8116 Culvert Rehabilitation

REVISION 07/05/2024

8116.1 Introduction

This Supplementary Specification refers to culvert rehabilitation works and is intended to be used by Mackay Regional Council (MRC) and the appointed Contractors when carrying out types activities associated with culvert rehabilitation (including concrete patch repairs, corrugated steel culvert protective coating, concrete paved invert in corrugated culverts, concrete crack repair, sealing gaps between culvert components, scupper extension, culvert joint repair, grouting of undermined culvert bases and aprons).

8116.1.1 Definitions of Terms

This section describes any term which are specific to this specification or requires clarification due to an ambiguous understanding:

Term	Definition
CMP	Corrugated Metal Pipe
RCBC	Reinforced Concrete Box Culvert
SLBC	Slab Linked Box Culvert
CP	Cathodic Protection

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8116.2 Referenced Documents

This Supplementary Specification shall be read in conjunction with the following with all workmanship and materials to comply with the requirements of the latest relevant Australian Standards (AS), Queensland Department of Transport and Main Roads (QTMR) Technical Specifications (MRTS) and other referenced standards, in particular:

- EN 1504-3: Products and systems for the protection and repair of concrete structures. Definitions, requirements, quality control and evaluation of conformity. Part 3: Structural and non-structural repair
- AS 1012.8.3: Methods of testing concrete - Methods of making and curing concrete – Mortar and grout specimens
- AS 1012.9: Methods of testing concrete – Compressive strength tests –Concrete, mortar and grout specimens

- AS 1012.18: Methods of testing concrete - Method 18 - Determination of setting time of fresh concrete, mortar and grout by penetration resistance
- AS 1012.2: Method 24: Determination of the Tensile Bond Strength of Concrete – Repairs and Strengthening Systems
- AS 1379: Specification and supply of concrete
- AS 1478 Set: Chemical admixtures for concrete, mortar and grout
- AS 1554 Set: Structural steel welding
- AS 1627.4: Metal finishing - Preparation and pretreatment of surfaces - Abrasive blast cleaning of steel
- AS2239: Galvanic (sacrificial) anodes for cathodic protection
- AS2312: Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings
- AS 2350.13: Methods of testing portland, blended and masonry cements – Determination of drying shrinkage of cement mortars
- AS 2758.1: Aggregates and rock for engineering purposes - Part 1 - Concrete aggregates
- AS 2832.5: Cathodic protection of metals, Part 5: Steel in concrete structures
- AS 3582 Set: Supplementary cementitious materials for use with Portland and blended cement
- AS 3600: Concrete structures
- AS 3610 Set: Formwork for concrete
- AS 3972: General purpose and blended cements
- AS 3799: Liquid membrane-forming curing compounds for concrete
- AS 4100: Steel structures
- AS 4671 Set: Steel reinforcing materials
- AS 4680: Hot-dip galvanised (zinc) coatings on fabricated ferrous articles
- MRTS 01: Introduction to technical specifications
- MRTS 02: Provision for traffic
- MRTS 28: Contractor’s site facilities and camp
- MRTS 50: Specific quality system requirements
- MRTS 51: Environmental management
- MRTS 52: Erosion and sediment control
- MRTS 70: Concrete
- MRTS 71: Reinforcing steel
- MRTS 88: Protective Coatings for New Work
- QTMR Technical Note 144: Paint Systems for MRTS88
- HB86: Guide to concrete repair and protection, by Australian Concrete Repair Association (ACRA)
- Manual - Design Criteria for Rehabilitation of Circular Corrugated Metal Culverts
- QTMR Approved products and Suppliers – Bridges and other structures

- Accepted development requirements for operational work that is constructing or raising waterway barrier works – Department of Agriculture and Fisheries.

8116.3 Description of Works Items

Work items incorporated by this Supplementary Specification are identified in Section 8116.6 and 8116.7 with individual activities/tasks for measurement and payment sourced from the Bill of Quantities and listed in MRC Supplementary Specification Annexure 8116_1 Culvert Rehabilitation Section 1.

8116.4 Quality Systems Requirements

The Contractor is to submit a quality plan to the Superintendent for review and approval a minimum 4 weeks prior to commencement of works or the prestart. The quality plan shall be compliant to MRTS50 and other reference requirements with as minimum incorporate the following Testing, Inspections, and Tolerances.

8106.4.1 Standard Test Methods (Testing Regime)

Unless otherwise approved by the Superintendent the following minimum testing regime applies to this specification**.**

8116.4.1.1 General

The Contractor shall demonstrate weekly throughout the execution of the Works, that adequate and accurate records are being kept such as shall ensure the ultimate completeness and accuracy of the records.

The Contractor shall produce records and documentation (including completed and signed Inspection and Test Plans) which shall demonstrate that hold and witness points were observed and approved and results of the testing as completed. These are to be submitted with the close out of the relevant ITP.

Repairs which require concrete pours as liners shall be tested in accordance with MRTS70.

8116.4.1.2 Test Method – Soundness of Repair

8116.4.1.2.1 Compressive Strength of Cementitious Repair Material

Three 75 mm test cubes shall be taken from the first batch of material mixed, then three 75 mm cubes for every 100 kg of material used thereafter to test for compressive strength. The cubes shall be cured for 7 days under conditions which match that used for the repair. Two cubes shall be tested at 7 days and the third cube at 28 days to confirm that the minimum compressive strength complies with this Specification.

Test cubes shall be prepared and cured in accordance with AS 1012.8.3 and tested in accordance with AS 1012.9.

8116.4.1.2.2 Bond Strength (Pull-off) Testing

The Contractor shall conduct partially cored direct pull-off tests of the fully cured in situ repair material to verify the tensile bond strength between the insitu repair material and the existing concrete substrate, 7 days after the completion of application. The pull-off testing shall be undertaken in accordance with AS 1012.24.

The test locations shall be jointly determined by the Contractor and the Superintendent.

Testing shall be carried out at a frequency of three tests per 10 m^2 at representative test locations of a completed repair area.

The failure mode shall be determined by visual inspection of the test specimens and categorised as follows:

- Mode 1: Tensile failure within the existing concrete substrate

- Mode 2: Tensile failure within the repair material
- Mode 3: Bond failure at the interface between the existing concrete substrate and the repair material
- Mode 4: Bond failure between the adhesive layer and the dolly
- Mode 5: Partial bond failure at the interface between the existing concrete substrate and the repair material and partial tensile failure within the repair material
- Mode 6: Partial bond failure at the interface between the existing concrete substrate and the repair material and partial tensile failure within the existing concrete substrate

Where a combination of failure modes occur the percentage of each failure mode shall be recorded to the nearest 10% based on the surface area of the failure face.

The mean bond strength at 7 days shall not be less than 0.75 MPa, with no individual result less than 0.65 MPa.

The failure mode of the pull-off test shall be in accordance with Mode 1, with tensile failure within the existing concrete substrate.

Mean bond strengths less than 0.75 MPa or failure modes 2, 3, 4, 5 and 6 shall be raised as a non-conformance.

8116.4.1.2.3 Testing for Drummy Areas

Testing for drummy areas shall be conducted using a small (0.8 kg) hand-held hammer along the whole surface area of the concrete patch repairs and delaminated areas shall be characterised by a 'drummy' or hollow sound.

Any delaminated patch repairs shall be removed and repaired in accordance with the requirements of this Specification.

Testing for drummy areas shall be conducted in the presence of the Superintendent.

HOLD POINT

8116.4.1.3 Test Results

The Contractor shall supply for review by the Superintendent a copy of all quality control testing including photographic records within one week of undertaking such testing.

HOLD POINT

8116.4.1.4 Process and Visual Inspection

The Contractor must inform the Superintendent of all completed repair material areas one day after final application for the Superintendent's inspection and approval.

All areas of the repaired surfaces must be visually examined for any areas of non-conformance with the specified finishing and surface condition requirements.

Upon the Superintendent's approval that all repair works have been completed in accordance with this specification, the Contractor must submit drawings or sketches showing the as-constructed extent and dimensions of any additional repairs or variations to the Project Drawings.

HOLD POINT

8116.4.1.5 Non-conformances

Areas where the repairs do not comply with the specified standards and/or where the repair material is, in the Superintendent's opinion, defective in other ways, must be removed and replaced by the Contractor in accordance with the requirements of this Specification. For any test batch that fails to meet the specified standards, all repairs to which the test batch relates shall be removed and replaced.

Replacement must be carried out to the Superintendent's satisfaction at the Contractor's own cost. Additional testing may be carried out to non-conforming designated areas at the Contractor's own cost.

