Road Structures Inspection Manual

Part 1: Inspection Policy and Procedures

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Government of South Australia
Department of Planning, Transport and Infrastructure

Road Structures Inspection Manual

Part 1: Inspection Policy and Procedures
Department of Planning, Transport and Infrastructure, South Australia

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This manual has been compiled based on material sourced from:

- **Ontario Ministry of Transportation, *Ontario Structure Inspection Manual***
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- **Main Roads Western Australia, *Inspection Guidelines Documents***
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and adjusted for South Australian conditions.

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ABBREVIATIONS AND ACRONYMS

In this report the following abbreviations and acronyms have the meanings shown:

Term/Acronym	Meaning
ACM	Asbestos containing material
ARTC	Australian Rail Track Corporation
AWS	Amazon Web Services – Cloud Computing Services
BCMS	Buried corrugated metal structure
DPTI	Department of Planning, Transport and Infrastructure (SA)
MMP	Maintenance Marker Peg
MRWA	Main Roads Western Australia
RAMA	Road and Marine Assets Section
RAS	Road Assets Section
RRD	Road running distance
RSIM	Road Structures Inspection Manual
TMR	Department of Transport and Main Roads (Queensland)
VicRoads	formerly Roads Corporation Victoria, now part of Department of Transport (Victoria)

1. ROAD STRUCTURE INSPECTION POLICY

1.1 General

The Department of Planning, Transport and Infrastructure (DPTI) is committed to provide a safe, effective and efficient road network across the State that meets the needs of road users and the community.

Bridges and other structures are a vital part of the state network. The Road and Marine Assets Section helps provide a safe highway network through expert bridge and other structures inspection, reporting and client interaction.

DPTI is responsible for managing approximately 2,000 road structures including bridges, culverts, gantries, ferry ramps, the South Road Superway, O'Bahn Busway and Tunnel and the Heysen Tunnels. The estimated replacement value of these structures is in excess of $3.8 billion.

The Road and Marine Assets Section maintains a comprehensive structure inventory and condition data system for all road bridges and structures having DPTI management responsibility.

1.2 Purpose

The purpose of this manual is to ensure consistency in the assessment of the condition of all structures, and in providing data for:

- State asset management programs
- Bridge capacity assessment
- Providing regular reports to clients on condition of bridges and structures in order that required maintenance can be arranged, or replacement be anticipated
- Identify emerging problems
- Providing repair advice to ensure that maximum service life is achieved
- Providing regular condition reporting so that the database remains relevant
- Feedback to the design process

1.3 Scope

This manual states the requirements for a systematic program of inspections which comprises:

- Routine Maintenance Inspections (Level 1)
- Detailed Visual Condition Inspections (Level 2)
- Special Inspections and Investigations (Level 3)

1.3.1 Included Assets

The requirements of this manual apply to the following types of structure for which the Department of Planning, Transport and Infrastructure (DPTI) is responsible as defined in the Highways Act 1926:

- Bridges and major culverts
- Major sign gantry structures
- Retaining walls
- Noise and visual screen walls
- Pedestrian subway
- Architectural features and historic features
- Emergency bridging systems
- Ferry ramps
- Busway track
- Cattle grid
- Tunnel

There are a number of bridges and other structures that DPTI do not own or are not responsible for inspection/maintenance, but that cross the DPTI maintained state road network. These structures may be inspected by DPTI on a case by case basis, to ensure the safety of the state road network for road users.

1.3.2 Excluded Assets

There are a number of bridges and culverts within the state that are the responsibility of other authorities such as councils or are ARTC owned infrastructure, and therefore are not included unless they cross the DPTI maintained state road network as noted above.

Minor culverts (those that do not meet the definition in Section 1.6) are generally not recorded and do not form part of this inspection policy.

Cattle grids on the unsealed road network are also not included.

1.4 Information Management Systems

Inventory and condition data for all declared road structures on the South Australian state road network is stored in the Structures Manager system. This system provides accessible and timely information to all DPTI personnel involved in structures management and also makes structures' inspection history available to inspectors.

Structures Manager also incorporates access to other structure information including past inspection reports and photographs, drawings and other pertinent information stored in folders on AWS. Further information is available in Appendix C of this RSIM.

Information for non-DPTI structures as mentioned in Section 1.3.1 above shall also be captured in Structures Manager.

1.5 Work Health and Safety

Contractors, consultants and inspectors engaged to perform inspections must comply with the requirements of the *Work Health and Safety Act 2012 (SA), Work Health and Safety Regulations 2012 (SA)* and other relevant DPTI safety requirements specific to inspection contracts.

1.6 Structure Definitions

Structure Type	Definition
Bridge	A structure with a minimum span or diameter ≥ 1.8 m for the primary purpose of carrying a road or path over an obstacle.
Major Culvert	A structure with a minimum span or diameter ≥ 1.8 m (head wall, kerb or more) with a height ≥ 0.9 m and for the primary purpose of carrying water.
Pedestrian Subway	A structure with a minimum span or diameter ≥ 1.8 m for the primary purpose of allowing pedestrian access underneath an obstacle.
Retaining Wall	A structure, with the primary purpose of retaining material that is ≥ 1.0 m in height. Exclusions: 1. Walls underneath a bridge structure and forming the bridge abutment are part of the bridge structure. Wall lengths that extend each side of the bridge abutment or wingwalls shall be treated as a retaining wall and given a structure number (and be subject to a separate inspection regime). 2. Walls at major culvert inlets, outlets and access ramps are part of the major culvert structure. 3. Walls supporting or protecting road-related infrastructure for which DPTI is not the responsible road authority (service roads, footpaths and other) and walls supporting or protecting non-road infrastructure (adjoining properties, driveways, public transport infrastructure or other). 4. Landscaping treatments (feature walls, garden beds, beaching and paving and other).
Noise Wall	A structure that attenuates traffic noise.
Visual Screen Wall	A structure that serves as a visual screen.

