Engineering Construction Specification

C02 Quality Management

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1 General

1.1 Responsibilities

1.1.1 General

Requirement: Provide a project quality management system (QMS) as documented.

1.2 Cross references

1.2.1 General

Requirement: This worksection is not a self-contained specification. In addition to the requirements of this worksection, conform to the following:

- C01 General requirements (Construction)

1.3 Standards

1.3.1 General

Standard: To AS/NZS ISO 9001 and Austroads AGPD05.

1.4 Interpretation

1.4.1 Abbreviations

General: For the purposes of this worksection the following abbreviations apply:

- CAR: Corrective action request.
- ITP: Inspection and test plan.
- NATA: National Association of Testing Authorities.
- NCR: Non-conformance report.
- NNC: Notice of non-conformance.
- QA: Quality assurance.
- QAR: Quality assurance representative (principal).
- QMR: Quality management representative (contractor).
- QMS: Quality management system.
- WAE: Work-as-executed.

1.4.2 Definitions

For the purpose of this worksection, the definitions given in AS/NZS ISO 9000 and the following apply:

- As-built drawings: Copies of the design drawings with as-built changes (including repaired defects) marked up to scale with references to the relevant design change notices:
    - Interim as-built drawings are the as-built drawings at the stage of closure of the lot package.
    - Final as-built drawings are the as-built drawings incorporating the changes for all lot packages and are generally submitted before final completion of the project.
- Asset: A physical component of a road system or network. Typical assets include sections of pavements, bridges, culverts, traffic signals, signs, road furniture, road reserves etc.
- Certification: A written assertion of facts.
- Construction records: All lot records, non-conformance reports, design change notices, site instructions, photographs and interim as-built drawings applicable to a lot package.
- Corrective action request: A formal advice/instruction to the contractor requesting action to eliminate the cause of a detected nonconformity.

- Defect: A work lot non-conformance which continues to exist.
- Defect register: A register of all defects maintained by the contractor. Recorded as either OPEN or CLOSED.
- Disposition: Action taken to resolve non-conformance (Lot specific).
- Hold point: A mandatory verification position in the contract beyond which work cannot proceed without the designated authorisation.
- Inspection and test plan: The document identifying the required inspections and tests of the works. It includes verification check points designated as Hold point, Witness point and Review point.
- Lot: Any part of the works that has been constructed/manufactured under a continuous operation of uniform conditions and is homogeneous with respect to material and general appearance.
- Lot-package: One or more work lots of the same work kind collated under the same inspection and test plan.
- Non-conformance report: A mandatory (standard format) submission by the contractor that details the non-conforming work and the contractor's proposed disposition of the non-conformance.
- Notice of non-conformance: Formal instruction to the contractor of product non-conformance to documented requirements. It automatically creates a Hold Point and requires an NCR from the contractor.
- Performance audit (Process audit, technical procedure audit, methods audit): An evaluation of whether nominated methods and procedures are being adhered to in practice.
- Principal: The asset owner. Does not include agents such as the Superintendent or Independent certifier.
- Product: The result of a set of interrelated or interacting activities which transforms inputs into outputs.
- Product audit (Conformance audit, Service audit): An assessment of the conformity of the product with the specified technical requirements.
- Qualified registered surveyor: A surveyor who is eligible for membership of the Surveying and Spatial Sciences Institute as a registered surveyor.
- Quality assurance (QA): The systematic action necessary to give confidence of satisfactory quality. An element of QA is quality control.
- Quality assurance representative (QAR): Appointed by the principal for a specific project and responsible for the auditing, review and surveillance of procedures and documentation required by the contractor's approved Quality plan.
- Quality checklists: Forms completed during the manufacture/construction process verifying key steps, and records required for the Quality register. Checklists apply to each identified lot of work.
- Quality management representative (QMR): Also known as Project quality representative, appointed by the contractor for a specific project with the authority and responsibility for the implementation and operation of the Quality plan, so that QMS requirements are not subordinated to design and productivity.
- Quality plan: A management plan prepared by a contractor for a specific project, complying with relevant standards, setting out policies, management responsibilities, procedures and systems that will be used to ensure and demonstrate achievement of specified project requirements.