HOLD POINT

8116.4.2 Hold Points, Witness Points and Milestones

Separate to the Contractors inspections and checklists the following table represents the Superintendents minimum inspection and milestone requirements relating to the works as laid out for this specification.

Hold points are noted on various Sections of this Specification.

"HOLD POINTS" are critical stages of the work, which require inspection by the Superintendent (or his nominated representative) and beyond which the Contractor will not be permitted to proceed without the written approval of the Superintendent.

A written "request for inspection" form shall be submitted to the Superintendent at least 48 hours prior to reaching the relevant "HOLD POINT". One copy shall be submitted for each inspection. The signed copy will be handed back to the Contractor after the inspection to sanction work to proceed to the next stage or noting what work has to be done prior to re-inspection. This may involve inspection of the works by the Superintendent or approval of test results forwarded to the Superintendent by the Contractor.

"WINTTES POINTS" are also important stages of work. However, these are not necessarily as critical work stages as defined by the Hold Points. Witness Points are where the Superintendent (or his/her nominated representative) may review, witness, and inspect the work. The activities however may proceed.

The following table represents the minimum inspection requirements for this specification:

Activity	Inspection Type	When
Preliminaries, including program of works and other required documents as per 8116.5	Milestone	4 weeks prior to works commencing
Contractors personnel	Hold Point	10 days prior to undertaking site works
Defect Survey and Mapping	Hold Point	Prior to works commencing to verify type, location, and extent of repairs and approved by Superintendent
Relevant approvals (Accepted Development, Tidal Works or Operational Works approvals)	Hold Point	Prior to undertaking repair works
Risk assessment, SWMS, JSA and other relevant safe systems of work documentation	Hold Point	Prior to undertaking repair works
Scaffolding access system	Hold Point	Prior to undertaking repair works
Inspection of concrete patch repairs for drummy areas	Hold Point	After repairs have been carried out
Provide all quality control testing including photographic records	Hold Point	Within 1 week of undertaking such testing

Activity	Inspection Type	When
Soundness of repair non-conformances	Hold Point	After non-conformances have been addressed
Concrete Patch Repairs		
Design of sacrificial anodes and connection to reinforcing	Hold Point	After removal of delaminated concrete
Structural integrity of culvert requiring RPEQ assessment (as required)	Hold Point	At each breakout and during the removal of concrete
Inspection of repair area and reinforcing	Witness Point	After cleaning of scabbled area and prior to priming of reinforcing
Inspection of reinforcing for cross sectional area	Hold Point	Prior to approval to proceed with mortar activities
Confirmation of break-out extent and acceptance of insipient corrosion protection	Hold Point	At each breakout prior to application of patch repair material
Inspection of primed reinforcing	Hold Point	After priming has occurred
Application of bonding agent to the scabbled concrete	Witness Point	Prior to approval to proceed with the application of the mortar
Curing of repair material for seven days	Witness Point	Immediately after placement of repair material
Surface finish, cracking defects, and geometric tolerances	Hold Point	Immediately after 7 days curing
Corrugated Steel Culvert Protective Coating		
Submission of proposed material and application method and MSDS	Hold Point	Prior to repairs commencing
Preparation of internal culvert cell surface	Witness Point	Prior to applying protective coating
Concrete Paved Invert in Corrugated Culverts		
Formwork and reinforcing installation	Hold Point	Prior to concrete pour
Concrete pour	Hold Point	Approval to pour
Placing of concrete	Witness Point	During pour activities
Finished profile of liner	Witness Point	At completion of finishing of concrete
Finishing and curing of concrete	Witness Point	During Finishing of concrete surface

Activity	Inspection Type	When
Concrete Crack Repair		
Submission of proposed material and application method and MSDS	Hold Point	Prior to repairs commencing
Determination of repair area	Hold Point	Prior to repairs commencing
Cleaning out crack/s of all loose material	Witness Point	Prior to commencing epoxy and grouting activities commencing.
Grout injection process	Witness Point	At least 24hrs after epoxy and nipple placement
Surface finish method approval	Hold Point	After curing of crack filler/sealant
Sealing Gaps Between Culvert Components		
Submission of proposed material and application method and MSDS	Hold Point	Prior to repairs commencing
Confirmation of size and location of gaps	Hold Point	Prior to repairs commencing
Cleaning out gap of all loose material	Witness Point	Prior to commencing epoxy and grouting activities commencing.
Grout injection process	Witness Point	At least 24hrs after epoxy and nipple placement
Scupper Extension		
Submission of proposed material and application method and MSDS	Hold Point	Prior to repairs commencing
Culvert Joint Repair		
Submission of proposed material and application method and MSDS	Hold Point	Prior to repairs commencing
Cleaning of joint and internal face	Witness Point	Prior to backing rod and sealant being installed
Grouting of Undermined Culvert Bases and Aprons		
Determination of repair area and method of repair	Hold Point	Prior to works commencing
Post Construction		
As Constructed documentation for all works submitted and accepted	Hold Point	4 weeks prior to Works as Executed inspection request

8116.4.3 Construction Tolerances

Unless otherwise approved by the Superintendent the following construction tolerances shall apply as to this Specification:

- The tolerance on edges and surfaces in plan and level shall be ± 3 mm
- Maximum allowance for irregularities when measured with a 2.0 metre straightedge shall be 3 mm; and in addition, evenness shall not deviate by more than 1 mm when checked with a 300 mm straightedge
- Tolerances specific to the project are detailed on the design drawings and are included in Clause 2 of MRC Supplementary Specification Annexure 8116_1 Culvert Rehabilitation.

8116.5 Preliminary

The Contractor is to submit the following documentation 4 weeks prior to commencing work or a prestart is conducted:

- Data sheets and test certificates for nominated products and materials including Prequalification of materials
- Workplace Health and Safety (WHS) Plan including Work Method Statements (WMS)
- Contractors personnel experience, qualification, skills and training (10 days prior to undertaking work on site)
- Programme for the Work
- Environmental Management Plan
- Permits from Government bodies approving the proposed works and the methodology of the works
- Erosion and Sediment Control Plan (as required for site/s)
- Inspection and Testing Plans (ITP's)
- Traffic Management Plan and Traffic Guidance Scheme (TGS)
- Quality Plan detailing requirements of 8116.4

Other preliminary requirements unique to the project will be listed in the MRC Supplementary Specification Annexure 8116_1 Culvert Rehabilitation.

MILESTONE

The Contractor is to ensure their construction activities are based on the design drawing or documentation requirements. Alternate construction materials and procedures are not acceptable unless site conditions dictate and must have the Superintendents approval.

8116.5.1 Materials, Design and Manufacture

Supply of all materials to site is the responsibility of the Contractor at their cost, where items are Principal supplied the nominated storage site shall be obtained from MRC Supplementary Specification Annexure 8116_1 Culvert Rehabilitation Section 3 and shall be the point of supply.

Concrete, grout, and reinforcing steel shall comply with the relevant MRTS Specification or Australian Standard as listed in 8116.2.

The intended service life to be afforded by the repairs is:

- Concrete crack repairs: 15 years
- Concrete patch repairs: 20 years

- Concrete coating system: 15 years
- Concrete mortar system: 20 years

The end of a structure's service life is defined to occur when:

- Deterioration progresses to a level that makes the structure unsafe or unserviceable
- The level of maintenance necessary to maintain the functionality of the structure becomes uneconomical

Patch repairs must include protection against incipient corrosion, e.g. use of suitable reinforcement coatings or embedded sacrificial anodes. Anodic coatings used on steel reinforcement as sacrificial anodes must have a service life greater than the repair design life.

8116.5.2 Contractor's Personnel

Personnel, sub-contractors and suppliers utilised in the culvert repair shall have a minimum of 5 years' experience in the repair and rehabilitation of reinforced concrete structures and a demonstrated competency for surface preparation and application of the repair material to be applied.

The concrete repair supervisor shall be trained and qualified on all aspects of application techniques and shall be present at all times during repair work. Application personnel shall be trained and skilled in the application procedures of the repair material to be applied.

The Contractor shall engage a suitably qualified and experienced RPEQ Structural Engineer to provide advice in relation to:

- Any temporary support works or measures necessary to compensate for loss of structural capacity in existing culverts to ensure the repair works can be safety undertaken
- The need for any amendments to the default additional steel reinforcement provisions detailed in this Supplementary Specification and/or the Project Drawings based on inspection and assessment of the culverts following removal of defective concrete and confirmation of the extent of cross-section loss of existing steel reinforcement

The Contractor shall provide documented evidence for the Superintendent's approval to demonstrate the experience, qualification, skills and training of proposed personnel, sub-contractors and suppliers at least 10 working days prior to the relevant personnel, sub-contractors and suppliers undertaking works on the project.