Structure Type	Definition
Major Sign Gantry Structure	An overhead structure spanning, or partially spanning (if cantilevered), a road carriageway for the specific purpose of carrying regulatory, advisory, warning, variable message (VMS) or directional signs.
Architectural and Historic Feature Structure	Architectural or historic feature structure within the road reserve.
Ferry Ramp	A concrete ramp that allows vehicles to access a ferry from the top of an embankment. The ramp extends into the water to allow continued use during periods of low water levels.
Busway Track	An elevated concrete track used to carry guided buses.
Cattle Grid	A transverse grid of parallel metal bars over a ditch, which prevents passage of livestock and other animals.
Tunnel	An underground passageway dug through the surrounding soil/earth/rock and enclosed except for entrance and exit for the primary purpose of carrying a road, busway or railway underneath an obstacle.

Table 1: Structure Definitions

1.7 Description of Structures

A description of structures and structure components with appropriate diagrams and photographs is included in Appendix A.

2. ROAD STRUCTURE INSPECTION PROCEDURES

2.1 Inspection Types

The Road Structures Inspection Manual includes three levels of inspection:

Level 1 inspections are routine visual inspections which are used to check the general serviceability of a structure particularly for the safety of road-users, and to identify any emerging problems.

Level 2 inspections are detailed visual condition inspections which are used to assess and rate the condition of structures and their components.

Level 3 inspections are special inspections which may be instigated by request for a specific reason. They are not scheduled but may be required due to concerns over the structure's safety, condition, load capacity or for structures subject to complex associated repair, strengthening or widening works. They may also result from scheduled follow-up material surveys or be required to inspect those components that are not accessible for a normal Level 2 inspection.

In addition structures that show accelerated deterioration or are nearing the end of their serviceable life will require an amended management process which will involve more frequent inspections. Ongoing serviceability may be dependent on regular "monitoring" inspections to ensure structural integrity is maintained at a safe level. The inspection type and frequency for these structures is dependent on the nature of the associated problems, but will general be detailed and more frequent.

2.2 Work Health and Safety

Inspectors are responsible for their personal safety and that of others who may be affected by their inspection activities.

Inspections shall be conducted in accordance with the *Work Health and Safety Act 2012 (SA), Work Health and Safety Regulations 2012 (SA)* and other relevant DPTI safety requirements specific to inspection contracts or inspection brief. In addition, inspections on the roadway shall be conducted in accordance with the requirements of Safe Work Australia *Workplace traffic management guidance material*.

Boats used for inspection and their operation must comply with the requirements of the *Marine Safety (Domestic Commercial Vessel) National Law (Application) Act 2013* and the *Harbors and Navigation Act 1993* and any other relevant legal requirements and associated regulations.

If a structural inspection requires access over or under property or assets belonging to another authority (for example rail property), the inspection must comply with the relevant legal, regulatory, or other procedural requirements of that authority including relevant codes of practice. The Safe Work Method Statement for the inspection must include the authority's requirements.

In order to assist bridge inspectors with the management of safety, DPTI may provide the following information:

- a list of general hazards which may be encountered during structural inspections
- a list of structure-specific hazards to be included in the structure information issued to Level 2 inspectors.

DPTI will require the following actions by inspectors as appropriate:

- prior to the commencement of any site inspection an appropriate Traffic Management Plan, in conjunction with a safety management plan, shall be prepared to ensure a safe workplace is maintained for both inspectors and travelling public
- on their arrival at bridge sites, inspectors are to identify and address any potential hazards not previously identified
- if a risk cannot be safely managed, the inspection must be postponed and the DPTI representative advised immediately
- following completion of the inspection if there are any previously unrecognized hazards, inspectors must submit an updated list of hazards encountered during the inspection to DPTI, this can be done using the Survey 123 mobile inspection form for the structure.

DPTI may conduct safety audits and surveillance to ensure that inspectors perform inspections in accordance with all relevant safety practices.

2.2.1 Confined Spaces

The governing regulations for Confined Spaces are the *Work Health and Safety Regulations 2012 (SA)* which provides a definition for 'Confined Space' as follows:

"***confined space*** means an enclosed or partially enclosed space that—

(a) is not designed or intended primarily to be occupied by a person; and
(b) is, or is designed or intended to be, at normal atmospheric pressure while any person is in the space; and
(c) is or is likely to be a risk to health and safety from—
    (i) an atmosphere that does not have a safe oxygen level; or
    (ii) contaminants, including airborne gases, vapours and dusts, that may cause injury from fire or explosion; or
    (iii) harmful concentrations of any airborne contaminants; or
    (iv) engulfment,

but does not include a mine shaft or the workings of a mine"

Further information is contained in the Safe Work Australia *Confined Spaces Code of Practice.*

A number of bridge structures in South Australia have an enclosed space that would be covered by the definitions (a) and (b) above however DPTI are unaware of a bridge space that meets the definitions of (c) parts (i), (ii), (iii) or (iv) of the Regulation.