- Quality register: The files containing all quality control records including test results, completed check lists, certificates of compliance and consignment dockets for materials procured.
- Quality management system: The organisational structure, responsibilities, procedures, processes and resources for implementing quality management.
- Quality management system requirements: The administrative activities affecting quality that will be implemented and controlled so that the product or a service meets documented quality requirements.
- Registered testing authority:
  - An organisation registered by the National Association of Testing Authorities (NATA) to test in the relevant field; or
  - An organisation outside of Australia registered by an authority recognised by NATA through a mutual recognition agreement; or
  - An organisation recognised as being a Registered Testing Authority under legislation at the time the test was undertaken.
- Review point: Other check points other than hold points and witness points requiring verification of requirements and collection of records.
- Special processes: Those processes, the results of which cannot be directly examined to establish full conformance. Assurance of satisfactory conformance depends on evidence generated during the process.
- System audit: An examination of the documented quality management system represented by the quality manual, quality plan and quality register to evaluate their effectiveness in meeting the requirements of Australian Standards and the contract documents.
- Validation: Confirmation, through the provision of objective evidence, that requirements for a specific intended use or application have been fulfilled.
- Witness point: A nominated position, in the different stages of the Contract, where the option of attendance may be exercised by the Superintendent, after notification of the requirement.
- Works: All labour, plant, equipment and materials required to complete a project in conformance with the contract documents.

2 Project quality management system

2.1 General requirements

2.1.1 Conformance

Work on-site and off-site: Conform to the QMS described within the Quality plan including products and services for all works under the contract.
Contract documents: The QMS does not pre-empt, preclude or otherwise negate the requirements of any part of the contract documents.
Responsibility: QMS requirements do not relieve the contractor of the responsibility to conform with the contract documents. The Contractor is responsible for correcting all non-conformances.

2.1.2 System requirements

QMS: Plan, develop, implement and maintain a documented QMS conforming to this worksection, and AS/NZS ISO 9001, with the following purpose:

- Proposed work methods consistent with documented requirements.
- Adequate and complete ITPs and checklists.

- Implementation of approved work methods.
- Adherence to Hold and Witness Points.
- Appointment of QMR and QAR.

Format: If the format of the QMS documents differ from the format of AS/NZS ISO 9001, provide a matrix outlining how the documented requirements are addressed by the QMS.

2.2 Documentation requirements

2.2.1 General

QMS documentation requirements: Include the following:

- Quality policy and objectives.
- Procedure documents.
- Work instructions.
- Forms.
- Quality plan(s).
- Specification(s).
- Safety documentation
- Environmental documentation
- Inspection and Test Plans (ITP's)
- Relevant external documents.
- Records.

Changes: Immediately implement changes to the project Quality plan and QMS if the following occurs:

- Specification requirements are not adequately addressed.
- Non-conformity resulting from the Quality plan or QMS.
- Audit initiates changes to the QMS.
- Practices have changed.

Records: Provide copies of any quality records within 14 days of request.

2.2.2 Project Quality plan

Requirement: Plan, develop, implement and maintain a Quality plan to AS/NZS ISO 9001 and AS/NZS ISO 10005. Include the following:

- Progressive documentation of new procedures as the work types become evident.
- Planning and control systems: Description of critical processes and activities, including verification for product control.
- Coordination with the contractor's corporate Quality manual.
- Project specific quality system: Information and direction for personnel about the specific quality practices, resources, sequence of activities, controls and checks that must be implemented during the works.
- Controlled conditions: Documentation to explain how each work process will be carried out.
- Organisation structure: Details of the specific responsibilities and authorities of the key personnel nominated for the management of the project.
- QMR: Qualifications and technical experience, together with responsibilities and authorities to resolve quality matters.

- Details of the personnel or contracted testing organisations who will be conducting each type of conformance inspection and testing of completed works, their experience, qualification and responsibilities.
- Details of the person authorised to change construction processes on site.
- ITPs and checklists to verify the works conform with the contract documents.
- Purchasing quality requirements:
  - Critical characteristics of purchased products that affect the quality of the final product.
  - Method of communication with suppliers.
  - Methods used to evaluate, select and control suppliers.
  - The facilities and services that will be outsourced.
  - Material samples: The approved sample is the quality benchmark.
- Purchasing quality verification.
- Procedure for corrective action to AS/NZS ISO 9001 clause 10.2.
- Registered testing authority: Terms of registration and current signatories for the organisation providing testing and test reports.
- End-of –contract review procedures.