HOLD POINT

8116.5.3 Proposed Materials, Work Method Statement and Inspection and Test Plans

Prior to commencement of the works, the Contractor must submit to the Superintendent, technical data sheets and test certificates regarding the quality of materials and performance of products proposed for use in the Works.

The submissions must provide evidence of product compliance with the relevant performance criteria detailed in this Specification. Current test certificates supplied by the manufacturers or suppliers may be accepted. Where in the opinion of the Superintendent insufficient data is available, the Contractor must execute sufficient additional tests to prove the suitability and adequacy of such material, at the Contractor's expense.

The Contractor must submit for the Superintendent's approval a detailed Work Method Statement (WMS) and Inspection and Test Plans (ITPs) for the specific concrete patch repair works. The WMS and ITPs shall reference all specification clauses and identify all testing and performance requirements and hold points and detail preparation and application techniques to be used, inclusive of all repair material manufacturer's specifications and supplied drawing details.

The Contractor shall not commence any concrete patch repair works until the WMS and ITPs have been reviewed and approved by the Superintendent.

HOLD POINT

8116.5.4 Water

All water used for cleaning or other work must be potable.

8116.5.5 Handling and Storage of Material on Site

Repair materials must be stored in accordance with the manufacturer's requirements including:

- In dry conditions not exposed to direct sunlight, not in contact with a damp floor or ground.
- Within the specified maximum and minimum temperature range
- In their original, sealed moisture resistant bags or containers.

All material shall be brought to site in the original sealed bags or unopened containers clearly labelled with the appropriate manufacturer's name, product type, reference number and batch number. Materials that have deteriorated in any way or that have been stored beyond the manufacturer's recommended shelf life shall be discarded.

The following information shall be provided for each batch of repair material:

- Manufacturer's name and address
- Product reference
- Batch number of identification
- Quantity manufactured in the batch
- Certificate of date of manufacture.

8116.5.6 Provision for Working in and around Water

The Contractor is to be aware of the following when performing the required works.

8116.5.6.1 Inundation

The culverts may be subject to inundation from:

- Stormwater flow from rainfall events. The works may need to be secured at all times for this occurrence and culverts evacuated while the stormwater passes. The duration and severity of this event would vary with the duration and intensity of the rainfall that occurs.
- Tidal water inundation in tide-affected locations. This will restrict the available time for the work to be completed and the culverts must be evacuated in the event of this inundation. Note also options for flow restriction for the categories of waterway in the Accepted development requirements for operational work that is constructing or raising waterway barrier works. Alternative work methods to create safe dewatered working spaces will be considered subject to meeting Accepted Development requirements.
- Standing water in culverts / waterways. The Contractor shall be responsible and make provision in their WMS for dewatering work sites subject to inundation from standing water to enable works to proceed.
- Any temporary bunding installed during repair works must take into account the relevant time restrictions referred for declared waterway categories in the latest version of Accepted development requirements for operational work that is constructing or raising waterway barrier works.

8116.5.6.2 Electrical Hazard

Working with electrical tools may be restricted when a site of affected by water. There may be low levels of continual water flow in the culverts for extended periods of time. The Contractor shall make the necessary arrangements to ensure a safe workplace at all times.

8116.5.6.3 Concrete Repair Works

Freshly scabbled concrete and newly placed concrete / mortar are to be protected from inundation events. Formwork and reinforcement are to remain clean without salt exposure. New repairs are to be cured for a minimum of 7 days without exposure.

The Contractor is to make all necessary allowances to cater for the above occurrences and provide a detailed methodology of mitigation measures in their Work Method Statement. No reliance shall be placed on the Superintendent's acceptance of any particular method of mitigation.

8116.5.7 Defect Survey and Mapping

8116.5.7.1 Purpose

Prior to undertaking the repair works, the full extent of defects requiring remediation is identified.

8116.5.7.2 Method

Defect areas must be identified by visual inspection and hammer tap survey, as a minimum. Areas identified for repair must be marked out using a waterproof marker with reference numbers correlating to the Project Drawings, where applicable. **No works shall commence prior to the Superintendent's approval of the type, location and extent of repairs**. The defect mapping will be required to be supported by RPEQ certified designs as required.

HOLD POINT

Drawings / documents confirming the approved type, location and extent of repairs must be kept by the Superintendent and the Contractor and will be used as a record for the purpose of measuring the Work.

8116.5.7.3 Defect Mapping

The Contractor must provide the Superintendent with a marked-out sketch of each element identifying the areas requiring repair, correlated to the Project Drawings for approval. These shall include elevations, sections and/or plan views as appropriate to best identify and record the defects.

HOLD POINT

8116.5.8 Environmental

8116.5.8.1 General

The Contractor shall remove all rubbish, debris, disused materials etc. from the Site. The Site shall be maintained in a clean state.

During works, the Contractor shall provide suitable shielding, masking and environmental encapsulation to collect blast media and prevent debris from leaving the work area, in accordance with all relevant environmental legislation.

Residues created by blasting, chipping or any other removal techniques shall be collected by an appropriate ground sheet beneath the work area. The ground sheet shall be impervious and shall prevent the residue from contacting the ground surface.

The Contractor shall take necessary measures to recover all removed coating, spent abrasive and associated debris. The Contractor shall dispose of all collected residues and waste materials in accordance with the appropriate statutory requirements.

Protection shall be provided for all equipment, structures, and any other areas as required by applicable statutory requirements or as directed by the Superintendent, from damage due to surface preparation methods or repair material/coating droppings.

The Contractor shall be responsible for ensuring no debris is deposited on public or private rights of way because of the works, including any deposits arising from the movement of plant and vehicles.

The Contractor shall keep pollution in the vicinity of the Works within reasonable minimum limits or within the limits controlled or required by legislation.

The Contractor shall collect, transport and dispose of the waste at a registered waste facility.

Any works undertaken to facilitate access to the culvert invert level should take note of accepted Development Requirements applicable and must as part of the works be fully restored to preconstruction line and level and the surface fully revegetated.

The Contractor is responsible for lodgement of all Pre and Post Works notification requirements under the relevant Accepted Development, Tidal Works or Operational Works approvals and shall not proceed until all approvals are provided to the Superintendent.

HOLD POINT

8116.5.8.2 Noise and Dust Control

All plant and equipment supplied by the Contractor for use on the Works shall be selected to ensure nuisance caused by noise is minimized. The use of plant and equipment shall meet the relevant noise control legislation.

The Contractor shall minimise nuisance caused by dust and shall provide measures necessary to avoid nuisance caused by dust to the public and surrounding environment. Complaints shall be handled and recorded as per the Contractors management plans,

The Contractor must ensure access is maintained for residents at all times.

8116.5.8.3 Water Supply Protection

It is critical that contaminants from repair works are prevented from entering the waterway. The Contractors Environment Management Plan shall nominate the measures to be put in place.

Any such contamination must be cleaned up and disposed of legally at the Contractors' expense at a registered waste facility.

8116.5.8.4 Vegetation Removal within Waterway and for Access

While vegetation removal within the road reserve is exempt under the Vegetation Management Act the Contractor shall note and take necessary action to meet the requirements of the relevant ADR referenced in relation to the following matters in relation to both the works to be undertaken and access to the waterway bed level:

- Minimise disturbance to the instream bed and banks e.g. use geofabric as a work base, or construct a work platform above the substrate
- If it is necessary to remove vegetation, aim to cut vegetation no lower than ground level and leave the root in the ground to aid in stabilisation. If deep excavation is required during construction the roots may only be removed within the construction footprint area.
- Minimise the area of land disturbed or compacted e.g. construct a work platform above the substrate
- Ensure the least volume of soil or sediment is disturbed
- Limit the use of machinery within waterways
- Use machinery no greater than the capacity required for the purpose
- Implement sediment and erosion protection measures

Any works undertaken to facilitate access to the culvert invert level shall take note of accepted Development Requirements applicable and must as part of the works be fully restored to preconstruction line and level and the surface fully revegetated.

8116.5.9 General Workplace Health and Safety Requirements

As a condition of this document, it is required that the Contractor and its workers (including all sub-contractors etc. and their workers) engaged to perform a service or work on site must at all times ensure (so far as reasonably practicable) the health and safety of all persons who are, or may be, affected by work under this specification or the services provided.