DPTI will advise if a structure has been assessed as a confined space at the last inspection.

Care needs to be exercised at culverts as they may be more likely to get contaminants e.g. hydrogen sulphide from the presence of rotting vegetation.

If the Inspector feels the air quality in an enclosed or partially enclosed space is compromised and will impact the safety of inspection, the Inspector shall consider safety implications and make allowances in the safety management plan. There are various light weight, hand-held instruments commercially available that could be used by the inspector to monitor air quality if deemed appropriate.

2.2.2 Asbestos

Notwithstanding whether asbestos is included in the known material risks section of the Survey 123 mobile inspection form, Inspectors should always be aware of the potential presence of asbestos and asbestos containing materials (ACM) at inspection sites.

Inspectors should also be aware of the potential presence of synthetic mineral fibre (SMF) commonly known as glass fibre at inspection sites.

In all cases, inspections must comply with the requirements of the *Work Health and Safety Act 2012 (SA),* the *Work Health and Safety Regulations 2012 (SA)* and the Safe Work Australia *How to manage and control asbestos in the workplace Code of Practice.*

2.3 Level 1 – Routine Maintenance Inspections

2.3.1 Purpose

Level 1 inspections may be completed in conjunction with routine maintenance "loop" inspections of the roadway and the adjacent road reserve. The primary purpose of Level 1 inspections is to:

- check for visible defects which might affect the safety of road users and/or the serviceability of a structure
- identify items that may require routine maintenance and/or urgent attention/further investigation.

2.3.2 Scope

The inspection may include the following structure types:

- bridges and major culverts
- roadside structures -including major sign/gantry structures, noise walls, visual screen walls and retaining walls

The scope of a Level 1 inspection varies with the structure under inspection but will generally include:

- inspection of the road surface, guardrails/barriers, road drainage, vegetation and debris around the structure
- recommendation of a detailed inspection if it is warranted by observed distress or unusual behaviour of the structure
- identification of any routine maintenance requirements.

Level 1 Inspections shall be conducted by personnel employed by the routine maintenance contractor.

2.3.3 Issues Identified

If an Inspector identifies any structural integrity issues or if further inspection is required, these shall be notified to DPTI on the day of the inspection or sooner if the inspector perceives there is immediate danger to the public.

2.4 Level 2 – Detailed Visual Condition Inspections

2.4.1 Purpose

The purpose of the Level 2 inspection is to measure and rate the condition of structures in order to:

- identify and prioritise maintenance needs
- assess the effectiveness of past maintenance treatments
- model and forecast changes in condition (deterioration modelling) and residual life
- estimate future requirements for maintenance budgets

2.4.2 Scope

The scope of the Level 2 inspection includes the following:

- Verifying the inventory for refurbished and existing structures
- Visual inspection of components to assess their condition using the condition rating system described in Part 3
- Reporting the condition of each component and the extent over which that condition applies
- Reporting the overall condition of the structure (Overall Rating)
- Identification of structures and/or components which may require special inspection or investigation* (Level 3) due to rapid changes in structural condition or deterioration
- Identification of components which require closer observation at the next Level 2 inspection and/or more frequent condition monitoring inspections due to rapid changes in structural condition or deterioration
- Identification of requirement for maintenance practices
- Capturing a photographic record of the structure and any deficient or non-standard components identified
- Auditing of selected components for structure inventory records

* The recommendation will be reviewed by the Principal Engineer Structures to determine the extent of investigation needed.

2.4.3 Frequency of Inspections

Level 2 inspections are currently undertaken at a frequency of 4 to 8 years based on the following criteria:

Age of Structure

- More than 40 years old — 4 years
- Less than 40 years old — 8 years

Overall length

- Greater than or equal to 50 metres — 4 years
- Less than 50 metres — 8 years

Spans

- Greater than or equal to 35 metres — 4 years
- Less than 35 metres — 8 years

Environment

- If within one (1) kilometre of the ocean — 4 years

2.4.4 Inspector prequalification and auditing

Level 2 inspections shall be conducted by Level 2 inspectors who are prequalified in accordance with the requirements of DPTI *Prequalification for Professional and Technical Services 17C811*. Inspectors in this category must have extensive practical experience in either the inspection, construction, design, maintenance or repair of road structures. They shall be competent to judge the condition of structures and the importance of visual defects.

Level 2 inspectors need not be qualified professional bridge engineers, but are required to consult with and take advice from such a person to aid in decision making or interpreting visual defects or unusual structural behaviour.

Inspector performance is subject to ongoing review, including independent audits of completed inspections.

Details of DPTI's *Prequalification System* including terms and conditions and application requirements are available on the DPTI website.

2.4.5 Inspection Procedure

2.4.5.1 Preparation for Site Inspection

Prior to commencing an inspection, the inspector shall ensure that they have all relevant documentation together with inspection and safety equipment and have made appropriate arrangements with the relevant road, rail or other authorities for access to the structure requiring inspection.