Include any additional Council requirements relating to the management of quality.
Additional system elements:

- Safety documentation
- Environmental documentation
- Relevant external documents, eg geotechnical

2.2.3 Control of documents

Requirement: To AS/NZS ISO 9001 clauses 7.5.3 and AS/NZS ISO 10005 clauses 5.6 and 5.7.
Register: Maintain a register of each part of the Quality plan. Register the number, date and recipient(s). Reissue to all registered recipient(s) when the Quality plan is changed, superseded or recalled, as required.
Requirement: Document in the Quality plan the method of keeping quality registers, tracking and handling of NCR's, NNC's and site correspondence.
Quality register: Implement and maintain systematic records, indexed and filed so that the records are retrievable and accessible to the Superintendent or an appointed quality auditor within one working day of request.
Register of method statements: Provide a register listing all method statements (both standard and job specific) including the title, identifier and revision status.
Construction records: Certify the completeness and compliance of construction records as each section of the work is completed.
Location: State in the quality plan where records are to be located.
WAE: Keep records of any amendments to design details for inclusion in WAE drawings.
Quality audit schedule: Include a quality audit schedule with the project quality plan in conformance with AS/NZS ISO 19011.
Audit reports: Provide copies to the Superintendent as requested.

2.3 Resource management

2.3.1 General

Requirement: To AS/NZS ISO 9001 clause 7.1 and AS/NZS ISO 10005 section 5.8.

Provision of resources: Determine and provide resources for the successful implementation of the project Quality plan.
Limited availability: If a resource has limited availability, identify how demand from other projects/contracts will be satisfied.
Human resources: Provide personnel with the appropriate education, training, skills and experience for the project.
Infrastructure: Identify, provide and maintain the infrastructure required to achieve product conformity.
Work environment: Establish and manage the work environment to achieve product conformity.

2.4 Product realisation

2.4.1 Planning and design

Planning: To AS/NZS ISO 9001 clause 8.3 and AS/NZS ISO 10005 clause 5.11. Include the following:

- Quality objectives and requirements for the product.
- Processes and documents specific to the product.
- Required verification, validation, monitoring, measurement, inspection, test activities and the criteria for acceptance of the product.
- Records required as evidence that the realisation processes and resulting products conform.

Design: Verify the following, for conformance with the documented requirements and AS/NZS ISO 9001:

- Temporary structures.
- Checking of permanent structures for construction loadings.
- Lifting devices for manufactured items.
- Alternative permanent structures or structural components proposed.
- Concrete mixes for structures and pavements and asphalt mixes for permanent works.
- Traffic control, temporary roadways and detours.
- Permanent works where design is nominated in the contract.
- Consultation of design with relevant stakeholders

2.5 Construction and service provision

2.5.1 Control

Method statements: Detail the construction processes for all activities scheduled in **Construction activities schedule**.
Content: Include the following:

- Sequence of operations.
- Documented procedures and work instructions.
- Types of equipment required, capability, maintenance and calibration.
- Any special working environment requirements.
- Personnel competency and skills required.
- Criteria for workmanship and tolerances.
- Materials required.
- Safety requirements.
- Environmental requirements

- Reference documents.
- Records produced.
- Planning.
- Verification measures.
- Inspection, test and control points.
- Monitoring of continuous suitability.
- Responsibility for implementing and monitoring work process controls and rectifying any deficiencies.

Checklist: Provide a checklist, including the relevant inspection and test points, surveying control points, Hold Points, Witness Points and the officer responsible to verify each check point.
System audit: Audit each Method statement during operation of the process.
Absence of a Method statement: If a Method statement for a particular activity is required and none is submitted, this is a Hold Point.

2.5.2 Lot identification

Lots: Divide all items of work into lots as follows:

- Limits: Before sampling, choose lots within the limits given in the relevant worksection.
- Lot size: Not exceeding one day's output for each work process being tested.
- Lot numbering: Allocate unique lot numbers compatible with the construction program. Use lot numbers as identifiers on all QMS data.
- Field identification: Physically identify each lot and clearly identify lot boundaries. Maintain identification until the lot has achieved the specified quality.

Work on a lot: Do not start work before the field identification is established.
Lot boundaries: When boundaries of a lot change, update the quality register.
Lot identification system: Make sure all site records and sample numbering systems allow easy identification of all test results and the materials incorporated in the works.

2.5.3 Traceability

General: Provide and maintain records of components for audit. Traceability is required as follows:

- Concrete: Start the trace at the batch plant and finish at the location where the concrete is incorporated in the works.
- Asphalt: Start the trace at the batch plant and finish at the location where the asphalt is incorporated in the works.
- Stabilised material: Start the trace at the batch plant and finish at the location where the material is incorporated in the works.
- Steel: Start the trace at the steelworks and finish at the location where the steel is incorporated in the works. Record the steel heat number, testing details and final location of installation.