8116.5.10 Legislative Compliance

Without limiting the Contractor's other obligations, the Contractor must comply with all Acts, Regulations, Standards and Codes of Practice about work health and safety matters that are applicable to the scope of work undertaken or services being provided.

8116.5.11 Council Work Health Safety Contractor Requirements

The Contractor must ensure they and their workers (including all Contractor's sub-contractors etc.) comply with the following work health and safety requirements:

- Undertake Council Contractor and site inductions prior to commencing work
- Ensure all workers are competent, and provide proof of competencies, licenses and training on request
- Have an approved safe system of work (including risk assessment) for the task and ensure the work is completed according to this safe system of work
- Provide adequate supervision for all high-risk construction tasks
- All incidents and near misses are to be reported to their Council representative within 60 minutes
- Participate in Contractor pre-start meetings, safety interactions, site meetings and site inspections
- Review information provided by Council such as site-specific hazards, risks and interaction issues and implement controls to, so far as reasonably practicable, eliminate, or if that is not possible, mitigate the risk
- Supply safe plant and equipment with pre-start checks, maintenance/ service records and manufacturer's manual
- For all hazardous chemicals, ensure current Safety Data Sheets (SDS) are available and that appropriate controls (including as required under SDS requirements) are implemented
- Comply with Council Safety, Drug and Alcohol and Fitness for Work policies
- Be familiar with applicable site emergency procedures, closest emergency assembly point and sign in and out of site registers where required
- Compliance with any reasonable direction given by Council relating to work health and safety

8116.5.12 Permits for Work

The Contractor must ensure applicable permits to work are completed. Permits are to be completed and obtained at the Contractors cost.

8116.5.13 Safe Systems of Work / Risk Assessment

The Contractor must prepare and submit a safe method of work (risk assessment) and relevant controls prior to commencement of work.

Safe Work Method Statements (SWMS) are required for all high-risk construction activities and Job Safety Analysis (JSA) or similar risk assessments are required for other tasks. The risk assessment (whether SWMS, JSA or other) must be reviewed and signed by the workers prior to undertaking the work.

The Contractor shall implement a Safety Management System (SMS) that includes sections addressing the project scope.

The completed risk assessment, SWMS, JSA and any other relevant safe systems of work documentation shall be provided to the Superintendent for review and approval prior to works commencing.

HOLD POINT

8116.5.14 Handling of Chemicals

Material safety data sheets shall always be available for review during transport and at all times when the product is in use.

The manufacturer's instructions for the safe handling of products shall be followed to minimise the risk of injury or creation of health hazards to personnel.

Handling of coatings, solvents and chemicals shall be carried out with due care and diligence. Personnel not directly concerned with coating operations shall be protected against the effects of products used during coating application.

The correct use of personal protective equipment shall be employed during the surface preparation, coating material preparation and application and site clean-up.

Disposal of chemicals must be treated with due regard to environmental protection and shall be in accordance with manufacturer's guidelines and statutory requirements.

8116.5.15 Silica Dust

Contractor to manage the silica dust at work site via SWMS detailing controls which are to be implemented. SWMS must be available at the worksite.

8116.5.16 Pressure Equipment

The safe operation of all pressure equipment shall be detailed in the Contractor's SWMS. It shall detail how, and when, inspection of such equipment shall be carried out and the method of recording and logging the inspections. Other equipment and associated connections shall be regularly inspected and well maintained.

8116.5.17 Access

All scaffolding and other access methods used during the Works shall comply with the relevant Government safety regulations. Scaffolding, platforms, lifts or floating stages must only be erected and operated by licensed or qualified personnel.

The appropriate tagging system, as stipulated by the relevant authorities, shall be employed and clearly displayed. Adequate warning notices shall be posted where overhead work is in progress.

Safety harnesses, standby personnel and any other appropriate safety precautions shall be used.

The proposed scaffolding or access system shall adequately protect personnel from the repair work.

All operators of Elevating Work Platform (EWP) shall have current licenses appropriate to the type of equipment, and familiarity with the operation and maintenance of the specific equipment to be used on the site and shall have completed recognised EWP Training with the National unit of competency TLILIC2005A, or RIIHAN301D for the appropriate equipment. The Superintendent may require a practical demonstration of competence of nominated personnel prior to granting approval to commence work.

The Contractor shall submit the proposed scaffolding or access system to the Superintendent for approval prior to undertaking repair works, including independent verification.

HOLD POINT

8116.6 Construction

8116.6.1 Works Scope

The scope of repair works (including associated activities) covered under this specification is as follows:

- Defect Survey and mapping
- Concrete Patch Repair
- Removal of Sediment and Debris at and within Culvert Inlets and Outlets noting 8116.5.8.4
- Corrugated Steel Culvert Protective Coating
- Concrete paved invert in Corrugated Culverts
- Concrete Crack Repairs
- Sealing of Gaps between Culvert Components
- Scupper Extension
- Culvert Joint Repair

8116.6.2 Concrete Patch Repair

8116.6.2.1 Purpose and Location

This section covers the repair of deteriorated concrete having areas of delamination, spalling and damaged concrete or areas of exposed reinforcement. This applies to precast and cast in-situ concrete culvert floors, walls and crowns.

8116.6.2.2 Materials

8116.6.2.2.1 Repair Mortar

The cementitious patch repair mortar shall be a single component polymer modified cementitious non-shrink repair mortar or be part of a complete polymer modified cementitious repair system. The proposed repair mortar shall be capable of being hand applied in vertical and overhead sections up to 30 mm thick in one application with no slumping.

The repair mortar shall conform to the requirements of EN 1504-3 Class R3 with the following additional performance requirements:

- Compressive strength (AS 1478.2:2005): ≥ 15 MPa @ 1 day, ≥ 30 MPa @ 7 days, ≥ 45 MPa@ 28 days
- Drying shrinkage (AS 2350:13:2006): < 600 microstrain @ 28 days
- Bond or pull-off strength to concrete at 7 days (AS 1012.24): 0.75 MPa
- Minimum wet density of 1600 kg/m3
- Maximum water/powder ratio of 0.17
- Resistant to alkaline solutions
- Possess an acid soluble chloride-ion content expressed as the percentage of the total mass of cementitious material of not greater than 0.05%

Acceptable products include Renderoc HB40 Plus or Sikagrout GP or approved equivalent product.

8116.6.2.2.2 Substrate Primer

The substrate primer shall be compatible with the repair mortar and be part of the same range of proprietary repair system. Acceptable products include Nitobond HAR or approved equivalent.

8116.6.2.2.3 Reinforcement Primer

The reinforcement primer shall be compatible with the repair mortar and be part of the same range of proprietary repair system. Acceptable products include Nitoprime Zincrich or approved equivalent.

8116.6.2.2.4 Curing Membrane

A curing membrane meeting the requirements of AS 3799:1998 must be used in accordance with manufacturer's specification. Acceptable products include Nitobond AR or approved equivalent.

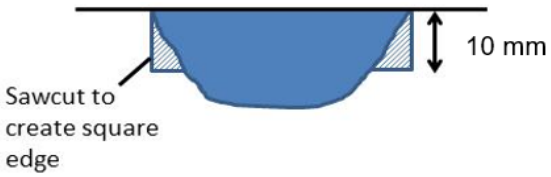
8116.6.2.2.5 Cathodic Protection

The use of suitable reinforcement coatings or embedded sacrificial anodes shall be used to prevent insipient corrosion. Acceptable product include Sika® FerroGard® or approved equivalent.

8116.6.2.3 Preparation and Construction

8116.6.2.3.1 Concrete Breakout Extent and Depth

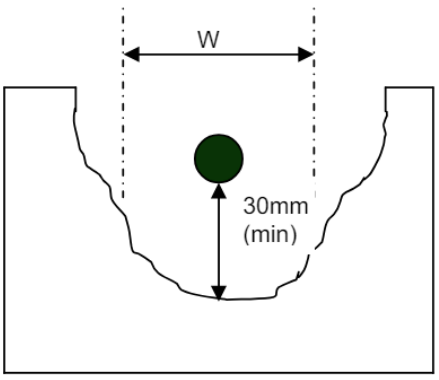
The perimeter of the repair must be delineated by saw cutting to a depth of at least 10 mm at 90^{o} to the surface with a grinding disk or diamond cutting wheel to avoid feather edges and to provide a square edge. Concrete must be removed to the saw cut edge of the repair area, including the minimum necessary removal of sound concrete to achieve the saw cut edge depth. The saw cut surface shall roughened by removing the surface layer to expose small particles of well bound aggregate.