Prior to commencing site inspections, Inspectors should review the most recent inspections available in the 'Inspections' AWS folder for the structure. This would normally include all inspection types up to and including the most recent Level 2 (full) inspection. Inspectors should also have access to the Survey 123 mobile inspection form for the structure to be inspected.

Plans and drawings (available in the 'Plans' AWS folder for the structure) may also be reviewed if this is considered helpful.

2.4.5.2 Site Inspection

Inspections shall be conducted in a systematic manner. Structure components have been organized into Inspection Groups to allow systematic inspection along the structure:

Inspection Groups types may comprise:

- Approach
- Abutment
- Spans
- Piers
- Deck
- Other

Where there is more than one Inspection Group type present a group number is also used. For example: all bridges have two approaches, therefore there would be Inspection Groups "Approach 1" and "Approach 2". Similarly for abutments. This would be similar for "Pier" and "Span" which may have multiple Group Numbers depending on the number of spans of the bridge.

Further detail regarding Inspection Groups is in Section 2.4.8.1.2 "Grouping and Location of Components".

Site inspections must be conducted during daylight hours, unless there are unique circumstances agreed with the DPTI Principal Engineer Structures (e.g. rail occupation at night).

The inspector shall:

- inspect and assess the condition of each structural component and the extent of the component over which the rating applies, using the standard condition rating criteria (refer to Part 3 of the RSIM)
- record and provide comment for all defects identified during the course of the inspection and the extent of these defects
    - comment regarding recommended repair and priority of repair is required

    - comment and photograph/s of all components in condition state 4 and 5 is required
- record the components that were not possible to fully inspect
- assess the general condition of the overall structure and record the results of the assessment on the Survey 123 mobile inspection form
- record any discrepancies in the inventory information provided (refer "Structure Inventory Information" below)

2.4.5.3 Extent of Inspection

The Level 2 inspection typically comprises a visual inspection of all components above ground and water level. The individual components shall be inspected from within 3 m of the surface of the component. Where this is not possible, the inspector shall use telescopic equipment (binoculars or other optical equipment such as a spotting scope) to conduct the inspection. In this case, the optical equipment shall be sufficiently powerful and properly adjusted to enable a close-up view of the components being inspected.

The surface of components to be inspected shall be in good natural or artificial light sufficient to observe fine cracks in concrete. The inspector may highlight cracking with a water-spray or damp cloth.

All bearings at bridge abutments and piers shall be inspected, and bearings for at least one abutment and one pier (where present) shall be inspected at eye level wherever possible. If this is not possible comment should be included in the Survey 123 mobile inspection form.

Components that are not required to be inspected in Level 2 inspections are:

- areas behind abutments that are inaccessible; and
- components below ground level or below water level.

If required, these components may be inspected as part of a Special Inspection and Investigation (Level 3).

The quantity of a component in each condition state shall be based on the total area of the component that can be observed. Where it is estimated that 25% or less of the component is visible, this shall be recorded in the Comments field for the component in the Survey 123 mobile inspection form, stating the reason why it cannot be fully observed.

2.4.5.4 Photography

Photographs are a vital part of the structural inspection record. The Level 2 inspection includes specific requirements for photographic records. It is important that Level 2 inspectors have a suitable camera and are able to use its features sufficiently to ensure good quality photographs. Photographs should be taken in bright natural light. Flash photography is permitted as detailed below but should only be used when necessary as intense light can obscure fine details such as cracks.

Photographs must:

- include a digital date-stamp (correct date and time)
- be taken in natural light unless the defect is in deep shadow or a dark area
- be in sharp focus sufficiently to enable fine details such as cracks in concrete to be observed -blurred images will not be accepted

- be composed so that the subject of the photograph is centralised and occupies the full frame of the image

Photographs shall be taken of all components at condition rating 4 and 5, showing the extent of the defects present.

Wetting of a cracked concrete surface may be used to highlight crack patterns.

Each photograph is to be numbered. Photograph numbers are referenced in the "Photograph Number" field on the Survey 123 mobile inspection form. Each photograph must have a caption that provides a clear description of the photograph, and should also be as brief as possible.

The quality of the photographs must be checked before leaving the site, and repeated if the quality is poor.

2.4.6 Data Recording

Inspections must be completed and submitted to DPTI using the Survey 123 mobile inspection form for the structure. The Survey 123 form is pre-filled with the data from the most recent inspection of the structure.

During the inspection, the inspector completes the condition rating for all elements in each Inspection Group (refer "Condition Rating of Components" below) and makes comments for any new defects found. Comments on defects from the previous inspection may be retained, deleted, noted as repaired or amended. The inspector details the repairs required for the defects and their priority for repair. Photos of the bridge and defects are taken.

Note: For previous inspections conducted outside Survey 123, existing defect comments for elements may be duplicated across inspection groups. Care will need to be exercised to ensure the existing defects are correct for each inspection group element, if not they should be noted as 'deleted' as per the above paragraph.

All information obtained from the site inspection is recorded in the Survey 123 mobile inspection form. Any discrepancies in the structure inventory or the structure elements information are to be noted in the appropriate Comments field in the Survey 123 mobile inspection form.

The inspection information can then be saved in the Survey 123 form for later "tidy up" before submitting to DPTI.