Batch details: Record all batch quantities, mix and dispatch time, testing details and location of placement.

2.5.4 Control of monitoring and measuring equipment

Equipment accuracy: Maintain inspection, testing and measuring equipment able to produce the degree of accuracy required by the referenced test methods.
Records: Demonstrate accuracy with regular records of calibration.

2.6 Monitoring, measurement and analysis

2.6.1 General

Requirement: Demonstrate conformance of the works by systematic inspection and tests.
Testing and sampling: Conduct testing by a registered testing authority accredited for the documented test methods and sampling procedures. Include the latest NATA advice of the terms of registration and current signatories within the quality plan.
Sampling personnel: From the registered testing authority and supervised by the approved signatory.
Sampling locations: Propose sampling locations for approval before proceeding.
Lots: All conformance inspections and tests are based on lots. In all cases the samples are considered representative of the lot and test results are required to meet the appropriate lot tolerances.
Test results: Provide a registered testing authority report on test results, including certification that correct sampling procedures have been followed.
In-process and conformance inspections: Review the results for each lot to confirm that all tests have been carried out to verify conformance.
Verification: Certification by the QMR.
Reinstatement: Reinstate all core holes, test holes, excavations and any other disturbance resulting from any testing activity to the standard in the relevant worksection.

2.6.2 Frequency of testing

Minimum frequency of testing: Not less than that stated in the relevant worksection.
Request for reduced frequency of testing: Submit a proposal with supporting statistical analysis, verifying consistent conformance to the quality requirements.

2.6.3 Random sampling

Requirement: Use random sampling techniques for each lot for the control of compaction of continuous layer of earthworks, selected subgrade zone, flexible pavement layers and asphalt layers.
Test locations: Determine test locations for random sampling in conformance with AS 1289.1.4.1.
Location restrictions: Do not restrict sampling to locations dimensioned or otherwise defined for setting out the works in the drawings or specification.

2.6.4 Inspection and test plans

ITP: Establish and progressively maintain a system to demonstrate inspection and testing in conformance with AS/NZS ISO 9001 clause 9.1 and AS/NZS ISO 10005 clause 5.18.
Minimum information for ITP (or ITP forms): Include the following:

- Person responsible for carrying out in-progress and final inspections or testing.
- Proposed inspection or test methods and recording of results.
- Acceptance criteria and frequency of inspection and testing.
- Specification tolerances.
- Person responsible for reviewing inspection and test results, evaluating whether work conforms, determining future action when work does not conform and closing out work lots.
- Measures to control non-conformity.
- When statistical analysis of test results is required.
- Person responsible for performing the final review of results to confirm that all inspections and tests have been carried out to verify complete conformity for each lot.

- Time limits for testing, submission, Hold Points and Witness Points that are nominated in the specifications.
- Identification of Hold Points or Witness Points.
- Checklist for each lot.

Submission of ITPs: Submit the ITPs, construction procedures and **Construction activities schedule** 10 working days prior to commencing any construction activities.

2.6.5 Test register

Lot identification register: Include the following information:

- Three-dimensional surveyed location of each lot, including the chainage of the start and finish points, lateral location and layer location and/or the particular structure (e.g. pier or abutment number, concrete placement number).
- Indication of conformance or non-conformance.
- Summary of test results.
- Location of test sites including test identification numbers.
- For non-conforming lots, allocate a new number to the resubmitted/subdivided lot(s), with reference to the original lot number.

Inspection and test status: Show either on the ITP records or physically mark in the field the conformance status for each lot.

2.6.6 Hold points

Notice of inspection: Give notice in advance of a Hold Point being reached.
Requirements for approval to proceed: Provide the following:

- Information required by the specification or relevant worksection.
- Certification that the particular lot/process is conforming.
- Certification that all underlying and adjacent lots affected by the lot in question are conforming.
- The appropriate form (checklist, NCR or NNC) at least 24 hours before the proposed placement/construction of the next lot.

Witness point: If the Hold Point has resulted from an NCR or NNC, approval may be conditional on a Witness Point being included.
Release of Hold Points: The Contractor is responsible for the release of hold Points subject to audit by the QMR and QAR from time to time.