The Contractor must ensure that no reinforcement is cut or damaged. The Contractor shall undertake a cover meter assessment of the full repair area to confirm the positioning of existing reinforcement prior to any concrete cutting or breakout and shall inform the Superintendent of any areas of low cover or where cover will prevent saw cutting to the specified 10 mm depth. The Superintendent will direct the Contractor how to proceed should this occur. The Contractor must inform the Superintendent immediately when any reinforcement is cut.

All defective and delaminated concrete and existing repair materials shall be broken back to a sound and dense concrete surface. Hammer sounding shall be conducted on completion of breakout to ensure that all delamination has been removed. Breakout depth of concrete must stop at sound alkaline base (pH>10, pink when tested with 1% phenolphthalein solution) and must not exceed 50 mm for precast culverts and 100 mm for cast-in-situ culverts without the Superintendent's written approval.

Where the depth of the breakout is within the cover zone and within 10mm of the reinforcement, or where the reinforcement is exposed, the breakout must extent to at least 30mm depth behind the reinforcement to ensure that a plane of weakness is not created at the reinforcement.



Continue the removal of sound concrete along visibly corroding reinforcement until 100 mm minimum of sound, rust free reinforcement is revealed or length required to meet minimum lap length requirements.

Where a reinforcement steel coating does not meet the design life requirements for concrete patch repairs, the type, size and spacing of embedded sacrificial anodes shall be designed and connected to the continuous reinforcement to ensure that the patch repair meets the minimum life requirements specified in 8116.5.1.

HOLD POINT

Do not remove excessive concrete on any one area, which may compromise the structural integrity of the structure.

The Contractor shall provide the Superintendent with an RPEQ assessment of any structural impacts and load bearing capacity reductions that may occur as a result of the concrete breakout works. If the impacts to the load capacity result in the structure not being trafficable by the design vehicle; then the Contractor shall provide an RPEQ certified temporary works design for Superintendent review and approval.

HOLD POINT

8116.6.2.3.2 Procedure

Defective concrete shall be removed using light hand-held percussive equipment or high-pressure water jetting. Care shall be taken to ensure that:

a) Any steel reinforcement exposed is not cut or damaged

b) Damage to sound concrete is minimised

c) Dust which has the potential to be a hazard or nuisance is not created

If high-pressure water jetting is used, the water pressure must be greater than 18 MPa and less than 60 MPa .

All demolished materials must be removed from site and disposed of by the Contractor in accordance with local environmental laws and regulations. The Contractor's Work Method Statement shall detail how demolished materials will be prevented from contaminating the waterway.

Any plant, equipment, or other assets that are damaged because of concrete removal works must be repaired by the Contractor to the satisfaction of the Superintendent and at the Contractor's expense.

8116.6.2.3.3 Reinforcement Preparation and Protection

Cleaning

Upon satisfactory completion of the concrete breakout, all exposed corroding reinforcement and/or embedded steelwork must be cleaned by wet grit blasting with potable water to a standard equivalent to AS 1627.4: 2005 Class Sa 2½ with particular attention to the back of exposed bars. Care must be taken to protect adjacent sensitive materials from damage.

After wet grit blasting, the steel must be high-pressure washed with clean potable water to remove corrosion products from pits and imperfections within the surface.

WITNESS POINT

The Contractor must report to the Superintendent where corrosion has resulted in the loss of more than 10% of the original cross-sectional area of the steel reinforcement.

For avoidance of doubt, the original and residual (minimum) bar diameter with corrosion acceptable is shown for discrete bar diameters as follows:

Original Bar Diameter (mm)	Original Area of Steel (mm2)	Max Loss Area of Steel (mm2)	Min Residual Area of Steel (mm2)	Min Residual Bar Diameter (mm)
8	50	5	45	**7.6**
10	79	8	71	**9.5**

12	113	11	102	**11.4**
16	201	20	181	**15.2**
20	314	31	283	**19.0**
24	452	45	407	**22.8**
28	616	62	554	**26.6**
32	804	80	724	**30.4**
40	1257	126	1131	**37.9**
48	1810	181	1629	**45.5**
60	2827	283	2545	**56.9**

The Superintendent's Representative may instruct the installation of additional steel at this stage. In instances where galvanic protection is in use, an electrical continuity strap must be installed to ensure continuity of steel within the patch repair, as directed by the Superintendent and subject to the testing in accordance with this Supplementary Specification.

HOLD POINT

Priming to Reinforcement

Where galvanic protection is in use, only primers that have been approved with the manufacturer of the galvanic anodes are to be used, notwithstanding the continuity requirement with the sacrificial anodes.

Within 3 hours (subject to manufacturer's specification and Superintendent's approval) of wet grit blast cleaning, the reinforcement primer must be applied to all exposed reinforcement in accordance with the manufacturer's specification using a stiff paintbrush, or other method as recommended by the primer manufacturer and approved by the Superintendent.

The primer must be mixed, applied and cured in strict accordance with the manufacturer's specifications. A minimum dry film thickness (DFT) of 40 microns per coat is recommended.

Care must be taken to avoid the occurrence of defects such as pinholes in the coating and that all exposed steel surfaces are coated, including behind bars and where steel bars are tied together where applicable. 100% coverage is required and mirror inspection must be employed to confirm full coverage behind exposed bars.

The Contractor must provide access for such testing. A detailed visual inspection must also be performed by the Superintendent to ensure complete envelopment of the steel bars.

Where the reinforcement coating system fails to comply with the requirements of this clause, the reinforcement coating system will be rejected by the Superintendent. The Contractor must rectify any areas of non-complying reinforcement coating in accordance with the manufacturer's specifications to the Superintendent's satisfaction at the Contractor's expense.

HOLD POINT

Provision of Additional Reinforcement

The Contractor shall assess the residual cross-sectional area of all exposed steel reinforcement and report to the Superintendent where corrosion has resulted in the loss of more than 10% of the original **cross-sectional area** of the steel reinforcement.

The Contractor's RPEQ Structural Engineer shall inspect and assess each culvert following the removal of defective concrete and confirm the extent of cross-section loss of existing steel reinforcement and the recommended treatment (be it accepting the loss as is or providing additional reinforcement to replace that lost from corrosion).

The Contractor shall submit to the Superintendent written advice from the Contractor's RPEQ Structural Engineer detailing recommendations for reinforcement augmentation where required.

HOLD POINT

New bars shall be installed along side or above (not below) existing or removed bar to ensure that concrete cover depths are not compromised. The minimum lap length with existing uncorroded reinforcement shall be as per AS3600 requirements. Unless otherwise directed by the Superintendent following confirmation of the size of existing reinforcement, new reinforcing steel shall be D500N16.

The existing bars shall be cleaned and primed in accordance with this Specification. Both tie wire or spot welding are acceptable methods of securing the new reinforcement.

8116.6.2.3.4 Repair Mortar Preparation and Application

Concrete Substrate Surface Preparation

All exposed broken out concrete surfaces that are to receive repair materials must be prepared by high pressure water jetting with potable water to remove loose or weak concrete, surface laitance, and other contaminants and to produce a surface suitable to ensure that the bond of the repair material to the substrate can satisfy the performance requirements.

Care must be taken to ensure the method of preparation does not cause weakness of the interface due to fracture or loosening of aggregate.

Where necessary, fresh saw cuts must be made to eliminate feather edges at the completion of the breakout.

Where concrete breakout is not required, the concrete surface must be cleaned to the above condition, and the surface roughened as necessary, by light scabbling or grit blasting.

Concrete substrate wetting must be applied in accordance with the repair material manufacturer's instructions. Typically, the substrate must be saturated with potable water and any excess water removed from the surface.

Where the concrete repair material manufacturer's system requires a bonding agent to be applied the bonding agent must be applied to the prepared concrete substrate only after approval from the Superintendent.

HOLD POINT

The method of application must be by brush or by other method as recommended by the manufacturer and approved by the Superintendent.

The substrate bonding agent must be applied immediately prior to repair mortar application and shall not exceed the maximum time recommended by the manufacturer.

WITNESS POINT

8116.6.2.3.5 Application of Repair Mortar

The repair material must be thoroughly mixed in accordance with the repair material manufacturer's specifications.