Once fully completed, the inspection results are to be submitted using the Survey 123 mobile inspection form. Once submitted, a draft inspection report will be available for review and amendment if required, prior to formal submission of the inspection to DPTI. Inspection results are expected to be submitted to DPTI within 14 days of the date of the inspection.

2.4.7 Condition Rating of Components

The inspector shall make an assessment of the condition of each component in accordance with Part 3.

The inspector shall compare the observed component defects with the description in the condition rating and the accompanying photographs if available.

The quantity of the component in each condition rating shall be determined on the basis of the total component area that is visible. The unit of measurement shown in the condition rating descriptions shall be used to determine the quantity in each condition state as described in Part 3.

Part 4 provides further guidance in assessing the condition of components, with descriptions and photos (where available) of the 5 condition states for each component.

2.4.8 Structure Inventory Information

Inventory data pre-filled into the Survey 123 mobile inspection form shall be confirmed and any discrepancy recorded.

2.4.8.1 Bridge and Major Culvert Inventory Data

The inspector is required to check the overall measurements and components of the structure against data included in the previous inspection reports and Survey 123 mobile inspection form.

2.4.8.1.1 Inventory Photographs

The following photographs for inventory and identification purposes are required for all inspections.

Bridges

- Overall view from approach 1
- Overall view from approach 2 (only required if not a single carriageway)
- Upstream elevation*
- Downstream elevation*
- General underside of bridge

Culverts

- View from approach 1 end
- View from approach 2 end (only required if not a single carriageway)
- Upstream elevation*
- Downstream elevation*

* If not over a watercourse, side elevations from left hand side and right hand side (in the direction of increasing RRD) of the bridge/culvert will be required.

2.4.8.1.2 Grouping and Location of Components

Components will be grouped for inspection purposes, to allow a systematic inspection along the structure.

The inspector should check that the number of components included in the inspection groups is correct and if there are discrepancies, report these in the inspection comments field for the relevant inspection group.

The location of bridge components is based upon the direction of the road:

- All state maintained roads in South Australia “run” in one direction, this is generally from West to East or from North to South. Road running distance (RRD) is measured in kilometres from the start point of the road. Further information regarding the

linear referencing system for roads maintained by the State or Federal Government is available at Data.SA https://data.sa.gov.au/data/dataset/state-maintained-roads and roads information can be viewed on an interactive map in the Location SA Map Viewer at http://location.sa.gov.au/viewer/?%20map=hybrid&uids=205;

- In rural areas, Maintenance Marker Pegs (MMP) are located along the road corridor at approximate 1 km intervals, to assist locate features along a road. Physical features are a star dropper with a number plate which can be referenced to the RRD along a road from the start for that road. MMPs are displayed on the Structures Map (refer Appendix C Section 2);
- Approaches and Abutments are numbered in the direction of increasing RRD;
- Spans, Piers and Culvert Cells are numbered along the bridge in ascending order from Abutment 1 to Abutment 2;
- Piles, Columns, Girders and Culvert Cell Units are numbered across the bridge in ascending order from left to right when facing the direction of increasing RRD.

A diagram showing this bridge orientation and example component numbering follows.