2.7 Survey control

2.7.1 Requirements

Survey control: Establish and maintain a system, for measurement, calculation and recording procedures appropriate to the following:

- Set-out of the works.
- Verification of conformance with the drawings and specification in relation to dimensions, tolerances and three-dimensional position.

Determination of lengths, areas or volumes of materials or products, where required for measurement of work.
Method statement: Describe the control parameters for special processes which cannot be fully verified by inspection and testing. Address all potential errors that may be introduced by survey methods.

Surveyor qualifications: Appoint qualified surveyors or survey technicians to supervise and take responsibility for all surveying control.
Equipment and procedures: Capable of attaining the documented tolerances.
Survey locations: Surveying for conformance verification is not restricted to the locations used to set out the works.
Conformance verification surveys: Perform verification surveys not later than one working day after the lot or component has become accessible for survey.

2.7.2 Control of documents

Survey conformance report: Submit a survey conformance report for each lot or component where design levels, position and/or tolerances have been specified. Reference the relevant field book page numbers.
Information required: Indicate the difference between actual and documented values for position and level (defined by co-ordinates or chainage and offset) and provide certification by the qualified surveyor responsible for the verification survey.
Survey records: Provide all survey records including equipment calibration records and non-conformity registers.
Field book pages: Include the following, clear labels, date and signature by the surveyor, cross indexed references to equipment used and lot/component identification.
Recorded data: Retain any automatically recorded data used for verification surveys, including a printout of both raw (field) data and reduced data.
Audit trail: Prepare procedures to describe the records system, including the method of storing and indexing of electronic records and the computer software used for the reduction of survey measurements and calculations.

2.8 Risk assessment

2.8.1 Reliability of the QA System

Reliability assessment: Conform to the following:

- Provide construction documentation, recording compliance with construction procedures and inspection and test plans.
- Assessment criteria and ratings to AGPD05 Table 6.2.
- Monitoring frequency to AGPD05 Table 6.3.

2.9 Control of Non-conforming works

2.9.1 General

Detection and reporting: Report any works that depart from the documented requirements on a NCR form within two working days of detection, including the proposed disposition.
Proposed disposition: Include any of the following:

- Proposed additional works to bring the lot up to the documented standard.
- Proposed replacement of all or part of the lot to bring it up to the documented standard.
- A request to use the lot for a reduced level of service, if allowed by the documented requirements.
- For incidental defects, a request that the Superintendent accept the lot without alteration, as an exception with or without alteration to the respective unit rates.

2.9.2 Monitoring and measuring

NCR: A Hold Point until non-conformance is rectified and Hold point is released.

Progress: Do not cover up non-conforming works until a disposition has been accepted/approved and implemented.
Reworking: If the non-conformance can be rectified by reworking the lot with the original process, an NCR is not required. Maintain a record of the non-conformance to aid continual improvement.
Conformance: Verify that reworked/replaced lots conform to the documented requirements.
Discrepancy: If there is any discrepancy in test results, the Superintendent's test results will prevail.

2.9.3 Control of documents

CAR: Review and improve the QMS to eliminate the cause of identified non-conformance.
NCR: Submit an NCR based on the proforma in the **ANNEXURE** including the following:

- Details of non-conformance.
- Proposed disposition.
- Provision for attachments.
- QAR comment/approval/rejection.
- Completion of disposition.
- Release of Hold Point.
- Corrective action to improve quality.
- Close-out of NCR.

Authorised representative: Sign off all actions by authorised representatives of the contractor and superintendent as appropriate.
Register: Implement and maintain a numbering and registration system for all NCRs and NNCs, including cross referencing as required.

2.9.4 Corrective action

Requirement: Review and improve the Quality plan to eliminate the causes of the non-conformance to prevent recurrence.
Proposed corrective action: Indicate the corrective action appropriate on the NCR form.

2.10 Completion

2.10.1 Finalisation

Quality register: Submit a copy within one month of the date of practical completion. If requested, also provide a copy of all quality records and the **Construction records schedule**.
Record management: Provide an electronic copy of the design and construction records of final completion in a format to archive the records in the principal's asset management system.
Defects liability period: Resolve and close-out all quality non-conformance before the end of the defects liability period.