All materials shall be applied fully in accordance with the manufacturer's specifications in a continuous process. Repair material shall be applied while the substrate bonding coat is still tacky. The repair material must be applied to the substrate using hand packing and a steel trowel. In overhead application scenarios, if slumping of the repair material occurs, or if the material cannot be successfully applied to a high-quality standard in accordance with the manufacturers' recommendations for any reason, the hand packing methodology shall be abandoned and a form and pump methodology adopted in accordance with ACI RAP-5 subject to the approval of the Superintendent, including selection of a product appropriate for a form and pump methodology.

The repair mortar application must be built up to the finished surface profile in layers not exceeding the repair material manufacturer's recommendations. Where multiple layers are applied, the surface of the intermediate layers must be scarified, cured and reprimed in accordance with the repair material manufacturer's specifications prior to the application of subsequent layers. The final build-up layer within a repair must not be less than 10 mm thick.

The applied material must have no voids, must be properly compacted and must have no sagging. If sagging occurs the material must be completely removed and replaced at reduced thickness, or a form and pump material and methodology must be adopted.

The finished surface profile of the repairs shall generally be the original surface profile. However, the level of the soffit or finished surface of the wall may be proud of the existing concrete surface if necessary to ensure that a minimum cover of 40 mm is provided to new steel reinforcement (as per the example shown below).

Where formwork is used to facilitate the patch repair, it must be pre-treated such that it prevents moisture absorption from the repair mortar and positioned such that it does not inhibit effective compaction of the repair material.

Repair material shall only be applied when the concrete substrate temperature and the air temperature measured at the point of application is:

a) Above 5°C or 5°C and rising; and

b) Below 35°C

Where the ambient temperature at the point of application of material is above 30°C and the area to be treated is subject to direct sunlight, protective shading shall be used and equipment that comes into direct contact with the repair material shall be kept cool and not exposed to direct sunlight.

8116.6.2.3.6 Curing and Protection

The repair material must be cured in accordance with the repair material manufacturer's specifications.

Immediately after placement and for seven days thereafter, the repair material shall be cured and protected from drying out and against the harmful effects of water movement and weather, including rain and rapid temperature changes.

WITNESS POINT

Cementitious material shall be cured with the application of two coats of a curing compound in accordance with the material manufacturer's specification. In addition to a curing compound, heavy duty polyethylene sheeting fastened and sealed at the edges shall also be provided for concrete patch repairs greater than 500 mm x 500 mm in size and for all concrete repairs to chloride affected concrete structures or components.

Large areas must be cured as staged completion progresses (0.5 m^2 at a time) without waiting for completion of the entire area.

8116.6.2.3.7 Finishing and Surface Condition

The standard of the surface finish on completed repairs shall at least match that of the surrounding existing concrete, which may require the use of steel forms or steel trowel finish.

The surface of the concrete repair shall not have voids, cracks of width greater than 0.10 mm measured at the concrete surface nor craze cracking covering more than 20% of the area of the repair at the completion of the curing period.

There shall be no cracking or debonding at the interface of the concrete repair with the existing concrete.

The repaired area is to be inspected by the Contractor and the Superintendent seven days after the curing period commenced for surface finish and cracking defects, as well as geometric tolerances.

HOLD POINT

8116.6.2.4 Calculation of Quantities

Actual quantities of patch repair shall be based on volume (litres) as agreed between the Contractor and Superintendent.

8116.6.3 Removal of Sediment & Debris within and at Culverts

8116.6.3.1 Purpose and Location

This Supplementary Specification applies to the removal of sediment and debris at culvert structures. It shall be read in conjunction with:

- MRS01 and MRTS01 Introduction to Technical Specifications
- MRS03 and MRTS03 Drainage, Retaining Structures and Protective Treatments
- MRS04 and MRTS04 General Earthworks
- MRS50 and MRTS50 Specific Quality System Requirements.

8116.6.3.2 Preparation and Removal

Prior to works commencing, the extent of material to be removed from each culvert structure shall be approved by the Superintendent. Any foreign material that is impeding the free flow of water through the culvert shall be removed.

Removed sediment and debris shall be disposed of in accordance with the provisions of Clause 11 of MRTS04 *General Earthworks*.

The Contractor shall take all reasonable measures to ensure that removal of sediment and debris does not result in any additional damage to the existing culvert structure. Damage attributable to the Contractor's works shall be rectified to the satisfaction of the Superintendent at the Contractor's expense.

The Contractor shall note and comply with the requirements of section 8116.5.8.4.

Any temporary bunding installed during repair works must take into account the relevant time restrictions referred for declared waterway categories in the Accepted development requirements for operational work that is constructing or raising waterway barrier works.

Similarly, restrictions exist for vegetation removal for maintenance action under the Accepted Development requirements for operational work that is constructing or raising waterway barrier works. The Contractor shall acquaint themselves with the areas to which such works can be undertaken and ensure no works are undertaken outside of such zones.

8116.6.3.3 Calculation of Quantities

Actual quantities of sediment and debris removed from culverts shall be determined based on truck tallies or other method of measure appropriate to the method adopted for removal of sediment and debris as agreed between the Contractor and Superintendent.

8116.6.4 Corrugated Steel Culvert Protective Coating

8116.6.4.1 Purpose and Location

This Supplementary Specification applies to the protective coating of corroded areas of the corrugated steel pipe culvert. It shall be read in conjunction with:

- MRS01 and MRTS01 Introduction to Technical Specifications
- MRS03 and MRTS03 Drainage, Retaining Structures and Protective Treatments
- MRS70 and MRTS70 Concrete
- MRS50 and MRTS50 Specific Quality System Requirements.
- TN144 Paint Systems

8116.6.4.2 Material

The protective coating system to be applied to internal steel surfaces of corrugated metal pipe (CMP) culverts shall consist of:

- SigmaZinc 109HS, Amerlock 400, PSX 700 as per section 4.1.1 of TMR's Technical note TN144 (or approved equivalent)

The protective coating system to be applied to the top of concrete invert lining of corrugated metal pipe (CMP) culverts shall consist of:

- SigmaCover 350, PSX 700 as per section 5.1.2 of TMR's Technical note TN144 (or approved equivalent)

The Contractor shall nominate the proposed material and application method and provide the relevant Product Data Sheet and Material Safety Data Sheet (MSDS) to the Superintendent with their product nomination. Repairs shall not commence until the Superintendent has approved the repair material.

HOLD POINT

8116.6.4.3 Surface Preparation and Coating Application

All protective coatings shall be applied in accordance with the product manufacturers recommendations, TMR Technical Note TN144 and AS2312.1-2014 "Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings".

Prior to commencement of works, the area of internal culvert cells needs to be dried and the surfaces prepared.

WITNESS POINT

At the site, the paint system materials shall be stored in a dry, shaded area free from sources of heat and ignition.

The coating methodology shall comply with the product manufacturers recommendations, TMR Technical Note TN144 and AS2312:2014, including provisions for material storage, substrate preparation, coating procedure, dry/wet film thickness testing and defect rectification of each coating layer

8116.6.4.4 Calculation of Quantities

Actual quantities of pain system shall be based on tallies of delivery dockets from the supplier of the paint materials or other method of measure appropriate to the pain system as agreed between the Contractor and Superintendent.

8116.6.5 Concrete Paved Invert in Corrugated Culverts

8116.6.5.1 Purpose and Location

This Supplementary Specification applies to the supply of materials and installation of a concrete liner in the invert of CSP culverts to address invert corrosion issues impacting the structural integrity of the CSP culvert. The work specified in this section shall be undertaken only after protective coatings referenced in 8116.6.4 are completed. It shall be read in conjunction with:

- MRS01 and MRTS01 Introduction to Technical Specifications
- MRS03 and MRTS03 Drainage Structures, Retaining Structures and Embankment Slope Protections
- MRS70 and MRTS70 Concrete
- MRS50 and MRTS50 Specific Quality System Requirements

8116.6.5.2 General and Materials

Concrete and reinforcement shall comply with the requirements of MRTS70 Concrete and MRTS71 Reinforcing Steel respectively. Concrete shall be minimum Class S32 MPa/10. Epoxy-based bonding agent shall be an approved proprietary product.

Reinforcement shall be SL62 mesh and shear studs 9.5 x 50mm.

The Superintendent will conduct an inspection of the reinforcement placement prior to approval to pour concrete.

HOLD POINT

8116.6.5.3 Preparation and Installation

Concrete paved inverts shall be constructed in the locations and in accordance with the drawings.

