoring Field Forms for Barangaroo dated 17/4/2018 (piling and hammering) and 22/6/2018 (High Street Wall hammering) |
| AMBS Technical Memo 16314M dated 23/4/18 re High Street Wall Rockface Protective Mesh | Environmental Coordinator inspections |
| High Street Cutting Protection Report, JCG-TPW-EN-RPT-97230-01 dated 6/6/17 | Various Environmental Representative Inspection Reports |
| AMBS High Street Wall protective mesh Technical Memo 16314M dd 23/4/2018 | |
| Statement of Heritage Impact for High Street Wall ref 16314 V3 dated July 2017 | |
| Applicable Archaeological Method Statements (AMSs) as indicated below | |
| | |
| **2. Management, protection and control of impacts on heritage structures;** | |
| Construction Noise & Vibration Management Plan PLN-002012 v6 dd 5/12/17 | Permit to Tunnel, PTT-SWL-283 minutes of 23/9/18 |
| Barangaroo CNVIS TH511-02 01.06.04 F01 BN dated 17/8/18 | Geodata Barangaroo Heritage Wall settlement data from 26/7/18-26/9/2018 |
| Monitoring & Protection Plan JCG-TPW-CN-PLN-002036.03 dated 24 May 2018 | Geodata Waterloo settlement data from 30/4/18-17/9/2018 |
| Permit to Tunnel Procedure JCG-TPW-CN-MPR-003152.01 dated 10 May 2018 | Geodata Waterloo tiltmeter B112 data from 21/9/18-4/10/2018 |
| | Published EPL daily real-time Vibration Monitoring (et al) data Report EM-RPT-097304 for August 2018 |
| | Waterloo Church Vibration Triggers Event Report EVT 052002 dated 3/7/18 |
| | Waterloo Congregation Church-Engineering Report-Revision 2F-2018 dd 3/10/18 |
| | Victoria North Vibration Exceedance Investigation EM-RPT-097320 dated 26/9/18 |
| | Waterloo Station Congregation Church Engineering Report rev2-F dated 3/10/2018 |
| | |

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|---|---|
| **3. Construction Heritage Management Plan implementation** | |
| Construction Heritage Management Plan PLN-002015 v10 dated 30/8/2018 | 20180629_TSE Works Internal Environmental Audit CHMP (TSE_027) Final Audit Report |
| Construction Environmental Management Plan PLN-000817-05 dd 15/11/17 | GML Heritage Archival Recording Report for Chatswood to Sydenham draft of July 2017, McMahons Point Seawall of April 2017 and more recently of 37-51 Martin Place, reported April 2018. |
| Pitt Street North AMS, EM-RPT-002075 / 097249 | Blues Point Wharf Consistency Assessment GEN-SMCSWTSE-SMD-P_GEN-001316-TSE3 dated 14/7/2017 |
| Barangaroo AMS, SBR-EM-RPT-002073/ 097247 | Various compliance records evidenced below |
| Blues Point Heritage AMS, SMCSWTSE-JCG-BPS-EM-MST-00478 | |
| | |
| **4. Approval & Regulatory compliance records** | |
| | OPUS Pre-Construction Survey Macquarie Bank PRE-0930-00 of 12/7/2018 |
| | AMBS Building Monitoring Memo (Barangaroo and Martin Place) dated 14/9/2018 |
| | AMBS Summary Report on historical archaeological investigations at Chatswood Site dated 14/3/2018 |
| | Archaeological Method statements approval letter from Heritage Council of OEH dated 20/12/2017 |
| | Casey & Lowe Site Clearance Certificate 22/07/2018 for Barangaroo Sharks Fin Area |
| | Folder of Casey & Lowe Site Clearance Certificates for Waterloo partial clearances (both historical and aboriginal) |