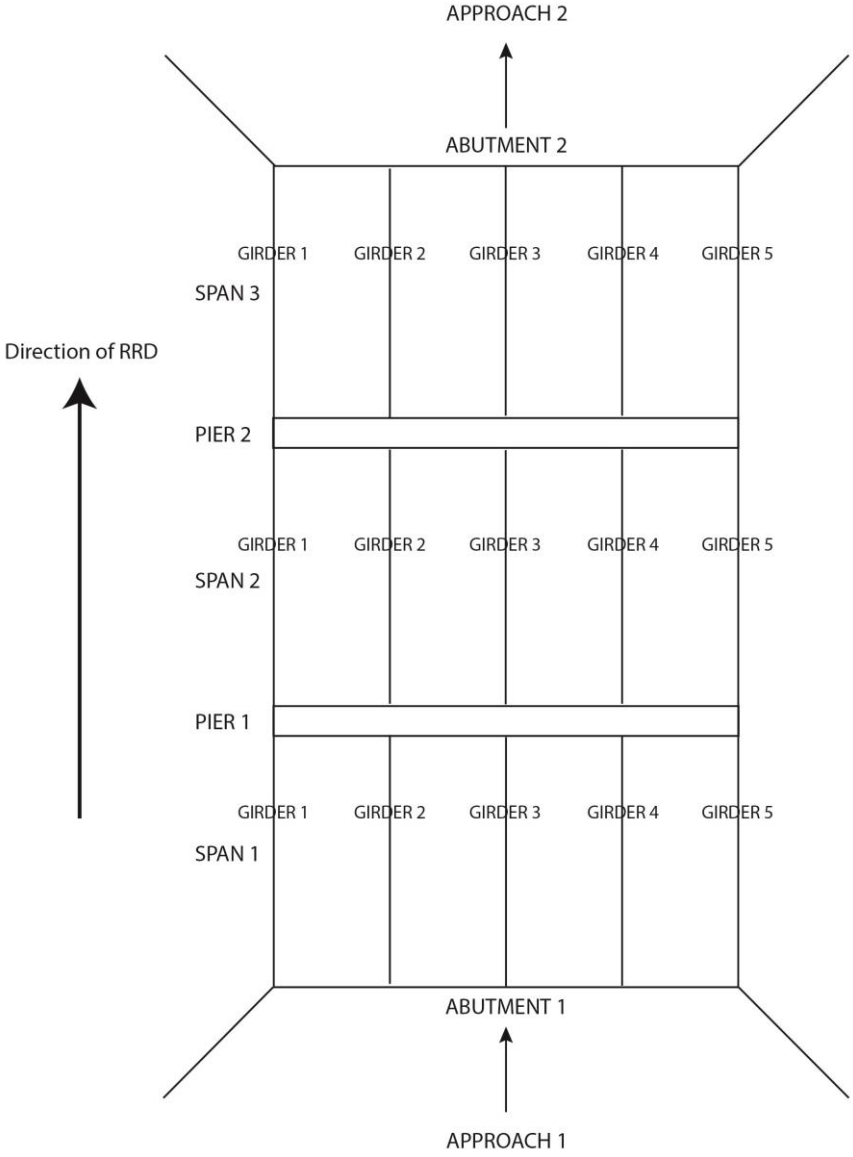

Figure 1: Bridge orientation

DPTI may provide an individual bridge orientation and components diagram for some structures with the structure documentation, note that if this is the case the diagram may for various reasons, differ from the structure plans and drawings.

Pedestrian bridges spanning a road are treated slightly differently. Abutment 1 is located on the left hand side of the road when facing the direction of increasing RRD. All other references are then consistently taken once this first abutment has been located.

This also applies for bridges that are not part of the state road network and are not maintained by DPTI, but cross the DPTI state road network. Abutment 1 is located on the left hand side of the DPTI road when facing the direction of increasing RRD. All other references are then consistently taken once this first abutment has been located.

If, following the review of previous Inspection Reports, structural drawings or other reference documents, it is found that there is some confusion or discrepancy of the allocation of Abutment 1 the inspector is required to contact the DPTI Principal Engineer Structures prior to commencing the bridge inspection to agree as to which abutment is Abutment 1.

2.4.8.1.3 Measurements and Quantities to be confirmed during the Inspection

If requested, the Inspector shall confirm the following:

- overall length and width of bridge*
- length of individual spans*
- number of spans
- width of structure between kerbs and/or barriers*
- width of footpath/shoulder
- deck height
- rail offset*
- number and/or quantities of structure components i.e. girders, slabs, piers, barriers etc.

*To limit exposure of inspectors to traffic on the road measurements shall only be taken if required by the Asset Manager. Subject to a risk assessment traffic management shall be provided.

The length of the bridge is the full length of the deck measured parallel to the road centreline between the abutment joints or, if the joints are not evident, the intersection of the deck and the approach-road pavement. The approach slabs are not included in the overall length of the bridge.

For arch bridges the length is measured to the back of the buttresses at the ends of the arches or to the junction of the wingwalls with the spandrel walls.

The overall width of the bridge is the width to the outer edges of the bridge including kerbs and footpaths measured perpendicular to the road centreline.

For major culverts, the width or diameter of the individual cell is measured. Where this varies between cells, the main pipe diameter or width of crown is to be measured. This also applies to the cell height where there is variance.

Kerb to kerb width is the distance between the kerbs. If a divided road and the median has kerbs, separate measurements are to be taken for the separate carriageways.

Barrier to barrier width is the distance between barriers. If a divided road and the median has barriers, separate measurements are to be taken for the separate carriageways. If the median has no barriers it should be ignored and the measurement taken from the outer barriers of the road.

The deck height is the distance between the top of the bridge deck (i.e. the traffic surface) and the under structure surface (road, rail, water, open fields, bushland etc below the bridge).

The rail offset is the distance between the edge of the carriageway and the barrier. The edge of the carriageway is defined as the kerb or if a kerb is not present, the edge of the seal including any sealed shoulder.

2.4.8.2 Major Sign Gantry Inventory Data

The inspector may be required to confirm the inventory dimensions which are given on the Field Inspection Advice form and the Survey 123 mobile inspection form. Dimensions which are not accessible for measurement such as outreaches can be omitted.

The following photographs for inventory and identification purposes are required for each structure:

- front of gantry
- rear of gantry
- footings on the left hand side (in the direction of increasing RRD)
- footings on the right hand side (in the direction of increasing RRD)

Additional photographs may be required if the sign gantry or base detail has any unusual features.

2.4.8.3 Retaining Wall, Noise Wall and Visual Screen Wall Inventory Data

The length of the wall to be inspected is provided from on the Field Inspection Advice form and the Survey 123 mobile inspection form. If the stated length is incorrect, this is to be reported in the Comments field on the Survey 123 mobile inspection form.

The following photographs for inventory and identification purposes are required for each structure:

- at the start and end of the wall
- a view along the wall

2.4.8.4 Ferry Ramp Inventory Data

The following photographs for inventory and identification purposes are required for each structure:

- view of the town side ramp
- view of the far side ramp

2.4.8.5 Cattle Grid Inventory Data

The following photographs for inventory and identification purposes are required for each structure:

- view from approach (specify end)
- general underside
- left fence (in the direction of increasing RRD)
- right fence (in the direction of increasing RRD)

2.5 Level 3 – Special Inspections and Investigations

2.5.1 Purpose

Level 3 inspections are intended to provide improved knowledge of the condition, load carrying capacity, in-service performance and other characteristics that are beyond the scope of Level 1 and Level 2 inspections. Level 3 inspections are instigated on a case-by-case basis with the affecting issue determining the level of investigation required. They generally target or address a specific issue relevant to an individual structure or a class of structures.