The invert of corrugated steel and aluminium pipe culverts shall be lined with concrete with the following requirements:

a) The minimum depth of concrete above the corrugations shall be 100 mm or in the case of extension of an existing liner to match the existing depth

b) The minimum height of lining above invert shall be D/6 – where ‘D’ = Diameter of culvert

The construction of paved inverts shall be delayed until all backfilling operations around and adjacent to the culverts concerned have been completed. Where practicable, the construction of paved inverts shall be delayed to the latest possible time within the construction period.

The surfaces on which paved inverts are to be constructed shall be dry and free of foreign matter. Immediately prior to paving, the surfaces shall be coated with an epoxy-based bonding agent for the full width of the paved area, plus an additional 100 mm width each side.

HOLD POINT

Concrete work shall be in accordance with the requirements specified in MRTS70. The concrete shall be thoroughly worked into the corrugations, screeded off and trowelled to provide a uniform surface free of depressions.

The edges of the concrete paving shall be sloped such that water shall not pond against the steel culvert. The surface of the trowelled concrete shall be scored longitudinally to a depth of 10 mm at 500 mm centres.

For projects requiring installation of new concrete inverts and/or projects requiring extension of existing invert liners the general construction process can be identified as follows:

- Where invert liner extension is required break out a minimum area of existing invert liner side wall to achieve the required extension i.e.: 2.5 mesh squares or 300mm
- All reinforcement shall be founded on shear studs removing galvanising at shear stud locations which shall be centre punched and ensure they are positioned at the top of corrugates and square to the surface
- Shear studs welded to the steel corrugates must have at least 4mm fillet welds to AS/NZS 1554.2 as well as to the concrete reinforcement and spaced at 600mm longitudinally

WITNESS POINT

- Impacted areas including shear studs shall receive protective coating treatments as per section 8116.6.4
- Reinforcement laps shall be as per AS3600
- Tape extent of any concrete installation to limit overcoating and install screeding rails and depth gauges to meet project plan requirements removing tape before set occurs
- All concrete shall have Class U1 finish to AS 3610.1
- Finish profile to be such that water flow does not pond especially between the culvert wall and the invert liner and the invert itself
- Deviations from the nominal profile shall be less than 10mm over a 500mm length

WITNESS POINT

- Following initial set prepare and apply Polymer Modified Cement Composite (PMCC) putty to smooth the junction between the culvert wall and the liner and prepare and apply 2000 micron thick coat of the PMCC over the existing coating to the culvert wall and liner to a point 150mm down the face of the liner in accordance with manufacturer's recommendations
- Concrete cover shall be a minimum 30mm
- Immediately after concrete placing and compaction, one coat of an approved curing compound shall be applied to the surface in accordance with the manufacturer's recommendations (plastic sheeting shall not be used as part of the curing process)

WITNESS POINT

8116.6.5.4 Calculation of Quantities

Actual quantities of concrete shall be based on tallies of delivery dockets from the supplier of ready-mixed concrete supplier or other method of measure appropriate to the liner installation method as agreed between the Contractor and Superintendent.

8116.6.6 Concrete Crack Repairs

8116.6.6.1 Purpose and Location

This Supplementary Specification applies to repair of cracks exceeding 0.3 mm wide in reinforced concrete components. It shall be read in conjunction with:

- MRS01 and MRTS01 Introduction to Technical Specifications
- MRS70 and MRTS70 Concrete
- MRS50 and MRTS50 Specific Quality System Requirements

8116.6.6.2 General and Materials

Cracks larger than 0.3 mm width shall be repaired using non-shrinkage epoxy resin injection system with low viscosity. Suitable products include relevant approved products listed on TMR's Product Index for Bridges and Other Structures.

The only cracks that require injection are those at which the adjacent concrete is sound and no evidence of corrosion staining is present, i.e., where a patch repair is not required at the site of cracking. The cracks associated with delamination and corrosion, or of a width >2 mm, must be further investigated.

The Contractor shall nominate the proposed material and application method and provide the relevant Product Data Sheet and Material Safety Data Sheet (MSDS) to the Superintendent with their product nomination. Repairs shall not commence until the Superintendent has approved the repair material.

HOLD POINT

8116.6.6.3 Preparation and Installation

The actual location and extent of crack repairs to be undertaken shall be determined on site by surveys of the existing structure by the Contractor and agreed after joint inspections by the Contractor and the Superintendent.

HOLD POINT

During these surveys the Contractor shall record all areas of cracking greater than 0.3 mm crack width. The Contractor is to ensure a true crack width is measured noting that the crack edges at the surface are likely to be broken away giving the appearance of greater crack width. The crack measuring shall be undertaken using a concrete crack measuring gauge or ruler.

The concrete surface shall be prepared in accordance with the manufacturer's specifications. The surface shall be dry and shall not have been exposed to water for at least 24 hours prior to application. For cracks that are leaking or permanently damp, an alternate product suitable for application to wet areas shall be used. Areas surrounding the cracks where the material shall be applied shall be prepared by removing contaminants. It is critical that the cracks be free from any form of debris and contaminants that may interfere with adhesion. All embedded and adhered dirt and debris shall be removed prior to application. This may require routing out of the cracks with a grinder.

Following removal of any embedded and adhered contaminants, individual cracks shall be thoroughly cleaned by high pressure, oil-free compressed air to remove dust and debris from the crack surfaces. Vacuuming of the cracks may also be used to remove loose materials.

Cleaning with chemical solvents is not permitted. All materials are to be prepared and applied in accordance with the manufacturer's specifications.

WITNESS POINT

Once the surfaces have been prepared, install injection nipples and apply a thin grout epoxy layer along the crack. Injection of the crack can proceed after 24hrs once the epoxy has cured sufficiently and shall be strictly in accordance with the manufacturers' recommendations.

WITNESS POINT

Once the injection operation is complete, remove the injection nipples and grind the crack surface flush to ensure a neat and clean finish.

8116.6.6.4 Blowhole Repairs and Honeycombing

If there are large blowholes or honeycombing in the concrete surface, these must first be filled with a suitable repair mortar, such as Sikadur® -31/41 epoxy mortar or filled or unfilled Sikadur® -30 adhesive.

Sikadur® -30 adhesive must be used as a bonding bridging layer for both of these options to ensure a good bond with the concrete substrate and no voids in the repairs.

Where concrete repairs are necessary to a structure prior to bonding the Sika CarboDur® plates, it is important that the repair materials are fully compatible with the adhesive and suitable for use in a structural situation (i.e., low shrinkage, compatible modulus of elasticity, good interface bond and adequate strengths).

If the repair materials are not suitable, the effect will be detrimental to the long-term performance of the bonded plates.

8116.6.6.5 Application

All materials must be thoroughly mixed in their original containers, and progressively intermixed in containers of the same colours as the job proceeds. Mixing shall be undertaken using a slow running drill or similar, as to ensure that the components are thoroughly mixed in.

Application must be conducted in dry conditions, where moisture is not present in the crack.

When filling the crack, the pressure injection shall start from one end of the crack, moving towards the other. The first flange should be sealed off first before proceeding to the subsequent flanges.

Upon curing, the flanges may be removed, ensuring that the surface of the crack is ground back flush with the finish surface level, using a paint scraper or mechanical means as approved by the Superintendent to ensure a clean substrate.

HOLD POINT

8116.6.6.6 Calculation of Quantities

Actual quantities of concrete crack repairs shall be based on the total length of crack repairs (m) and blowhole / honeycombing repairs per litre of material as agreed by the Contractor and Superintendent.

8116.6.7 Sealing of Gaps between Culvert Components

8116.6.7.1 Purpose and Location

This Supplementary Specification applies to the sealing of gaps between culvert cells and headwall. The purpose of this work is to prevent the loss of fill and ensure that moisture is directed to outlet through the appropriate locations. This Supplementary Specification shall be read in conjunction with:

- MRS01 and MRTS01 Introduction to Technical Specifications
- MRS50 and MRTS50 Specific Quality System Requirements

8116.6.7.2 Materials

All gaps between culvert cells and headwalls are to be sealed to prevent material loss from behind the structure. The Contractor is to undertake the prescribed works filling the gaps using SikaGroutGP or an approved equivalent.

The Contractor shall nominate the proposed material and application method and provide the relevant Product Data Sheet and Material Safety Data Sheet (MSDS) to the Superintendent with their product nomination. Repairs shall not commence until the Superintendent has approved the repair material.

HOLD POINT

8116.6.7.3 Preparation and Installation

The Contractor is to confirm the size and locations of the gaps with the Superintendent prior to repair works commencing.

HOLD POINT

All loose material shall be cleared out of the gap using a hand brush and high-water pressure jet.