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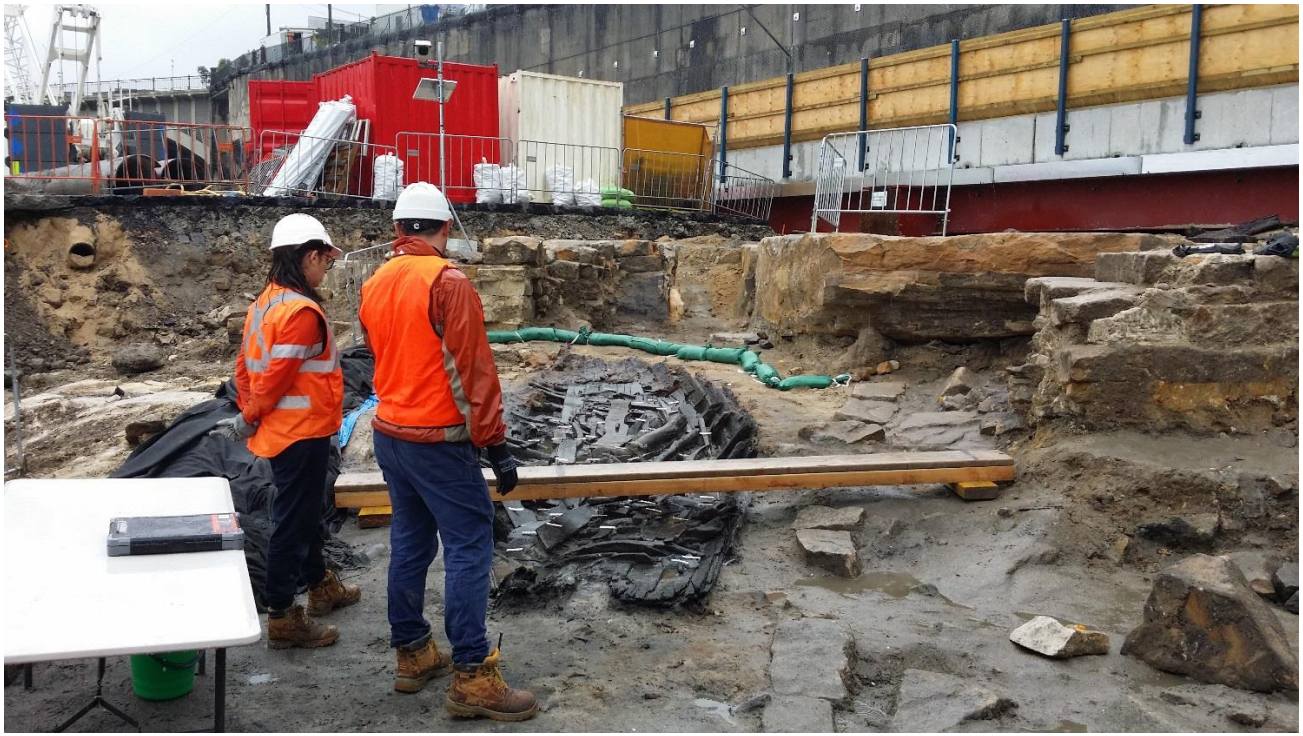
## Appendix 1B: Audit inspection observations

*The following summarises a few observations from the site inspection component of this audit:*



**Above**: Preparations for archival recording and salvaging of wooden boat hull (Barangaroo)

**Right (alongside):** Steel framework (in blue) as mitigation measure to prevent movement of the Waterloo Church Annex towards the Station Box excavation works (concrete capping beam atop piling, as shown).

## Appendix 2: Priority Definition

The priority for findings raised in this report is described in the table below.

| Priority | Definition | Guidelines for Implementing Actions |
|---|---|---|
| Very High | A significant control weakness / issue or fundamental non-compliance that exposes the project or area under review to a very high level of risk | Requires immediate management attention, with actions plans to be developed and enforced within an agreed time frame. The matter will be escalated immediately to senior management from all parties |
| High | A control weakness / issue or non-compliance that may expose the project or area under review to a high level of risk | Action plans to be developed and implemented within an agreed time frame. The matter will be escalated to relevant senior executives where it is deemed necessary |
| Medium | A control weakness / issue or non-compliance that may expose the project or area under review to a moderate level of risk | Action plans to be developed and implemented within an agreed time frame |
| Low | A control weakness / issue or non-compliance that may expose the project or area under review to a low level of risk | Action plans to be developed and implemented within an agreed time frame |
| OFI | Opportunity For Improvement (OFI) – opportunity to implement a good or better practice to improve efficiency or further reduce exposure to risk | Suggestion to be considered for implementation |
| Observation | Good Practice – process / system in place and implemented effectively across business. | Maintain to current standard. Share with other areas of business. |