2.10.2 Review

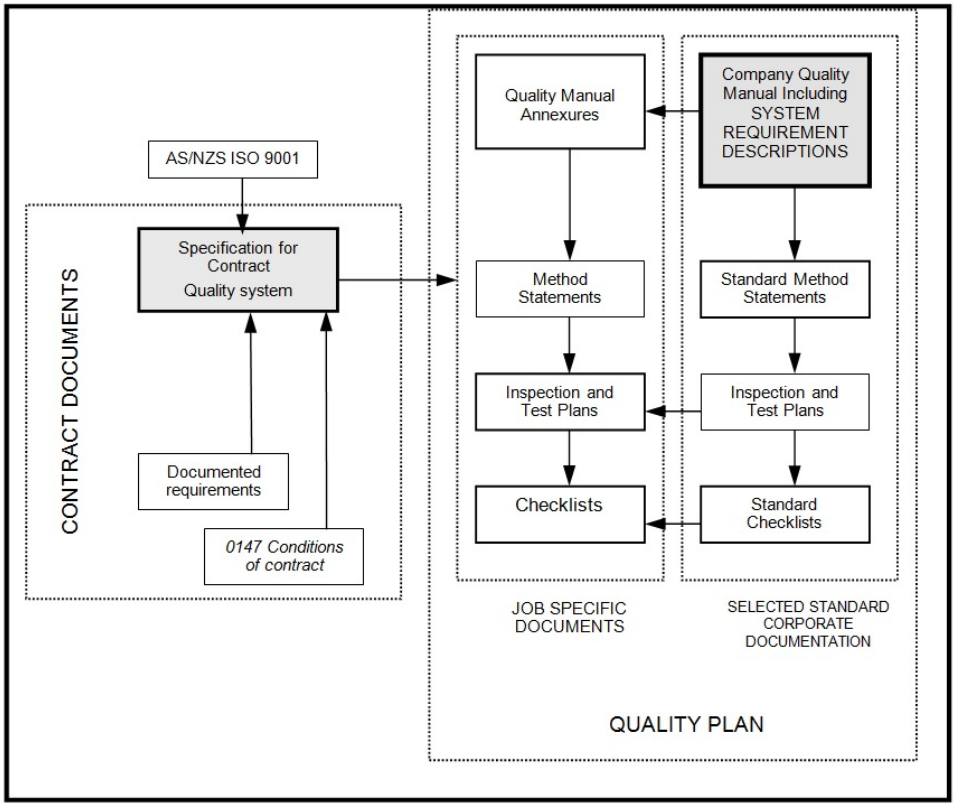
Requirement: Organise meeting(s) to review the quality system and technical issues met on the project, and identify the lessons to be learned for future projects, including the following:

- Identification of non-conformances and the implementation of corrective action.
- Issues arising from inspections and audits.
- Contract documentation issues.
- Design and technical issues.
- Safety issues.

Timing: Hold meeting(s) before the date for practical completion so that key personnel are still available to participate in review process.

3 Annexures

3.1 Annexure – Project QMS documentation flow chart



3.2 Annexure – Proforma Non-conformance report (NCR)

NON-CONFORMANCE REPORT	**NCR No**: Date:
CONTRACT: PRODUCT OR SERVICE: SUBCONTRACTOR (if appropriate): INSPECTION & TEST PLAN (ITP) No:	
LOT No AND DESCRIPTION/LOCATION:	
DETAILS OF NON-CONFORMANCE:	
PROPOSED DISPOSITION:	
PROPOSED CORRECTIVE ACTION:	
IS A SUPPLEMENTARY REPORT ATTACHED?:	YES ☐ No ☐
PRINCIPAL:	APPROVED ☐ REJECTED ☐
COMMENT:	
PRINCIPAL SIGNATURE:	DATE:
DISPOSITION COMPLETED (Contractor):	DATE:
RELEASE OF HOLD POINT (Superintendent):	DATE:
CLOSE OUT OF NON-CONFORMANCE REPORT (Contractor QMR):	DATE:

3.3 Annexure - Referenced documents

The following documents are incorporated into this worksection by reference:

AS 1289		Methods of testing soils for engineering purposes
AS 1289.1.4.1	1998	Sampling and preparation of soils - Selection of sampling or test sites - Random number method
AS/NZS ISO 9000	2016	Quality management systems - Fundamentals and vocabulary
AS/NZS ISO 9001	2016	Quality management systems – Requirements
AS/NZS ISO 10005	2006	Quality management systems - Guidelines for quality plans
AS/NZS ISO 19011	2014	Guidelines for auditing management systems
Austroads AGPD05	2018	Guide to project delivery- Road Constructions quality assurance