WITNESS POINT

Apply a thin grout epoxy layer along the crack. Insert nipple inject grout along the crack. The grout injection shall only take place at least 24hrs after installing the nipples. Injection process shall follow the manufacturers guideline.

WITNESS POINT

8116.6.7.4 Calculation of Quantities

Actual quantities of the sealing of gaps between the culvert components shall be based on the total length of gaps sealed (m) as agreed by the Contractor and Superintendent.

8116.6.8 Scupper Extension

8116.6.8.1 Purpose and Location

This Supplementary Specification applies to extension of existing scuppers in culvert structures. It shall be read in conjunction with:

- MRS01 and MRTS01 Introduction to Technical Specifications
- MRS50 and MRTS50 Specific Quality System Requirements

8116.6.8.2 Materials

Scuppers shall be extended using:

- PVC pipe with UV protection; and
- Sikardur 30 (or approved equivalent)

The Contractor shall nominate the proposed material and application method and provide the relevant Product Data Sheet and Material Safety Data Sheet (MSDS) to the Superintendent with their product nomination. Repairs shall not commence until the Superintendent has approved the repair material.

HOLD POINT

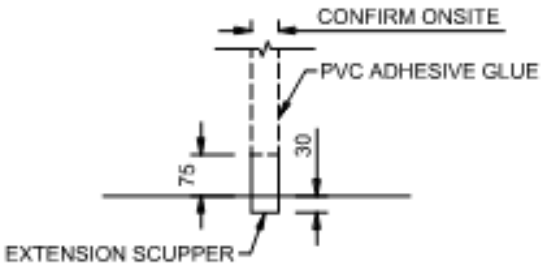
8116.6.8.3 Preparation and Installation

Thoroughly clean scupper surface of dust and debris using high pressure, oil-free compressed air. Vacuuming of the cracks may also be used to remove loose materials.

The Contractor needs to confirm the location, dimensions and number and dimension of scuppers on site before fabricating the new scuppers.

The new scupper is to be fabricated using PVC pipe with UV protection.

Install the scupper by coating the outer face (minimum 2mm) with Sikander 30 (or equivalent product) and attach the scupper to the existing hole. The Contractor needs to ensure that there is no gap between the scuppers external wall and internal hole surface. Manufacturers recommendations and instructions need to be followed when applying the epoxy to the scupper.



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8116.6.8.4 Calculation of Quantities

Actual quantities of scupper extensions shall be based on number of scuppers being extended (no.) as agreed by the Contractor and Superintendent.

8116.6.9 Culvert Joint Repair

8116.6.9.1 Purpose and Location

This Supplementary Specification applies to joints between culverts and is to be applied to external walls and top slabs of pre-cast units (not internal walls/legs). It shall be read in conjunction with:

- MRS01 and MRTS01 Introduction to Technical Specifications
- MRS50 and MRTS50 Specific Quality System Requirements

8116.6.9.2 Materials

Joint replacement shall be undertaken using:

- Sikafix HH (AU);
- Backing Rod; and
- Grout/Mortar

The Contractor shall nominate the proposed material and application method and provide the relevant Product Data Sheet and Material Safety Data Sheet (MSDS) to the Superintendent with their product nomination. Repairs shall not commence until the Superintendent has approved the repair material.

HOLD POINT

8116.6.9.3 Preparation and Installation

Remove all damaged material in the existing joint.

Clean the surface of the joint and internal face of the box culvert using high pressure water jet.

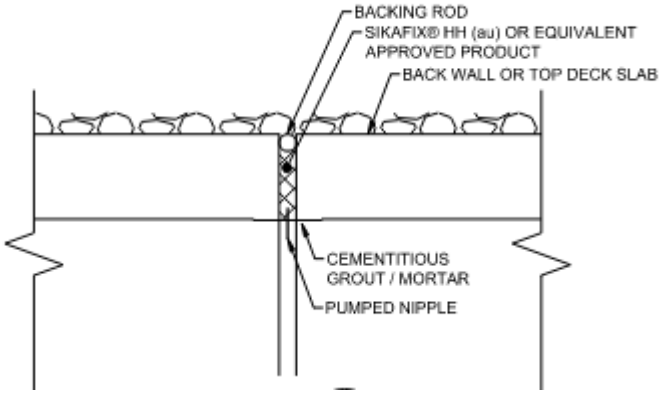
WITNESS POINT

Install the backing rods by pushing the rods to ensure that there are no gaps within the joints. The location of the rods is expected to be as shown below, in the case that the backing rods are not long enough then an overlap backing rod needs to be provided.

Cover the joint with cementitious grout. Wait until the grout dries to install injecting accessory.

Pump epoxy grout Sikafix HH (AU) or approved equivalent with low pressure until the gaps are filled.

Ensure that the gaps are filled entirely, the Contractor needs to calculate the volume of voids within the gap and mix equivalent volume of epoxy grout to be used.



8116.6.9.4 **Calculation of Quantities**

Actual quantities joint replacement shall be based on the total length of sealed joints (m) as agreed by the Contractor and Superintendent.

8116.6.10 Grouting of Undermined Culvert Bases and Aprons

8116.6.10.1 Purpose and Location

This Supplementary Specification applies to voids generated below culvert bases and aprons and is to be applied to these voids for pre-cast units and incite constructed units. It shall be read in conjunction with:

- MRS01 and MRTS01 Introduction to Technical Specifications
- MRS50 and MRTS50 Specific Quality System Requirements

8116.6.10.2 Material

The cementitious grout shall consist of:

a) Controlled Low Strength Material (CLSM) complying with AS 1379, achieving a 28-day compressive strength in therange 1.5 to 2.0 MPa and with aggregate shall be graded to achieve sufficient flow without segregation; or

b) An alternative product proposed by the Contractor and approved by the Superintendent.

8116.6.10.3 Construction

Prior to commencement of works, the area of undermined culvert and/or apron to be grouted and the proposed method of repair shall be agreed with the Superintendent.

HOLD POINT

The CLSM shall be placed at an adequate free-flowing slump and in accordance with the supplier's instructions to ensure adequate density and complete filling of the void(s).

The construction methodology shall:

a) Ensure the void is fully filled by the grout;

b) Ensure the affected member is underpinned or supported to its intended finished surface level by jacking and temporary supports; and

c) Incorporate all reasonable measures to prevent the loss of grout or contaminated runoff or leachate into the creekbed and watercourse.

8116.6.10.4 Calculation of quantities

Actual quantities of grout shall be based on tallies of delivery dockets from the supplier of ready-mixed grout or other method of measure appropriate to the grouting method as agreed between the Contractor and Superintendent.

8116.7 Post Construction

8116.7.1 As Constructed and QA Documents

The Contractor is responsible for collection and submission of all As Constructed data including QA data requirements.

The format of submitted "As Constructed" documentation shall be compliant with MRC Supplementary Specification 8919.

The Contractor is to supply and submit Works As-Constructed documentation as required by *MRC D20 - Drawings and Documentation* for approval by the Superintendent 4 weeks prior to requesting a practical completion inspection and include the following:

- The extent and scope of remedial work at the structure; including the dimensional location and extent of all concrete repairs including details of the concrete repair materials and their manufacturers.
- The layout, dimensional location and extent of all anodes installed showing sizes installed. Details of the sacrificial anode materials and their manufacturers shall be included; and layout, location and extent of all tensioning wires, connections, all sacrificial anode interconnecting wires and all sacrificial anodes.

The title block for the Drawings shall show the following information:

- The name of the contract, and, where appropriate, the structure designation MRC Asset ID.
- Description of drawing, drawing number, date, purpose of issue and scale.
- Name and address of the Contractor, the Employer and, where applicable, sub-contractor.

The completed drawings shall be signed by the Contractor as Works As-Constructed Drawings, and shall be submitted to the Superintendent.

HOLD POINT

The Superintendent will forward his comments to the Contractor within 14 days of receipt of the draft drawings.

Final Works As-Constructed Drawings in accordance with the D20 guidelines shall incorporate any modifications deemed necessary by the Superintendent and be endorsed by the Contractors RPEQ Engineer.

The Contractor shall provide all drawings in CAD 2012 or later, and PDF format.

8919.8 Measurement and Payment

Provision for these works shall be included in the scheduled unit rate for the items show in Clause 8116.3 of this Supplementary Specification and Annexure. No separate payment will be made for the works specified within this Supplementary Specification or its annexure.

Version Control:

Version	Description	Reviewed / Endorsed	Date
1.0	Original issue	G. Hawes	14.12.2023
1.1	Revised issue	G. Hawes	07.05.2024