## Appendix 3: Personnel Consulted and Timeline

We would like to extend our appreciation to the following individuals involved this audit:

| Name | Title |
|---|---|
| Anne Andersen | TSE Environment, Approvals, Sustainability & Interface Manager, JHCPBG |
| Robert Muir | TSE Environmental Manager, JHCPBG |
| Cale Kennedy | Environmental Coordinator, JHCPBG |
| Christian Timnsel | Project/Construction Manager, JHCPBG |
| Vimala Ferrari | Third Party Interface Manager, JHCPBG |
| Pam Tummers | Environment & Sustainability Manager, TSE IG, Sydney Metro C&SW |
| David Anderson | Acoustic Adviser, Acoustic Studio |
| Others: | Refer Attendance Register (Appendix below) |

The Audit timeline is shown in the table below.

| Milestone | Date |
|---|---|
| Briefing Meeting | 24 August 2018 |
| Issuance of Terms of Reference | 24 August 2018 |
| Desktop Audit | 31 August 2018 |
| Audit | 19 September 2018 |
| Issuance of Draft Report | 18 October 2018 |
| Issuance of Final Report | 8 November 2018 |

## Appendix 4: Audit attendance register

### QEM AUDIT ATTENDANCE REGISTER

| **AUDITEE:** TSE, JHCPBG-JV<br>**AUDIT:** Independent Environmental Audit, SM18.19-067-CSW-TSE-ENV (Heritage) | | | Project Office attendance<br>140 Sussex Street, Sydney | |
|---|---|---|---|---|
| **SITE(s)**: Waterloo & Barangaroo | | | **OPENING / REVIEW SESSION** | **CLOSING** |
| **NAME (print)** | **POSITION & ORGANIZATION** | | *4/10/2018* | *4/10/2018* |
| *Larry Weiss* | *Independent Environment Auditor* | *QEM* | | |
| DAVE ANDERSON | ACOUSTIC ADVISOR | ACOUSTIC STUDIO | | |
| Edward Borgos | Quality Officer | SM | | |
| RAN TUMMERS | Environmental & Sustainability | SM | RTummers | RTummers |
| Robert Maic | TSE Environment Manager | JHCPBG | | |
| Cale Kennedy | Environmental Coordinator | JHCPBG | | |
| Holly Hofland | Environmental Graduate | JHCPBG | | |
| CHRISTIAN TIMNELL | PROJECT/CONSTRUCTION MANAGER | JHCPBG | | |
| Vinala Ferrari | Third Party Interface Manager | JHCPBG. | part mtg 11:40 | 12:35. |
| Anne Anderton | EASI manager. | JHCPBG. | | |
| | | | | |

# Appendix 5: Audit Credentials

## *Audit process*

This Independent Environment Audit comprised an off-site desktop review, a one (1) day project contractor audit including 2 site inspections and a post audit assessment of documentation and records. The audit utilised an assignment specific Audit Checklist based on relevant Planning & Assessment Approvals plus Revised Environmental Mitigation Measures. The entire process was undertaken by Larry Weiss, of QEM Consulting Pty Ltd in accordance with AS / NZS / ISO 19011:2018 – Guidelines for Auditing Management Systems.

## *Auditor information*

| | |
|---|---|
| **Audit Organisation:** | QEM Consulting Pty Ltd |
| **Auditor & Report Author** | Larry Weiss |
| **Auditor Qualification** | EMS Auditor, Exemplar Global Certification 12355 |
| **Affiliations** | Member, Engineers Australia 938517 |

## *Auditor certification*

The abovementioned Auditor certifies as having personally undertaken this Independent Audit and preparing the contents of this Independent Audit Report; and that the findings of the audit are reported truthfully, accurately and completely; and that he has exercised due diligence and professional judgement in conducting the audit. The signed Statement of Interests and Association in our services agreement with Sydney Metro confirm our Auditor's independence and absence of pecuniary interest in the audited project.

## *Audit disclaimer*

It should be noted that this report is a snapshot in time, based on selected and supplied documentation, as well as site activities on the day, and does not purport to be a definitive confirmation of overall compliance or vice-versa.

**---------- END REPORT ----------**