2.5.2 Scope

A Level 3 investigation is a structure or structural class-specific inspection and/or a structural assessment. The RSIM does not specify a standard Level 3 investigation scope. The scope of a Level 3 investigation is specifically developed for the road structure or class of road structure under investigation.

Level 3 investigations are distinguished from other types of inspection by the following:

- their structure or class-specific scope
- inclusion of matters that are outside the scope of a Level 1 or a Level 2 inspection

2.5.3 Categories of Level 3 Inspection

The following has been included to provide guidance on the most common categories of Level 3 investigations and representative examples within each category. These categories and examples should be considered as being typical but not an exhaustive list.

These investigations may be specific to an individual structure or may involve an investigation into a common form of structure, component or material.

2.5.3.1 Response to Incident, Accident or Natural Event (Emergency or Ad-hoc Inspection)

A Level 3 investigation may be required if an incident occurs that potentially affects the integrity or load-carrying capacity of a structure.

Such incidents can include:

- an impact by a motor vehicle, train or river vessel with the substructure or superstructure of a bridge, major culvert, large sign structure or other highway structure
- an explosion or vehicle (hydrocarbon) fire (e.g. from a ruptured fuel tank or a gas service attached to a structure)
- a natural event such as a flood, bushfire or earthquake or other event that might damage or destabilise a structure (e.g. debris impact or loading, stream flow forces, settlement resulting from scour or collapse of bridge piers, abutments and embankments)
- receipt of a report regarding an issue or potential issue with the structure, where it may be prudent to investigate by means of on-site inspection. (This report could potentially originate from any source including the Traffic Management Centre or correspondence received from a member of the public, either direct or via a Member of Parliament.)

In instances such as the above, an emergency or ad-hoc inspection will be required to assess the damage to and its effect on the structure.

The nature of the incident and the significance of the impact of the issue will generally determine whether the inspection is considered “emergency” or “ad-hoc”. Emergency inspections are usually required at very short notice; ad-hoc inspections do not have the same levels of urgency.

Emergency and ad-hoc inspections are completed in the same manner, generally assessing only the component/s that are impacted by the incident. Condition ratings as used in Level 2 inspections are not required to be completed for the affected components.

The “Emergency/Ad-hoc Inspection” template in Survey 123 is to be used to submit the completed inspection.

2.5.3.2 Load Capacity Assessment of Structures

Detailed load capacity assessments may be required for new or proposed classes of commercial vehicles, such as quad axle semi-trailers and B-Doubles, to determine the adequacy of structures on individual or multiple routes on the network for these vehicles. This might be accompanied by an assessment of the practicality and level of strengthening required for each structure and estimated costs.

2.5.3.3 Programmed Level 3 Inspections

2.5.3.3.1 Inspections outside the Scope of Level 2 Inspections

Level 2 inspections provide data on the observed condition of structural components.

Level 3 investigations may be required to evaluate observations from Level 2 inspections or other condition data that is not visually evident, such as:

- underwater inspection of submerged components
- components that cannot be accessed during the Level 2 inspection
- asbestos containing material (ACM) identification and/or ACM verification
- confined space inspections

These investigations can be part of a programmed management system, at regular intervals but less frequently than Level 2 inspections. These inspections may be scoped as Level 3 investigations.

2.5.3.3.2 Investigation of Specific Categories of Bridges and Other Structures

Investigation of bridges and other structures in the following categories:

Monitoring Inspections	Refer Section 2.6
Complex Structures	This category of structure may be used to identify individual structures or families of structures that require structure specific inspection procedures, methods and reporting
Heritage and Historic Structures	Refer Section 2.7.1

These investigations may be conducted as part of a routine programmed management system. The scope and frequency of investigations shall be determined for each structure and shall require ongoing review depending upon the performance, intensity of loading, rate of deterioration (if any) maintenance, strengthening, component replacement or similar that potentially influence safety and whole of life costing.

2.5.3.3.3 Investigation of New Bridges and Other Structures

Investigation of bridges and other structures during construction, after completion and at handover from other bridge asset managers/constructors (such as):

- other road authorities
- rail authorities
- water authorities

In the case of existing structures, the Level 3 investigation shall include a detailed site investigation to confirm inventory data and to obtain condition data.

In the case of new structures, it is advantageous to develop and maintain liaison with the bridge asset managers/constructors and to participate in the review of design details and on-site inspections at critical stages. This approach reduces emphasis on final handover inspections. Detailed as-constructed drawings and information is an essential part of the handover process.

The following information is to be obtained from the transferring authority or organisation:

- design details
- as-constructed drawings* and information
- history of maintenance and modifications
- any other available historical records such as flood and/or fire events
- any other relevant information

*Design drawings are to be used if as-constructed drawings are not available.

2.6 Monitoring Inspections

2.6.1 Purpose

Structures that show accelerated deterioration or are nearing the end of their serviceable life require an amended management process which will involve more frequent inspections. Monitoring inspections are the primary means of ensuring the safety of these classes of structure.

Monitoring Inspections are carried out periodically and are visual, non-destructive, inspections of specific components aimed at detection of structural distress that could indicate reduced strength. They may include:

- visual observation at arms-length and assessment of the condition of critical components
- photography - in order to compare the condition of critical parts of the structure with previous records
- specific survey
- measurement of component defects such as crack widths, bearing positions, joint widths etc.

Monitoring inspections will most often be carried out at set time intervals, but may also be event based. That is, a structure may have a monitoring program that requires inspection after a specified event (for example, a flood) occurs.

2.6.2 Types of Monitoring

The type of monitoring required should be selected from the following list:

Monitoring Type
Settlement
Crack measurement
Movement
Survey
Spalling
Scour
Rusting/corrosion
Other

Table 2: Monitoring types

2.6.3 Identification of Monitoring Requirement

The need to monitor a structure will usually be recognised at a Level 2 inspection, in which case the Level 2 Inspector should add the details into the Level 2 inspection report using the Survey 123 mobile inspection form.

In such a situation, the Inspector will provide the details for the proposed new monitoring program as a general comment for the affected structural element.

Details required include:

2.6.3.1 Monitoring Type

The monitoring type should be selected from the list above. If the monitoring type “Other” is selected, the Inspector must provide full details in the Survey 123 mobile inspection form.

2.6.3.2 Monitoring Details and Comments

Describe the exact location of the defect or the portion of the element to be measured. Refer to the photo/s taken during the condition rating assessment of the element.

Also describe any equipment that must be used, such as Demec gauge or level, etc

2.6.3.3 Recommended Monitoring Frequency

The Inspector should make a recommendation for the frequency of monitoring required that is, the appropriate interval between measurements or observations.

If the proposed monitoring is to be event based, the nature of the event (e.g. flood, drought) should be noted.

2.6.3.4 Inclusion in Monitoring Program

All recommendations for structure inclusion in the monitoring program will be referred to the DPTI Principal Engineer Structures who will make a determination.

2.6.4 Inspection and Monitoring

The Monitoring Inspection comprises periodical re-inspection to identify any changes in the condition of a structure. The frequency of monitoring inspections depends on the number, disposition and severity of structural defects. The frequency of monitoring is subject to the DPTI Principal Engineer Structures recommendation.

Defects are recorded on the Survey 123 mobile inspection form and photographed. Location, extent and width of defects and, in particular, changes in these defects since the previous inspection are key indicators of possible changes in capacity of the structure which require further investigation.

Inspectors should also comment if they believe the frequency of monitoring inspections should be changed, or if they consider the monitoring is no longer required. These recommendations will be referred to the DPTI Principal Engineer Structures who will make a determination.

Monitoring inspections may also be completed as part of a programmed Level 2 inspection, in this case the Level 2 Inspector must complete the “Monitoring Program” section of the Survey 123 mobile inspection form in full, and include comment if they believe the frequency of monitoring inspections should be changed, or if they consider the monitoring is no longer required. Again, the DPTI Principal Engineer Structures will make a determination regarding these aspects.

2.7 Inspection Requirements for Specific Categories of Structures

2.7.1 Heritage and Historic Structures

Heritage or Historic Structures are structures included on the State Heritage Register and noted in the Structures Manager system.

Registered heritage bridges open to vehicular traffic are maintained to the same performance standards as equivalent non-heritage bridges in a manner that preserves the heritage characteristics of each bridge.

Heritage structures are included in the normal bridge inspection program for level 1 and 2 inspections even if they are not used by traffic.

While there are currently no specific additional inspection requirements for Heritage and Historic Structures, DPTI aims to retain the best examples of historic road-related structures and manage them in accordance with conservation plans and heritage legislation.

2.7.2 Disused Structures

DPTI has a responsibility for the management of disused (also called bypassed) and other potentially hazardous structures within the road reservation. A road bridge which is no longer in use by vehicular traffic (but which may be in use by pedestrians) or a pedestrian bridge no longer used is considered a disused bridge.

If the structure becomes disused for vehicles and remains open to pedestrians with footpath connection it is preferred that the asset be transferred to the relevant Council. DPTI preference is that disused structures that do not remain open for vehicles or pedestrians be demolished if they are not heritage registered or being nominated for registration.

Disused structures not open to vehicles and pedestrians often have a lower maintenance priority to other structures. As a result, a disused structure could deteriorate to a point where it is unstable or has partially collapsed and, provided that the structure is not subject to statutory or other protection, partial or total dismantling may be necessary in order to properly control the hazard.

Disused structures are included in the normal bridge inspection program even if they are not used by traffic. The focus of these inspections is to identify issues that may pose danger to the public.

2.7.3 Buried Corrugated Metal Structures (BCMS) - Pipe and Arch Culverts

Large buried corrugated steel pipe and arch culverts have been used in South Australia for many years. A very limited number of corrugated aluminium culverts have also been used. BCMS are recognised worldwide as a high risk structure, comprising a thin wall section of steel or aluminium that is prone to corrode longitudinally at the top of the wetted area or in the invert.

BCMS may also be vulnerable to damage as a result of flooding. If the invert of the BCMS is corroded or if the upstream endwall is absent or deficient, flood-waters can flow around the BCMS and wash-away the backfill material. BCMS have been completely washed away in these circumstances leading to an extremely hazardous void in the carriageway. This type of damage can also develop slowly over a period of moderate flow with the final collapse occurring in flood conditions.

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